



# MACHINE VISION + INFERENCE CAMERAS

2020 Product Catalog + Sensor Review





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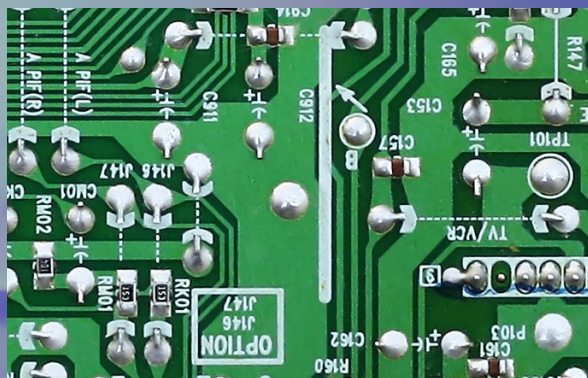
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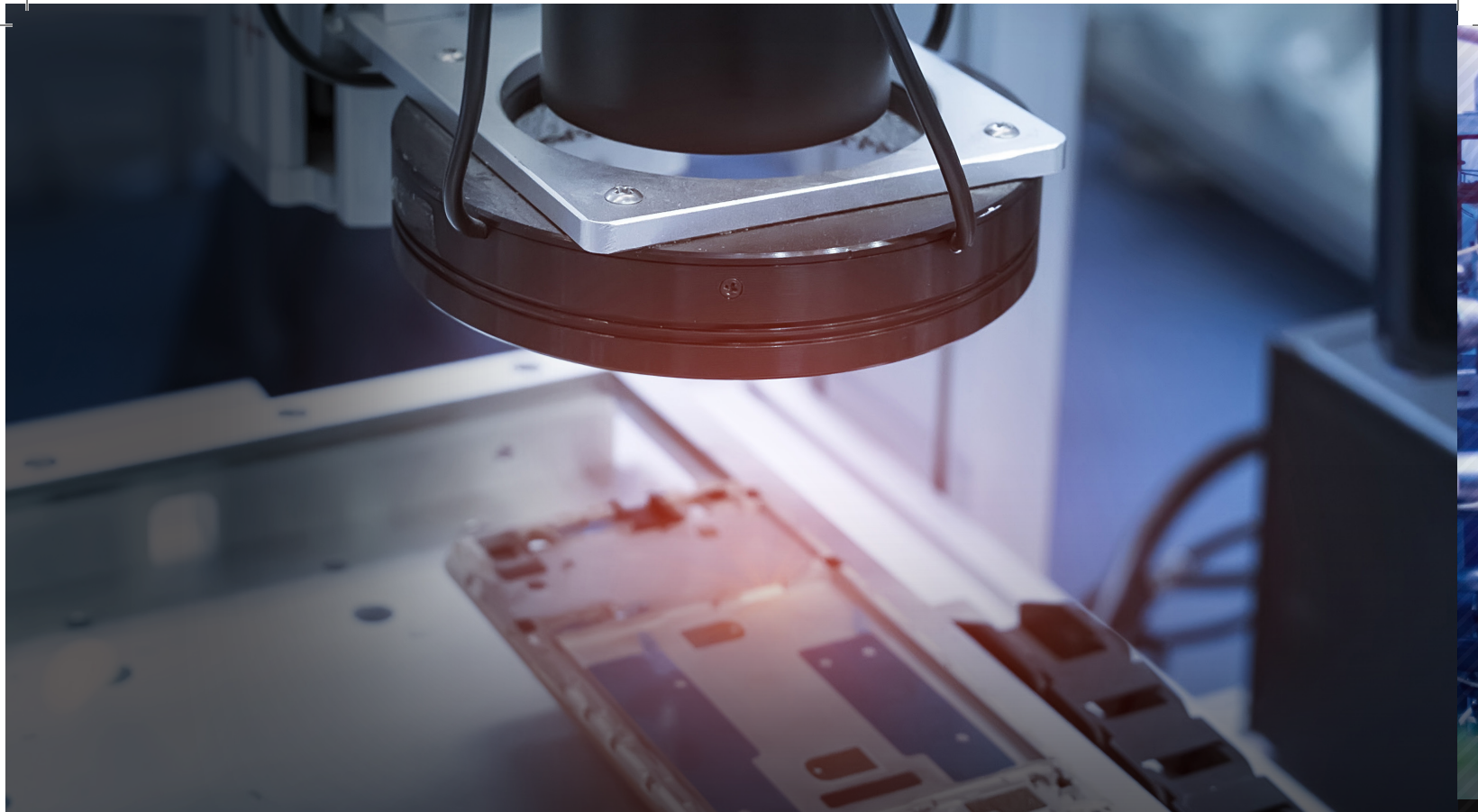
# MACHINE VISION

## AREA SCAN



FLIR Systems, Inc. designs, develops, manufactures, markets, and distributes technologies that enhance perception and awareness. We bring innovative sensing solutions into daily life through our thermal imaging, visible-light imaging, video analytics, measurement and diagnostic, and advanced threat detection systems.

FLIR offers a diversified portfolio that serves a number of applications in government & defense, industrial, and commercial markets. Our products help first responders and military personnel protect and save lives, promote efficiency within the trades, and innovate consumer-facing technologies. FLIR strives to strengthen public safety and well-being, increase energy and time efficiency, and contribute to healthy and intelligent communities.



## FLIR FIREFLY® S

The FLIR Firefly S delivers the essential machine vision features you need in an ultra-compact body. Its small size, low power, and light weight make it ideal for embedding into portable devices. The Firefly S provides amazing value by combining powerful on-camera features with the latest CMOS sensors.

MP range	0.4 - 1.6 MP
FPS range	60 - 121 FPS
Resolution range	750 x 540 to 1440 x 1080
Sensor size range	3.45 - 6.9 $\mu\text{m}$
Shutter	Global Shutter



## FLIR FIREFLY® DL

Deep learning is a powerful tool for system designers to quickly automate complex and subjective decision making and deliver higher quality products and improved productivity. Deploy your trained neural network to the FLIR Firefly DL with Neuro technology and reduce system cost and complexity by making decisions on-camera without host PC. With its very small size, low weight and power consumption, the Firefly DL camera is ideal for embedding into mobile, desktop, and handheld systems.

MP	1.6 MP
FPS	60 FPS
Resolution	1440 x 1080
Sensor size	3.45 $\mu\text{m}$
Shutter	Global Shutter



## FLIR ORYX®

The award winning Oryx 10GigE camera family allows systems designers to take advantage of the latest sensors by supporting transfer speeds up to 10Gbit/s enabling the capture of 4K resolution, 12-bit images at over 60FPS. Oryx's 10GBASE-T interface is a proven and widely deployed standard that provides reliable image transfer at cable lengths over 50 meters on inexpensive CAT6A, or greater than 30 m on CAT5e. On-camera features including IEEE1588 clock synchronization and full compatibility with popular third-party software supporting GigE Vision, gives system designers the tools to quickly develop innovative solutions.

MP range	5.0 MP to 31 MP
FPS range	27 - 162 FPS
Resolution range	2448 x 2048 to 6464 x 4852
Sensor size range	3.45 - 4.5 $\mu\text{m}$
Shutter	Global Shutter





## FLIR BLACKFLY® S GIGE

The Blackfly S leverages the industry's most advanced sensors in an ice-cube form factor. It is packed with powerful features enabling you to easily produce the exact images you need and accelerate your application development. This includes both automatic and precise manual control over image capture and on-camera pre-processing. On-camera features including IEEE1588 clock synchronization and full compatibility with popular third-party software supporting GigE Vision, gives system designers the tools to quickly develop innovative solutions.

MP range  
FPS range  
Resolution range  
Sensor size range  
Shutter

0.4 - 20 MP  
18 - 522 FPS  
720 x 540 to 5472 x 3648  
1.85 - 6.9 µm  
Global Shutter/Rolling Shutter  
with Global Reset



## FLIR BLACKFLY® S USB

The Blackfly S leverages the industry's most advanced sensors in an ice-cube form factor. It is packed with powerful features enabling you to easily produce the exact images you need and accelerate your application development. This includes both automatic and precise manual control over image capture and on-camera pre-processing. The Blackfly S is available in GigE, USB3, cased, and board-level versions.

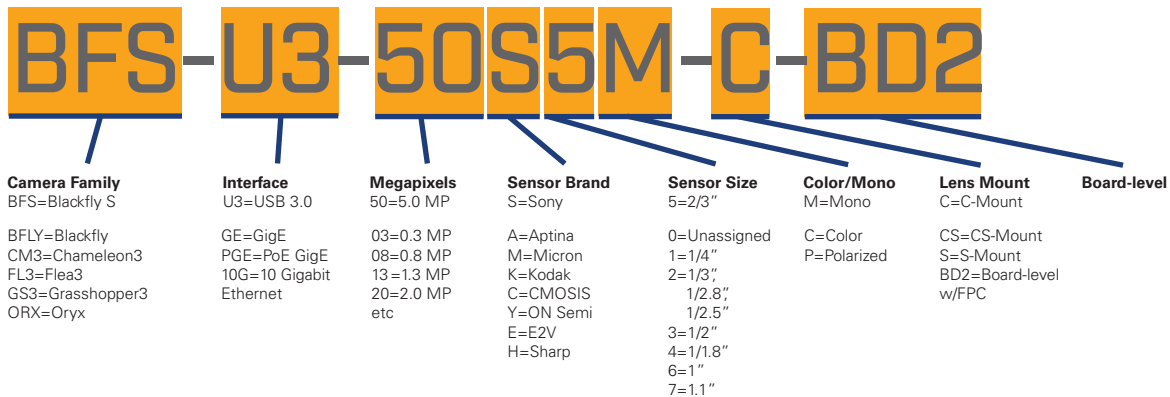
MP Range  
FPS Range  
Resolution range  
Sensor Size Range  
Shutter

0.4 - 24.5 MP  
18 - 522 FPS  
720 x 540 to 5472 x 3648  
1.85 - 6.9 µm  
Global Shutter/Rolling Shutter  
with Global Reset



# MODEL NUMBER EXPLANATION

Here is one example of our model numbers and what each section means. Understanding this will give you a quick explanation of the model's specifications and help you when comparing models.



## BLACKFLY S GIGE SPECIFICATIONS

PART NUMBER	TYPE	MP	SENSOR	SENSOR FORMAT	SHUTTER	PIXEL SIZE $\mu\text{m}$	MAX FPS
BFS-GE-16S2M-BD2	Mono	1.6	Sony IMX273 CMOS	1/2.9"	Global Shutter	3.45	78
BFS-PGE-16S2C-CS	Color	1.6	Sony IMX273 CMOS	1/2.9"	Global Shutter	3.45	78
BFS-PGE-16S2M-CS	Mono	1.6	Sony IMX273 CMOS	1/2.9"	Global Shutter	3.45	78
BFS-PGE-16S7C-C	Color	1.76	Sony IMX432 CMOS	1.1"	Global Shutter	9	69
BFS-PGE-16S7M-C	Mono	1.76	Sony IMX432 CMOS	1.1"	Global Shutter	9	69
BFS-PGE-19S4C-C	Color	2	Sony IMX430 CMOS	1/1.7"	Global Shutter	4.5	60
BFS-PGE-19S4M-C	Mono	2	Sony IMX430 CMOS	1/1.7"	Global Shutter	4.5	60
BFS-PGE-23S3C-C	Color	2.3	Sony IMX392 CMOS	1/2.3"	Global Shutter	3.45	53
BFS-PGE-23S3M-C	Mono	2.3	Sony IMX392 CMOS	1/2.3"	Global Shutter	3.45	53
BFS-PGE-27S5C-C	Color	2.8	Sony IMX429 CMOS	2/3"	Global Shutter	4.5	43
BFS-PGE-27S5M-C	Mono	2.8	Sony IMX429 CMOS	2/3"	Global Shutter	4.5	43
BFS-PGE-31S4C-C	Color	3.2	Sony IMX265 CMOS	1/1.8"	Global Shutter	3.45	35
BFS-PGE-31S4M-C	Mono	3.2	Sony IMX265 CMOS	1/1.8"	Global Shutter	3.45	35
BFS-PGE-50S5C-C	Color	5	Sony IMX264 CMOS	2/3"	Global Shutter	3.45	24
BFS-PGE-50S5M-C	Mono	5	Sony IMX264 CMOS	2/3"	Global Shutter	3.45	24
BFS-PGE-51S5P-C	Polarized	5	Sony IMX250MZR CMOS	2/3"	Global Shutter	3.45	24
BFS-PGE-51S5PC-C	Polarized	5	Sony IMX250MYR CMOS	2/3"	Global Shutter	3.45	24
BFS-PGE-63S4C-C	Color	6.3	Sony IMX178 CMOS	1/1.8"	Rolling shutter with global reset	2.4	19
BFS-PGE-63S4M-C	Mono	6.3	Sony IMX178 CMOS	1/1.8"	Rolling shutter with global reset	2.4	19
BFS-PGE-70S7C-C	Color	7.1	Sony IMX428 CMOS	1.1"	Global Shutter	4.5	17.4
BFS-PGE-70S7M-C	Mono	7.1	Sony IMX428 CMOS	1.1"	Global Shutter	4.5	17.4
BFS-PGE-88S6C-C	Color	8.9	Sony IMX267 CMOS	1"	Global Shutter	3.45	13.9
BFS-PGE-88S6M-C	Mono	8.9	Sony IMX267 CMOS	1"	Global Shutter	3.45	13.9
BFS-PGE-120S4C-CS	Color	12	Sony IMX226 CMOS	1/1.7"	Rolling shutter with global reset	1.85	8.5
BFS-PGE-120S4M-CS	Mono	12	Sony IMX226 CMOS	1/1.7"	Rolling shutter with global reset	1.85	8.5
BFS-PGE-122S6C-C	Color	12.3	Sony IMX304 CMOS	1.1"	Global Shutter	3.45	10
BFS-PGE-122S6M-C	Mono	12.3	Sony IMX304 CMOS	1.1"	Global Shutter	3.45	10
BFS-PGE-200S6C-C	Color	20	Sony IMX183 CMOS	1"	Rolling shutter with global reset	2.4	6.1
BFS-PGE-200S6M-C	Mono	20	Sony IMX183 CMOS	1"	Rolling shutter with global reset	2.4	6.1
BFS-PGE-120S4M-CS	Mono	12	Sony IMX226 CMOS	1/1.7"	Rolling shutter with global reset	1.85	8.5
BFS-PGE-122S6C-C	Color	12.3	Sony IMX304 CMOS	1.1"	Global Shutter	3.45	10
BFS-PGE-122S6M-C	Mono	12.3	Sony IMX304 CMOS	1.1"	Global Shutter	3.45	10
BFS-PGE-200S6C-C	Color	20	Sony IMX183 CMOS	1"	Rolling shutter with global reset	2.4	6.1
BFS-PGE-200S6M-C	Mono	20	Sony IMX183 CMOS	1"	Rolling shutter with global reset	2.4	6.1



# BLACKFLY S USB SPECIFICATIONS

PART NUMBER	TYPE	MP	SENSOR	SENSOR FORMAT	SHUTTER	PIXEL SIZE $\mu\text{m}$	MAX FPS
BFS-U3-04S2C-CS	Color	0.4	Sony IMX287 CMOS	1/2.9"	Global Shutter	6.9	522
BFS-U3-04S2M-CS	Mono	0.4	Sony IMX287 CMOS	1/2.9"	Global Shutter	6.9	522
BFS-U3-13Y3C-C	Color	1.3	On Semi PYTHON1300 CMOS	1/2"	Global Shutter	4.8	170
BFS-U3-13Y3M-C	Mono	1.3	On Semi PYTHON1300 CMOS	1/2"	Global Shutter	4.8	170
BFS-U3-16S2C-CS	Color	1.6	Sony IMX273 CMOS	1/2.9"	Global Shutter	3.45	226
BFS-U3-16S2M-CS	Mono	1.6	Sony IMX273 CMOS	1/2.9"	Global Shutter	3.45	226
BFS-U3-16S7C-C	Color	1.7	Sony IMX432 CMOS	1.1"	Global Shutter	9	97
BFS-U3-16S7M-C	Mono	1.7	Sony IMX432 CMOS	1.1"	Global Shutter	9	97
BFS-U3-17S7C-C	Color	1.7	Sony IMX425 CMOS	1.1"	Global Shutter	9	196
BFS-U3-17S7M-C	Mono	1.7	Sony IMX425 CMOS	1.1"	Global Shutter	9	196
BFS-U3-19S4C-C	Color	2	Sony IMX430 CMOS	1/1.7"	Global Shutter	4.5	131
BFS-U3-19S4M-C	Mono	2	Sony IMX430 CMOS	1/1.7"	Global Shutter	4.5	131
BFS-U3-20S4C-C	Color	2	Sony IMX422 CMOS	1/1.7"	Global Shutter	4.5	175
BFS-U3-20S4M-C	Mono	2	Sony IMX422 CMOS	1/1.7"	Global Shutter	4.5	175
BFS-U3-23S3C-C	Color	2.3	Sony IMX392 CMOS	1/2.3"	Global Shutter	3.45	163
BFS-U3-23S3M-C	Mono	2.3	Sony IMX392 CMOS	1/2.3"	Global Shutter	3.45	163
BFS-U3-27S5C-C	Color	2.8	Sony IMX429 CMOS	2/3"	Global Shutter	4.5	95
BFS-U3-27S5M-C	Mono	2.8	Sony IMX429 CMOS	2/3"	Global Shutter	4.5	95
BFS-U3-28S5C-C	Color	2.8	Sony IMX421 CMOS	2/3"	Global Shutter	4.5	130
BFS-U3-28S5M-C	Mono	2.8	Sony IMX421 CMOS	2/3"	Global Shutter	4.5	130
BFS-U3-31S4C-BD2	Color	3.2	Sony IMX265 CMOS	1/1.8"	Global Shutter	3.45	55
BFS-U3-31S4C-C	Color	3.2	Sony IMX265 CMOS	1/1.8"	Global Shutter	3.45	55
BFS-U3-31S4M-BD2	Mono	3.2	Sony IMX265 CMOS	1/1.8"	Global Shutter	3.45	55
BFS-U3-31S4M-C	Mono	3.2	Sony IMX265 CMOS	1/1.8"	Global Shutter	3.45	55
BFS-U3-32S4C-BD2	Color	3.2	Sony IMX252 CMOS	1/1.8"	Global Shutter	3.45	118
BFS-U3-32S4C-C	Color	3.2	Sony IMX252 CMOS	1/1.8"	Global Shutter	3.45	118
BFS-U3-32S4M-BD2	Mono	3.2	Sony IMX252 CMOS	1/1.8"	Global Shutter	3.45	118
BFS-U3-32S4M-C	Mono	3.2	Sony IMX252 CMOS	1/1.8"	Global Shutter	3.45	118
BFS-U3-50S5C-BD2	Color	5	Sony IMX264 CMOS	2/3"	Global Shutter	3.45	35
BFS-U3-50S5C-C	Color	5	Sony IMX264 CMOS	2/3"	Global Shutter	3.45	35
BFS-U3-50S5M-BD2	Mono	5	Sony IMX264 CMOS	2/3"	Global Shutter	3.45	35
BFS-U3-50S5M-C	Mono	5	Sony IMX264 CMOS	2/3"	Global Shutter	3.45	35
BFS-U3-51S5C-BD2	Color	5	Sony IMX250 CMOS	2/3"	Global Shutter	3.45	75
BFS-U3-51S5C-C	Color	5	Sony IMX250 CMOS	2/3"	Global Shutter	3.45	75
BFS-U3-51S5M-BD2	Mono	5	Sony IMX250 CMOS	2/3"	Global Shutter	3.45	75
BFS-U3-51S5M-C	Mono	5	Sony IMX250 CMOS	2/3"	Global Shutter	3.45	75
BFS-U3-51S5P-C	Polarized	5	Sony IMX250MZR CMOS	2/3"	Global Shutter	3.45	75
BFS-U3-51S5PC-C	Polarized	5	Sony IMX250MYR CMOS	2/3"	Global Shutter	3.45	75
BFS-U3-63S4C-C	Color	6.3	Sony IMX178 CMOS	1/1.8"	Rolling shutter with global reset	2.4	59.6
BFS-U3-63S4M-C	Mono	6.3	Sony IMX178 CMOS	1/1.8"	Rolling shutter with global reset	2.4	59.6
BFS-U3-70S7C-C	Color	7.1	Sony IMX428 CMOS	1.1"	Global Shutter	4.5	51
BFS-U3-70S7M-C	Mono	7.1	Sony IMX428 CMOS	1.1"	Global Shutter	4.5	51
BFS-U3-88S6C-BD2	Color	8.9	Sony IMX267 CMOS	1"	Global Shutter	3.45	32
BFS-U3-88S6C-C	Color	8.9	Sony IMX267 CMOS	1"	Global Shutter	3.45	32
BFS-U3-88S6M-BD2	Mono	8.9	Sony IMX267 CMOS	1"	Global Shutter	3.45	32
BFS-U3-88S6M-C	Mono	8.9	Sony IMX267 CMOS	1"	Global Shutter	3.45	32
BFS-U3-89S6C-C	Color	8.9	Sony IMX255 CMOS	1"	Global Shutter	3.45	42
BFS-U3-89S6M-C	Mono	8.9	Sony IMX255 CMOS	1"	Global Shutter	3.45	42
BFS-U3-120S4C-CS	Color	12	Sony IMX226 CMOS	1/1.7"	Rolling shutter with global reset	1.85	31
BFS-U3-120S4M-CS	Mono	12	Sony IMX226 CMOS	1/1.7"	Rolling shutter with global reset	1.85	31
BFS-U3-122S6C-C	Color	12.3	Sony IMX304 CMOS	1.1"	Global Shutter	3.45	23
BFS-U3-122S6M-C	Mono	12.3	Sony IMX304 CMOS	1.1"	Global Shutter	3.45	23
BFS-U3-123S6C-C	Color	12.3	Sony IMX253 CMOS	1.1"	Global Shutter	3.45	30
BFS-U3-123S6M-C	Mono	12.3	Sony IMX253 CMOS	1.1"	Global Shutter	3.45	30
BFS-U3-200S6C-BD2	Color	20	Sony IMX183 CMOS	1"	Rolling shutter with global reset	2.4	17
BFS-U3-200S6C-C	Color	20	Sony IMX183 CMOS	1"	Rolling shutter with global reset	2.4	18
BFS-U3-200S6M-BD2	Mono	20	Sony IMX183 CMOS	1"	Rolling shutter with global reset	2.4	17
BFS-U3-200S6M-C	Mono	20	Sony IMX183 CMOS	1"	Rolling shutter with global reset	2.4	18
BFS-U3-244S8M-C	Mono	24.5	Sony IMX540 CMOS	4/3"	Global Shutter	2.74	12
BFS-U3-244S8M-C	Mono	24.5	Sony IMX540 CMOS	4/3"	Global Shutter	2.74	12

## FIREFLY DL SPECIFICATIONS

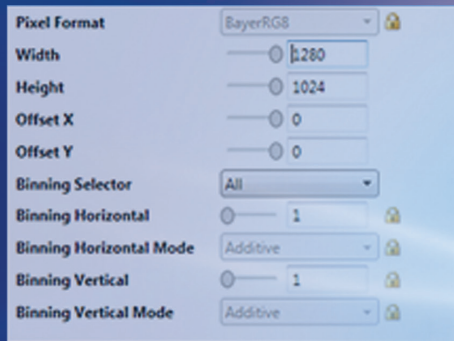
PART NUMBER	TYPE	MP	SENSOR	SENSOR FORMAT	SHUTTER	PIXEL SIZE $\mu\text{m}$	MAX FPS
FFY-U3-16S2C-C-DL	Color	1.6	Sony IMX296 CMOS	1/2.9"	Global Shutter	3.45	60
FFY-U3-16S2C-CS-DL	Color	1.6	Sony IMX296 CMOS	1/2.9"	Global Shutter	3.45	60
FFY-U3-16S2C-S-DL	Color	1.6	Sony IMX296 CMOS	1/2.9"	Global Shutter	3.45	60
FFY-U3-16S2M-C-DL	Mono	1.6	Sony IMX296 CMOS	1/2.9"	Global Shutter	3.45	60
FFY-U3-16S2M-CS-DL	Mono	1.6	Sony IMX296 CMOS	1/2.9"	Global Shutter	3.45	60
FFY-U3-16S2M-S-DL	Mono	1.6	Sony IMX296 CMOS	1/2.9"	Global Shutter	3.45	60

## FIREFLY S SPECIFICATIONS

PART NUMBER	TYPE	MP	SENSOR	SENSOR FORMAT	SHUTTER	PIXEL SIZE $\mu\text{m}$	MAX FPS
FFY-U3-04S2M-C	Mono	0.4	Sony IMX297 CMOS	1/2.9"	Global Shutter	6.9	121
FFY-U3-04S2M-CS	Mono	0.4	Sony IMX297 CMOS	1/2.9"	Global Shutter	6.9	121
FFY-U3-04S2M-S	Mono	0.4	Sony IMX297 CMOS	1/2.9"	Global Shutter	6.9	121
FFY-U3-16S2C-C	Color	1.6	Sony IMX296 CMOS	1/2.9"	Global Shutter	3.45	60
FFY-U3-16S2C-CS	Color	1.6	Sony IMX296 CMOS	1/2.9"	Global Shutter	3.45	60
FFY-U3-16S2C-S	Color	1.6	Sony IMX296 CMOS	1/2.9"	Global Shutter	3.45	60
FFY-U3-16S2M-C	Mono	1.6	Sony IMX296 CMOS	1/2.9"	Global Shutter	3.45	60
FFY-U3-16S2M-CS	Mono	1.6	Sony IMX296 CMOS	1/2.9"	Global Shutter	3.45	60
FFY-U3-16S2M-S	Mono	1.6	Sony IMX296 CMOS	1/2.9"	Global Shutter	3.45	60

# ORYX SPECIFICATIONS

PART NUMBER	TYPE	MP	SENSOR	SENSOR FORMAT	SHUTTER	PIXEL SIZE $\mu\text{m}$	MAX FPS
ORX-10GS-51S5C-C	Color	5	Sony IMX250 CMOS	2/3"	Global Shutter	3.45	162
ORX-10GS-51S5M-C	Mono	5	Sony IMX250 CMOS	2/3"	Global Shutter	3.45	162
ORX-10G-71S7C-C	Color	7.1	Sony IMX420 CMOS	1.1"	Global Shutter	4.5	112
ORX-10G-71S7M-C	Mono	7.1	Sony IMX420 CMOS	1.1"	Global Shutter	4.5	112
ORX-10GS-89S6C-C	Color	8.9	Sony IMX255 CMOS	1"	Global Shutter	3.45	93
ORX-10GS-89S6M-C	Mono	8.9	Sony IMX255 CMOS	1"	Global Shutter	3.45	93
ORX-10GS-123S6C-C	Color	12.3	Sony IMX253 CMOS	1.1"	Global Shutter	3.45	68
ORX-10GS-123S6M-C	Mono	12.3	Sony IMX253 CMOS	1.1"	Global Shutter	3.45	68
ORX-10G-310S9C	Color	31	Sony IMX342 CMOS	APS-C	Global Shutter	3.45	26
ORX-10G-310S9M	Mono	31	Sony IMX342 CMOS	APS-C	Global Shutter	3.45	26



# SPINNAKER SDK

## MULTIPLE PLATFORMS

• **Windows®** 32/64-bit 

7,10

• **LINUX®** 

Ubuntu 18.04 (64-bit)

Desktop Ubuntu 16.04

(32-bit)

Ubuntu 18.04 (ARM64)

(16.04 ARMHF & ARM64)

• **Mac® OS**

Mojave & High Sierra

## MULTIPLE INTERFACES

**USB VISION** **GIG E VISION** **GEN*i*CAM**

This SDK provides the same programming interface across USB3 Vision and GigE Vision cameras.

## MULTIPLE LANGUAGES

- **C, C++, C#**
- **Visual Basic .NET**
- **Python**

The Spinnaker SDK is FLIR's next generation GenICam3 API library built for machine vision developers. It features an intuitive GUI called SpinView, rich example code, and comprehensive documentation designed to help you build your application faster. Spinnaker is recommended for new projects.

## BUILD FASTER

Engineered for faster development into your application and better forward compatibility.

## ACCELERATED INTEGRATION

Unlock the power of GenICam3. Quickly build your own software and have UI customizations. Minimize future development time with Spinnaker's API forward compatibility.

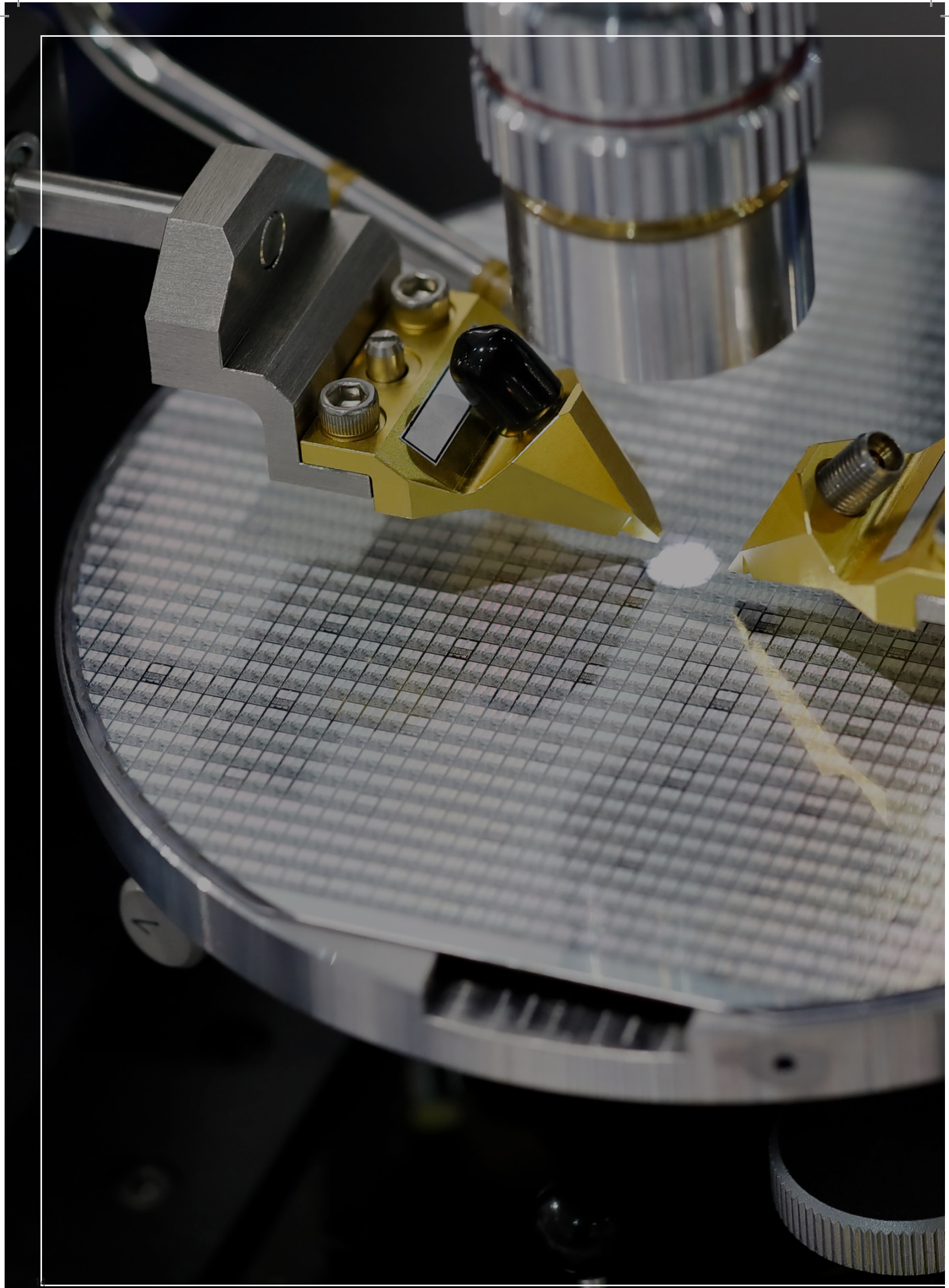
## DYNAMIC FEATURES

Simplify and improve performance by enabling camera events, imaging sequencer and programmable logic. Use chunk data to gather image metadata and validate system performance.

## TRANSMISSION RELIABILITY

Superior image transfer control and bandwidth management offers greater flexibility and insight into all transmission pipeline layers. Review detailed diagnostics and take command of our advanced logging functionality.





# SENSOR REVIEW MONO CAMERAS

EMVA 1288 Specification Comparison Charts



FLIR's Camera Sensor Review tool compares and ranks the latest CMOS sensors to help you find the best cameras in terms of EMVA 1288 specifications such as quantum efficiency, absolute sensitivity, dynamic range and more.

The EMVA 1288 standard goes beyond the basics of resolution or frames per second by providing specifications to help understand sensor and camera image performance such as its ability to perform well in low light, provide good dynamic range, or provide clear, low noise images.

# FREQUENTLY ASKED QUESTIONS

## What is included with my camera?

During your camera selection please be mindful of which accessories are included and which accessories are not included with the camera.

Here is a quick table guide for your reference:

<b>USB3</b> VISION	USB3 VISION CAMERAS	Tripod Adapter	5mm C-Mount Adapter	Cables	Lens
	Blackfly S USB3	No	No	No	No
	Blackfly USB3	No	No	No	No
	Chameleon3 USB3	No	No	No	No
	Firefly DL USB3	No	No	No	No
	Firefly S USB3	No	No	No	No
	Flea3 USB3	Yes	Yes for CS-mount models	No	No
	Grasshopper3 USB3	Yes	N/A (no CS-mount models)	No	No

<b>GigE</b> VISION	GIGE VISION CAMERAS	Tripod Adapter	5mm C-Mount Adapter	Cables	Lens
	Oryx GigE	N/A	No	No	No
	Blackfly GigE	No	No	No	No
	Blackfly S GigE	No	No	No	No
	Flea3 GigE	Yes	Yes for CS-mount models	No	No
	Grasshopper2 GigE	Yes	N/A (no CS-mount models)	No	No
	Grasshopper3 GigE	Yes	N/A (no CS-mount models)	No	No

## Where can I get more technical support?

You can search our online Knowledge Base for answers to camera issues below:

- Blackfly S GigE: [www.flir.com/support/products/blackfly-s-gige](http://www.flir.com/support/products/blackfly-s-gige)
- Blackfly S USB3: [www.flir.com/support/products/blackfly-s-usb3](http://www.flir.com/support/products/blackfly-s-usb3)
- Blackfly S Board Level: [www.flir.com/support/products/blackfly-s-board-level](http://www.flir.com/support/products/blackfly-s-board-level)
- Firefly DL: [www.flir.com/support/products/firefly-dl](http://www.flir.com/support/products/firefly-dl)
- Firefly S: [www.flir.com/support/products/firefly-s](http://www.flir.com/support/products/firefly-s)
- Oryx: [www.flir.com/support/products/oryx-10gige](http://www.flir.com/support/products/oryx-10gige)

You can contact our support team directly and email them your issue.

We have support teams staffed at our North America, Germany, China and Japan offices ready to assist with your cameras. You can contact our support team directly at [mv-support@flir.com](mailto:mv-support@flir.com).

## Where can I get more sales assistance?

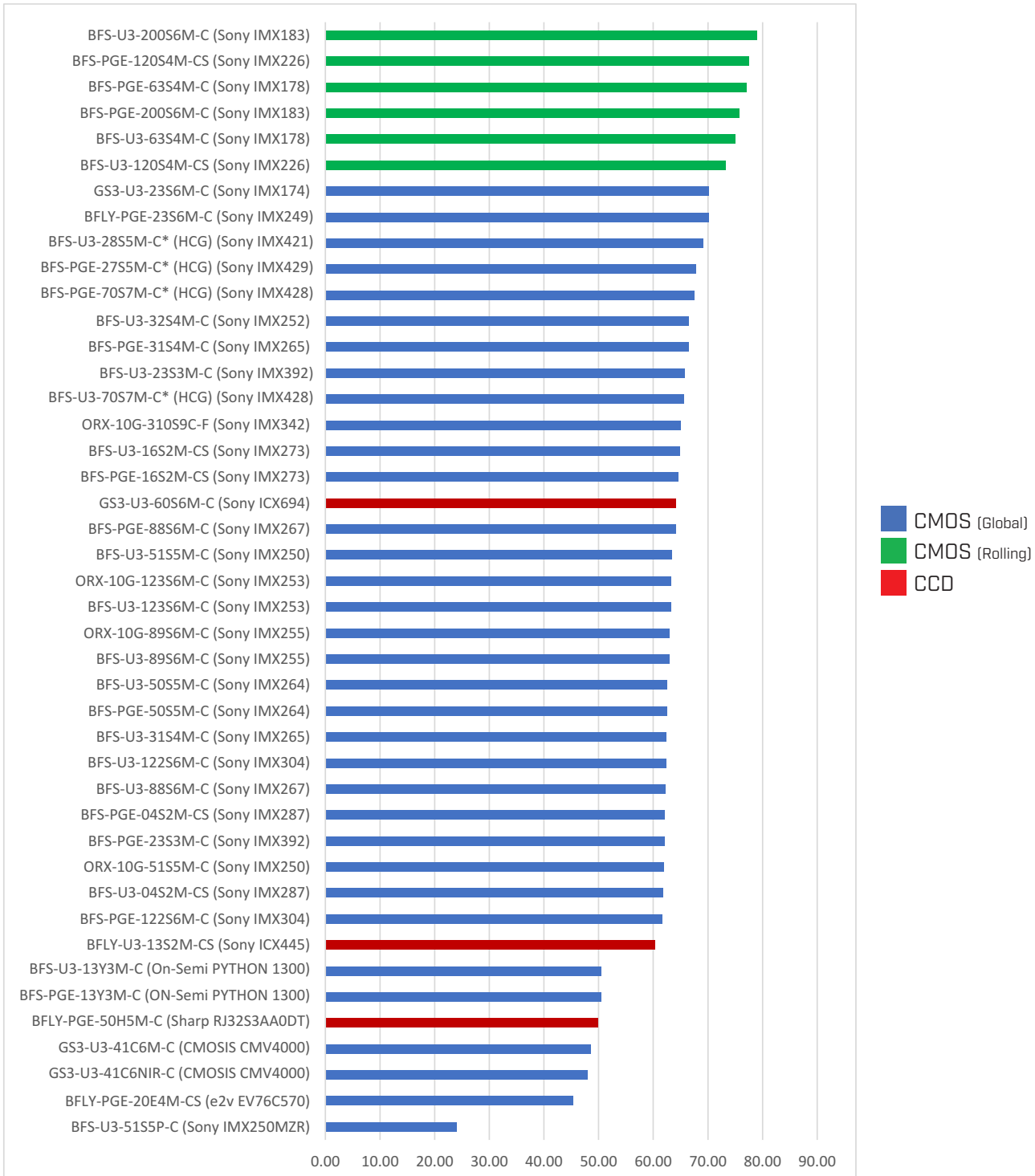
Pricing and web purchase are available at [www.flir.com/mv](http://www.flir.com/mv). You can also email us, we're always happy to help: [mv-sales@flir.com](mailto:mv-sales@flir.com)



# EMVA1288 Specification Comparison Charts

## QUANTUM EFFICIENCY (%) AT 530 nm [HIGHER IS BETTER]

Quantum efficiency (QE) is the ability of the sensor to turn photons into electrons, or in other words, turn incoming light into an electrical signal for imaging. A higher QE % means greater sensitivity for detecting light. A sensor with a measurement of 79% means that for every 100 photons that hit the sensor an average of 79 will be detected. Please note that the results below are taken at the wavelength of 530nm.



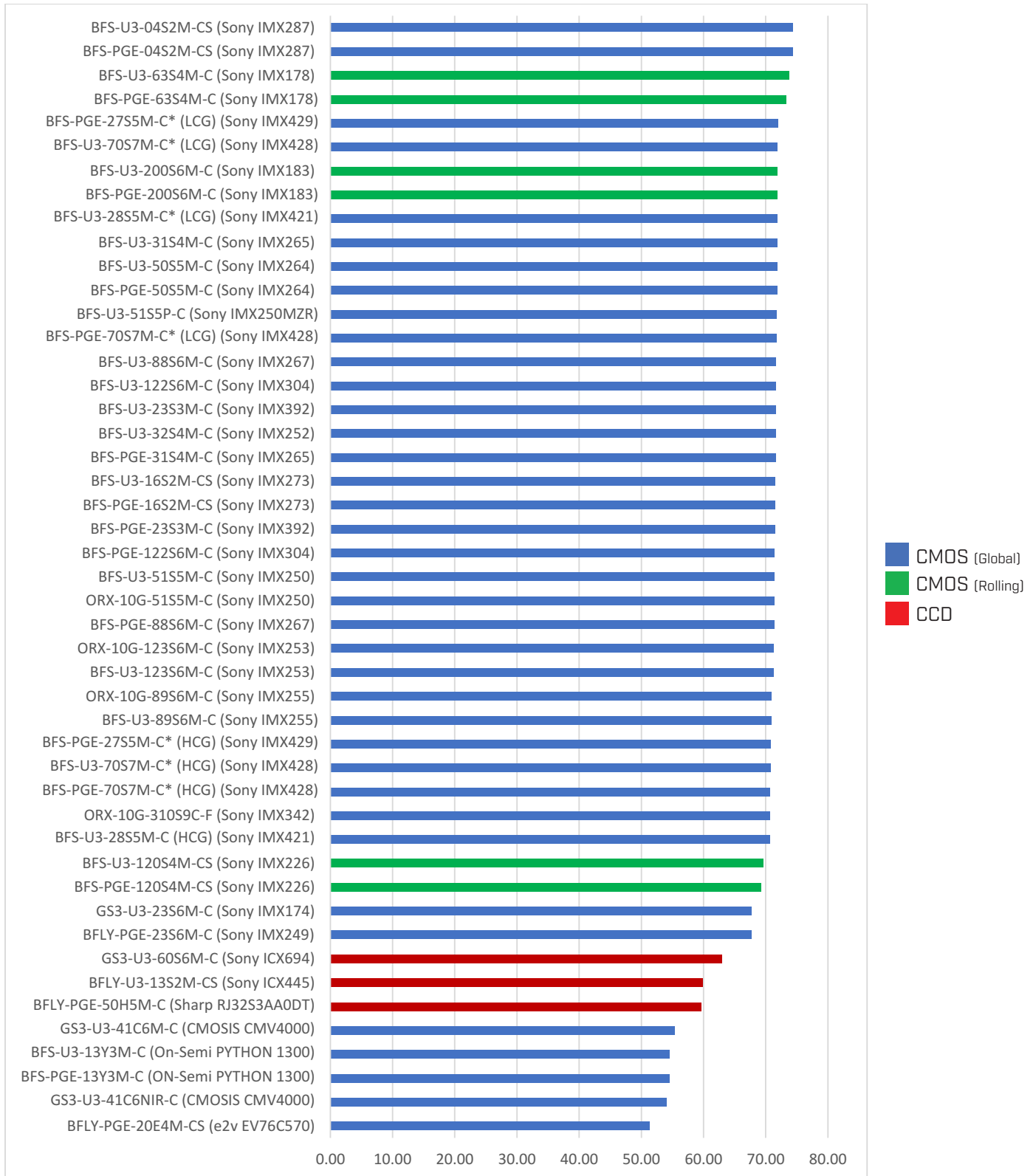
\*Low and high conversion gain is explained in section "Selectable Conversion Gain"

Please note that all measurements are taken based on guidelines in the EMVA 1288 standard. Camera settings are at maximum exposure time and bit depth unless otherwise noted. The pixel format is Mono 16 for mono cameras except for the last two Bandwidth and Throughput graphs which are done at Mono 8. Results are captured at room temperature (20°C). For more information on the EMVA 1288 standard please visit EMVA.org.

# DYNAMIC RANGE dB

[HIGHER IS BETTER]

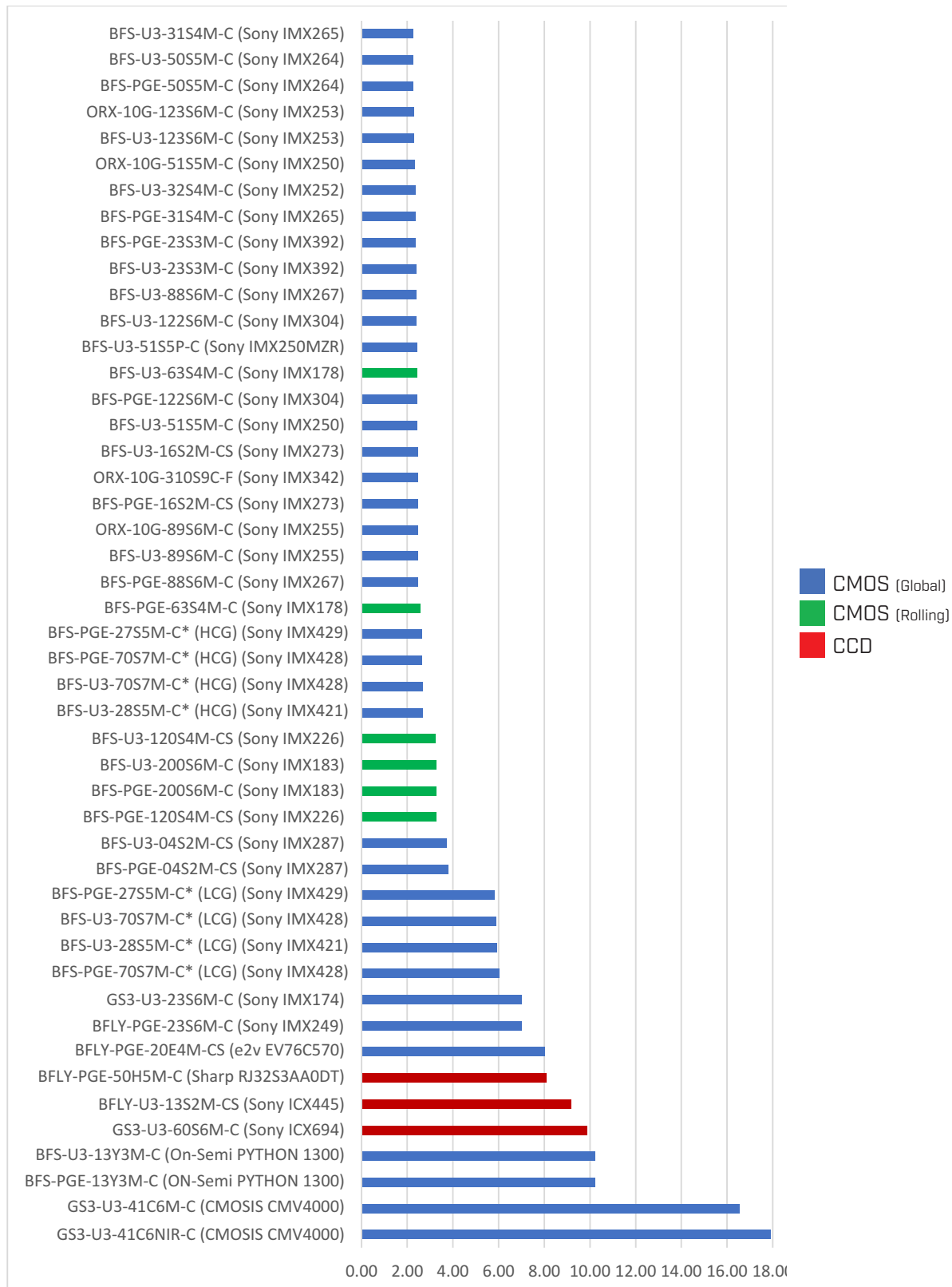
Dynamic range describes the camera model's ability to detect the maximum and minimum of light intensities (shadows and highlights). Models with higher dynamic range can detect more detail in the darks and lights.



\*Low and high conversion gain is explained in section "Selectable Conversion Gain"

# TEMPORAL DARK NOISE/READ NOISE e- [LOWER IS BETTER]

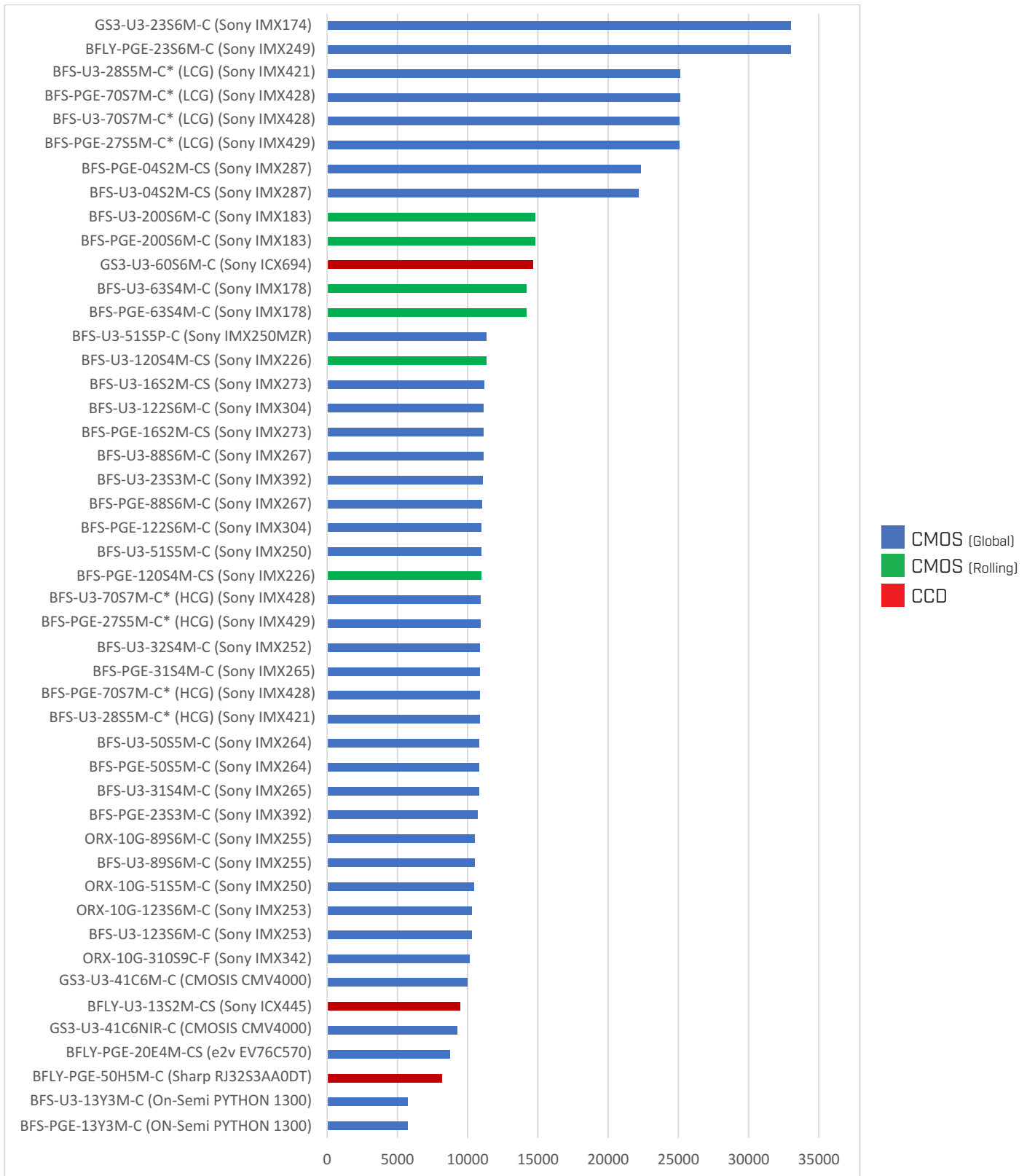
Temporal dark noise (also known as read noise) comes from energy within the sensor and the surrounding sensor electronics. Over time, random electrons are created that fall into the sensor wells and are detected and turned into signal. Models with lower read noise measurements produce cleaner images.



\*Low and high conversion gain is explained in section "Selectable Conversion Gain"

# SATURATION CAPACITY (WELL DEPTH) e- (HIGHER IS BETTER, SORTED BY PIXEL SIZE)

The saturation capacity (well depth) is the largest charge a pixel can hold before over-saturation occurs and signal degradation begins. Saturation must be avoided because it diminishes the quantitative ability of the sensor and in the case of CCDs produces image smearing due to a phenomenon known as blooming.

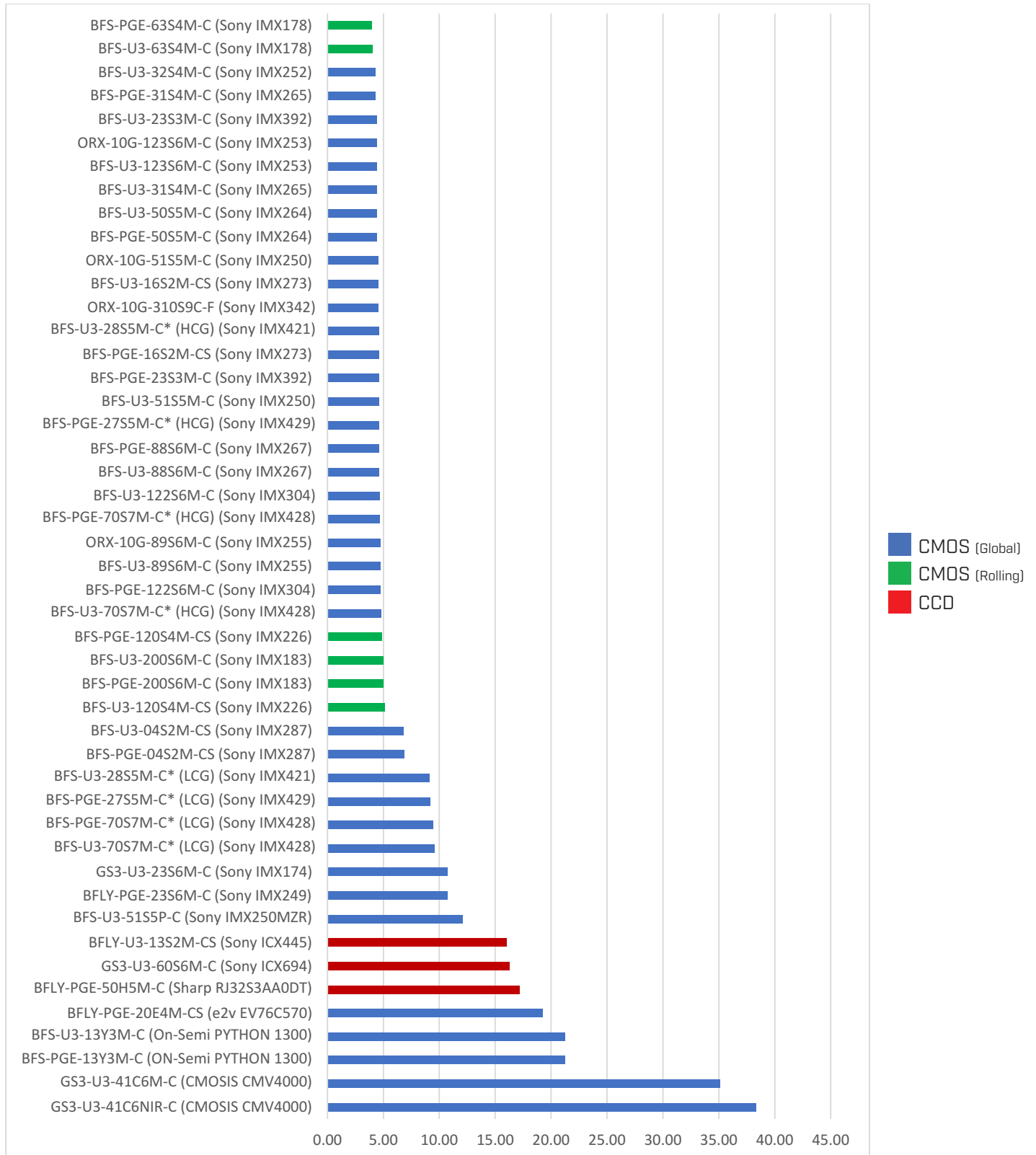


\*Low and high conversion gain is explained in section "Selectable Conversion Gain"

# ABSOLUTE SENSITIVITY THRESHOLD ( $\gamma$ )

(LESS IS BETTER)

Absolute sensitivity threshold is the minimum number of photons needed to equal the noise level. The lower the number the less light is needed to detect useful imaging data.



\*Low and high conversion gain is explained in section "Selectable Conversion Gain"

**MONO CAMERA SENSOR REVIEW** SORTED BY SENSOR TYPE (CMOS/CCD) AND RESOLUTION

PART NUMBER	SENSOR		SENSOR SIZE (inches)	INTERFACE	SENSOR TYPE	READOUT	MAX RESOLUTION
ORX-10G-310S9C-F	Sony	IMX342	APS-C	10GigE	CMOS	Global shutter	6464 x 4852
BFS-PGE-200S6M-C	Sony	IMX183	1	PoE GigE	CMOS	Rolling shutter with global reset	5472 x 3648
BFS-U3-200S6M-C	Sony	IMX183	1	USB 3.1 Gen 1	CMOS	Rolling shutter with global reset	5472 x 3648
BFS-U3-123S6M-C	Sony	IMX253	1.1	USB 3.1 Gen 1	CMOS	Global shutter	4096 x 3000
BFS-PGE-122S6M-C	Sony	IMX304	1.1	PoE GigE	CMOS	Global shutter	4096 x 3000
BFS-U3-122S6M-C	Sony	IMX304	1.1	USB 3.1 Gen 1	CMOS	Global shutter	4096 x 3000
ORX-10G-123S6M-C	Sony	IMX253	1.1	10GigE	CMOS	Global shutter	4096 x 3000
BFS-PGE-120S4M-CS	Sony	IMX226	1/1.7	PoE GigE	CMOS	Rolling shutter with global reset	4000 x 3000
BFS-U3-120S4M-CS	Sony	IMX226	1/1.7	USB 3.1 Gen 1	CMOS	Rolling shutter with global reset	4000 x 3000
BFS-PGE-88S6M-C	Sony	IMX267	1	PoE GigE	CMOS	Global shutter	4096 x 2160
BFS-U3-88S6M-C	Sony	IMX267	1	USB 3.1 Gen 1	CMOS	Global shutter	4096 x 2160
BFS-U3-89S6M-C	Sony	IMX255	1	USB 3.1 Gen 1	CMOS	Global shutter	4096 x 2160
ORX-10G-89S6M-C	Sony	IMX255	1	10GigE	CMOS	Global shutter	4096 x 2160
BFS-PGE-70S7M-C (LCG)	Sony	IMX428	1.1	PoE GigE	CMOS	Global shutter	3208 x 2200
BFS-PGE-70S7M-C (HCG)	Sony	IMX428	1.1	PoE GigE	CMOS	Global shutter	3208 x 2200
BFS-U3-70S7M-C (LCG)	Sony	IMX428	1.1	USB 3.1 Gen 1	CMOS	Global shutter	3208 x 2200
BFS-U3-70S7M-C (HCG)	Sony	IMX428	1.1	USB 3.1 Gen 1	CMOS	Global shutter	3208 x 2200
ORX-10G-71S7M-C (LCG)	Sony	IMX420	1.1	10GigE	CMOS	Global shutter	3208 x 2200
ORX-10G-71S7M-C (HCG)	Sony	IMX420	1.1	10GigE	CMOS	Global shutter	3208 x 2200
BFS-PGE-63S4M-C	Sony	IMX178	1/1.8	PoE GigE	CMOS	Rolling shutter with global reset	3072 x 2048
BFS-U3-63S4M-C	Sony	IMX178	1/1.8	USB 3.1 Gen 1	CMOS	Rolling shutter with global reset	3072 x 2048
BFS-PGE-50S5M-C	Sony	IMX264	2/3	PoE GigE	CMOS	Global shutter	2448 x 2048
BFS-U3-50S5M-C	Sony	IMX264	2/3	USB 3.1 Gen 1	CMOS	Global shutter	2448 x 2048
BFS-U3-50S5M-BD2	Sony	IMX264	2/3	USB 3.1 Gen 1	CMOS	Global shutter	2448 x 2048
BFS-U3-51S5M-C	Sony	IMX250	2/3	USB 3.1 Gen 1	CMOS	Global shutter	2448 x 2048
BFS-U3-51S5M-BD2	Sony	IMX250	2/3	USB 3.1 Gen 1	CMOS	Global shutter	2448 x 2048
BFS-U3-51S5P-C	Sony	IMX250MZR	2/3	USB 3.1 Gen 1	CMOS	Global shutter	2448 x 2048
ORX-10G-51S5M-C	Sony	IMX250	2/3	10GigE	CMOS	Global shutter	2448 x 2048
GS3-U3-41C6M-C	CMOSIS	CMV4000	1	USB 3.1 Gen 1	CMOS	Global shutter	2048 x 2048
GS3-U3-41C6NIR-C	CMOSIS	CMV4000	1	USB 3.1 Gen 1	CMOS	Global shutter	2048 x 2048
BFS-PGE-31S4M-C	Sony	IMX265	1/1.8	PoE GigE	CMOS	Global shutter	2048 x 1536
BFS-U3-31S4M-C	Sony	IMX265	1/1.8	USB 3.1 Gen 1	CMOS	Global shutter	2048 x 1536
BFS-U3-32S4M-C	Sony	IMX252	1/1.8	USB 3.1 Gen 1	CMOS	Global shutter	2048 x 1536
BFS-PGE-27S5M-C (LCG)	Sony	IMX429	2/3	PoE GigE	CMOS	Global shutter	1936 x 1464
BFS-PGE-27S5M-C (HCG)	Sony	IMX429	2/3	PoE GigE	CMOS	Global shutter	1936 x 1464
BFS-U3-28S5M-C (LCG)	Sony	IMX421	2/3	USB 3.1 Gen 1	CMOS	Global shutter	1936 x 1464
BFS-U3-28S5M-C (HCG)	Sony	IMX421	2/3	USB 3.1 Gen 1	CMOS	Global shutter	1936 x 1464
BFLY-PGE-23S6M-C	Sony	IMX249	1	PoE GigE	CMOS	Global shutter	1920 x 1200
GS3-U3-23S6M-C	Sony	IMX174	1	USB 3.1 Gen 1	CMOS	Global shutter	1920 x 1200
BFS-PGE-23S3M-C	Sony	IMX392	1/2.3	PoE GigE	CMOS	Global shutter	1920 x 1200
BFS-U3-23S3M-C	Sony	IMX392	1/2.3	USB 3.1 Gen 1	CMOS	Global shutter	1920 x 1200
BFLY-PGE-20E4M-CS	e2v	EV76C570	1/1.8	PoE GigE	CMOS	Global shutter	1600 x 1200
BFS-GE-16S2M-BD2	Sony	IMX273	1/2.9	GigE	CMOS	Global shutter	1440 x 1080
BFS-PGE-16S2M-CS	Sony	IMX273	1/2.9	PoE GigE	CMOS	Global shutter	1440 x 1080
BFS-U3-16S2M-CS	Sony	IMX273	1/2.9	USB 3.1 Gen 1	CMOS	Global shutter	1440 x 1080
BFS-PGE-13Y3M-C	ON-Semi	PYTHON 1300	1/2	PoE GigE	CMOS	Global shutter	1280 x 1024
BFS-U3-13Y3M-C	On-Semi	PYTHON 1300	1/2	USB 3.1 Gen 1	CMOS	Global shutter	1280 x 1024
BFS-PGE-04S2M-CS	Sony	IMX287	1/2.9	PoE GigE	CMOS	Global shutter	720 x 540
BFS-U3-04S2M-CS	Sony	IMX287	1/2.9	USB 3.1 Gen 1	CMOS	Global shutter	720 x 540
BFS-PGE-19S4M-C (LCG)	Sony	IMX430	1/1.7	PoE GigE	CMOS	Global shutter	1616 x 1240
BFS-PGE-19S4M-C (HCG)	Sony	IMX430	1/1.7	PoE GigE	CMOS	Global shutter	1616 x 1240
BFS-U3-20S4M-C (LCG)	Sony	IMX422	1/1.7	USB 3.1 Gen 1	CMOS	Global shutter	1616 x 1240
BFS-U3-20S4M-C (HCG)	Sony	IMX422	1/1.7	USB 3.1 Gen 1	CMOS	Global shutter	1616 x 1240
FFY-U3-16S2M-DL	Sony	IMX296	1/2.9	USB 3.1 Gen 1	CMOS	Global shutter	1440 x 1080
FFY-U3-16S2M-S	Sony	IMX296	1/2.9	USB 3.1 Gen 1	CMOS	Global shutter	1440 x 1080
FFY-U3-04S2M-S	Sony	IMX297	1/2.9	USB 3.1 Gen 1	CMOS	Global shutter	720 x 540
BFS-PGE-16S7M-S (LCG)	Sony	IMX432	1.1	PoE GigE	CMOS	Global shutter	1600 x 1100
BFS-PGE-16S7M-S (HCG)	Sony	IMX432	1.1	PoE GigE	CMOS	Global shutter	1600 x 1100
BFS-U3-17S7M-S (LCG)	Sony	IMX425	1.1	USB 3.1 Gen 1	CMOS	Global shutter	1600 x 1100
BFS-U3-17S7M-S (HCG)	Sony	IMX425	1.1	USB 3.1 Gen 1	CMOS	Global shutter	1600 x 1100
GS3-U3-60S6M-C	Sony	ICX694	1	USB 3.1 Gen 1	CCD	Global shutter	2736 x 2192
BFLY-PGE-50H5M-C	Sharp	RJ32S3AA0DT	2/3	PoE GigE	CCD	Global shutter	2448 x 2048
BFLY-U3-13S2M-CS	Sony	ICX445	1/3	USB 3.1 Gen 1	CCD	Global shutter	1288 x 964

MEGAPIXELS	MAX FPS	PIXEL SIZE (µm)	QE 530 nm (%)	GAIN (e-)	TEMPORAL DARK NOISE (ADU)	TEMPORAL DARK NOISE (e-)	SNR (dB)	SNR (Bits)	AST (V)	SATURATION CAPACITY (e-)	DYNAMIC RANGE (dB)	DYNAMIC RANGE (Bits)
31.4	27 FPS	3.45 µm	65.04	6.00	14.75	2.46	40.07	6.66	4.55	10160	70.72	11.75
20.0	6.1 FPS	2.4 µm	75.73	4.23	13.81	3.26	41.70	6.93	4.97	14794	71.89	11.94
20.0	18 FPS	2.4 µm	78.91	4.23	13.81	3.26	41.70	6.93	4.97	14794	71.89	11.94
12.3	30 FPS	3.45 µm	63.30	6.08	13.99	2.30	40.12	6.66	4.43	10287	71.30	11.84
12.3	10 FPS	3.45 µm	61.60	5.79	14.11	2.43	40.40	6.71	4.76	10971	71.45	11.87
12.3	23 FPS	3.45 µm	62.29	5.76	13.82	2.40	40.46	6.72	4.65	11130	71.69	11.91
12.3	68 FPS	3.45 µm	63.30	6.08	13.99	2.30	40.12	6.66	4.43	10287	71.30	11.84
12.0	8.5 FPS	1.85 µm	77.44	5.69	18.60	3.27	40.39	6.71	4.87	10944	69.26	11.50
12.0	31 FPS	1.85 µm	73.27	5.60	18.09	3.23	40.54	6.73	5.09	11323	69.64	11.57
8.8	13.9 FPS	3.45 µm	64.07	5.76	14.25	2.48	40.41	6.71	4.64	10998	71.35	11.85
8.8	32 FPS	3.45 µm	62.26	5.74	13.73	2.39	40.46	6.72	4.64	11107	71.69	11.91
8.8	42 FPS	3.45 µm	62.99	5.79	14.33	2.47	40.22	6.68	4.72	10514	70.97	11.79
8.8	93 FPS	3.45 µm	62.99	5.79	14.33	2.47	40.22	6.68	4.72	10514	70.97	11.79
7.1	17.4 FPS	4.5 µm	68.81	2.52	15.14	6.01	44.00	7.31	9.46	25119	71.73	11.91
7.1	17.4 FPS	4.5 µm	67.45	5.85	15.48	2.65	40.35	6.70	4.67	10846	70.75	11.75
7.1	51 FPS	4.5 µm	66.46	2.53	14.89	5.89	44.00	7.31	9.61	25101	71.89	11.94
7.1	51 FPS	4.5 µm	65.65	5.79	15.41	2.66	40.39	6.71	4.81	10938	70.78	11.76
7.1	112 FPS	4.5 µm	68.42	2.57	15.05	5.85	43.97	7.30	9.28	24969	71.89	11.94
7.1	112 FPS	4.5 µm	66.94	5.97	15.80	2.65	40.18	6.67	4.70	10432	70.41	11.70
6.3	19 FPS	2.4 µm	77.07	4.30	10.98	2.55	41.52	6.90	3.96	14177	73.33	12.18
6.3	59.6 FPS	2.4 µm	75.05	4.31	10.58	2.42	41.52	6.90	4.03	14204	73.73	12.25
5.0	22 FPS	3.45 µm	62.51	5.77	13.10	2.27	40.34	6.70	4.43	10824	71.83	11.93
5.0	35 FPS	3.45 µm	62.51	5.77	13.10	2.27	40.34	6.70	4.43	10824	71.83	11.93
5.0	35 FPS	3.45 µm	62.51	5.77	13.10	2.27	40.34	6.70	4.43	10824	71.83	11.93
5.0	75 FPS	3.45 µm	63.40	5.70	13.87	2.44	40.40	6.71	4.63	10970	71.45	11.87
5.0	75 FPS	3.45 µm	65.06	5.68	13.82	2.43	40.38	6.71	4.51	10917	71.42	11.86
5.0	75 FPS	3.45 µm	24.10	5.63	13.59	2.42	40.55	6.74	12.10	11359	71.81	11.93
5.0	162 FPS	3.45 µm	61.95	6.03	13.96	2.31	40.18	6.67	4.54	10435	71.38	11.86
4.2	90 FPS	5.5 µm	48.50	6.27	103.71	16.53	39.99	6.64	35.11	9983	55.36	9.20
4.2	90 FPS	5.5 µm	48.00	6.64	118.82	17.90	39.68	6.59	38.34	9282	54.06	8.98
3.1	35 FPS	3.45 µm	66.50	5.73	13.46	2.35	40.36	6.70	4.29	10858	71.62	11.90
3.1	57 FPS	3.45 µm	62.36	5.79	13.10	2.26	40.33	6.70	4.43	10791	71.83	11.93
3.1	118 FPS	3.45 µm	66.50	5.73	13.46	2.35	40.36	6.70	4.29	10858	71.62	11.90
2.8	43 FPS	4.5 µm	68.64	2.54	14.76	5.81	43.99	7.31	9.20	25048	71.97	11.95
2.8	43 FPS	4.5 µm	67.82	5.76	15.24	2.64	40.38	6.71	4.64	10912	70.81	11.76
2.8	130 FPS	4.5 µm	70.55	2.51	14.87	5.93	44.00	7.31	9.11	25122	71.84	11.93
2.8	130 FPS	4.5 µm	69.15	5.80	15.47	2.67	40.35	6.70	4.58	10841	70.69	11.74
2.3	41 FPS	5.86 µm	70.14	1.92	13.32	7.02	45.19	7.51	10.72	33022	67.71	11.25
2.3	163 FPS	5.86 µm	70.14	1.92	13.32	7.02	45.19	7.51	10.72	33022	67.71	11.25
2.3	53 FPS	3.45 µm	62.11	5.77	13.60	2.36	40.30	6.69	4.60	10724	71.49	11.87
2.3	163 FPS	3.45 µm	65.78	5.74	13.72	2.39	40.45	6.72	4.39	11088	71.68	11.91
1.9	50 FPS	4.5 µm	45.30	6.70	36.55	8.04	39.41	6.55	19.22	8727	51.38	8.53
1.6	78 FPS	3.45 µm	64.70	5.62	13.72	2.44	40.48	6.72	4.54	11170	71.60	11.89
1.6	78 FPS	3.45 µm	64.60	5.71	14.05	2.46	40.46	6.72	4.58	11127	71.50	11.88
1.6	226 FPS	3.45 µm	64.81	5.73	14.01	2.45	40.48	6.72	4.55	11179	71.58	11.89
1.3	84 FPS	4.8 µm	50.45	6.70	68.38	10.21	37.60	6.25	21.22	5756	54.61	9.07
1.3	170 FPS	4.8 µm	50.45	6.70	68.38	10.21	37.60	6.25	21.22	5756	54.61	9.07
0.4	291 FPS	6.9 µm	62.15	2.85	10.77	3.78	43.48	7.22	6.88	22297	74.34	12.35
0.4	522 FPS	6.9 µm	61.82	2.89	10.71	3.71	43.46	7.22	6.81	22187	74.43	12.36
2.0	60 FPS	4.5 µm	71.55	2.55	14.84	5.80	43.90	7.29	8.79	24521	71.81	11.93
2.0	60 FPS	4.5 µm	70.62	5.88	15.14	2.57	40.26	6.69	4.35	10611	70.76	11.75
2.0	175 FPS	4.5 µm	71.03	2.58	14.88	5.76	43.85	7.28	8.81	24262	71.77	11.92
2.0	175 FPS	4.5 µm	70.14	5.88	15.37	2.61	40.23	6.68	4.44	10548	70.60	11.73
1.6	60 FPS	3.45 µm	65.34	10.92	0.45	4.93	40.36	6.70	8.31	10865	66.03	10.97
1.6	60 FPS	3.45 µm	65.34	10.92	0.45	4.93	40.36	6.70	8.31	10865	66.03	10.97
0.4	120 FPS	6.9 µm	64.67	20.99	0.33	6.89	43.24	7.18	11.42	21068	69.10	10.41
1.7	69 FPS	9 µm	70.70	1.57	23.25	14.80	49.98	8.30	33.75	99483	72.44	12.03
1.7	69 FPS	9 µm	72.34	0.31	15.31	4.76	42.95	7.13	7.31	19744	71.49	11.87
1.7	196 FPS	9 µm	72.01	0.65	22.65	14.78	49.95	8.30	33.00	98883	72.61	12.06
1.7	196 FPS	9 µm	73.67	0.31	15.31	4.68	42.92	7.13	7.23	19581	71.56	11.89
6.0	13 FPS	4.54 µm	64.15	4.34	41.25	9.87	41.66	6.92	16.26	14670	62.99	10.46
5.0	7.5 FPS	3.45 µm	49.81	7.60	61.32	8.07	39.13	6.50	17.21	8193	59.61	9.90
1.2	30 FPS	3.75 µm	60.38	6.51	59.70	9.17	39.77	6.61	16.01	9487	59.84	9.94

\*Low and high conversion gain is explained in section "Selectable Conversion Gain"



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