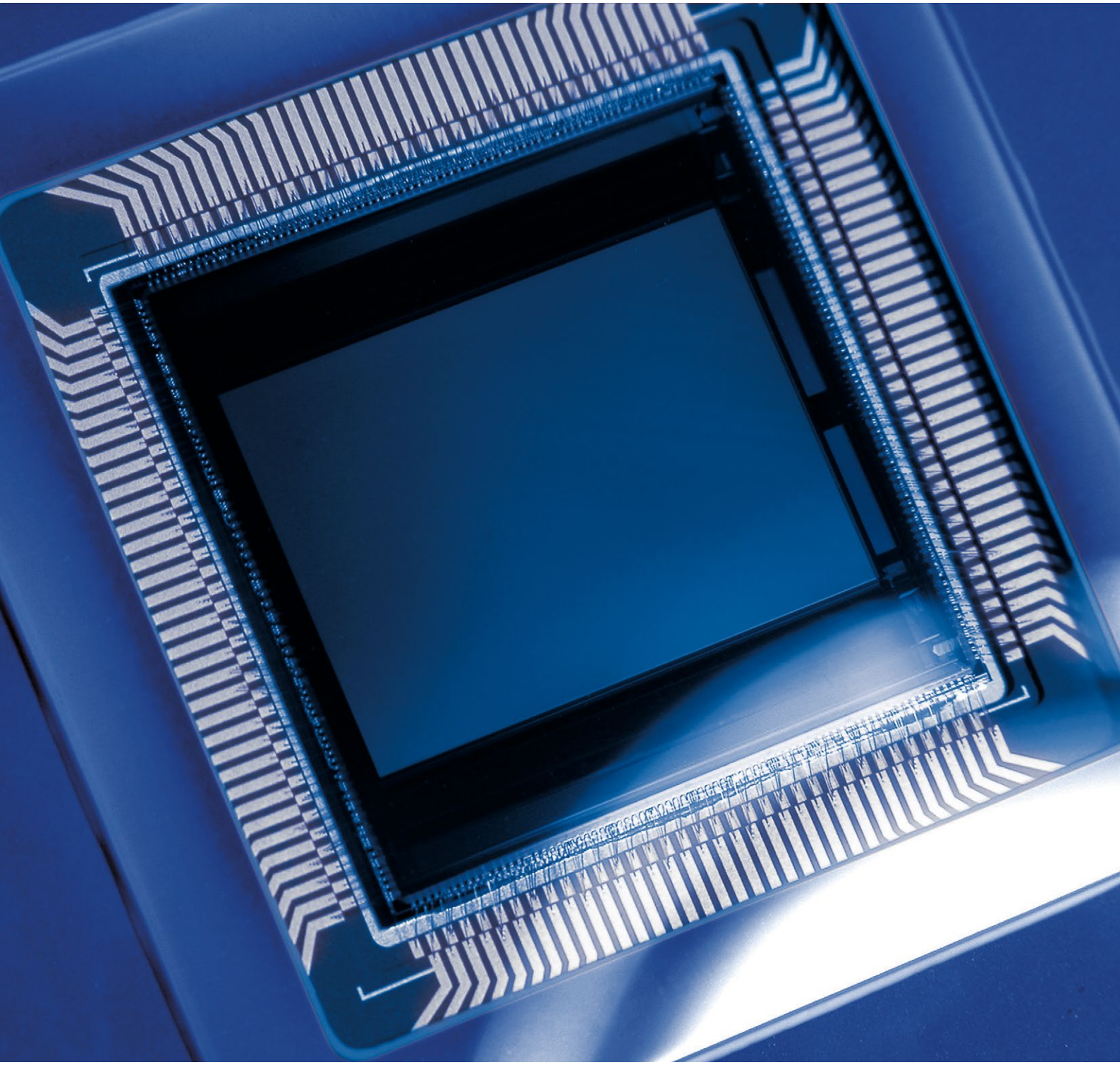
EMVA DATA OVERVIEW

MONOCHROME AREA SCAN CAMERAS



1288
EMVA Standard Compliant

BASLER
the power of sight

The EMVA 1288 Standard has been developed by the European Machine Vision Association with the goal of standardizing image quality and sensitivity measurements for machine vision cameras and sensors. Based on this standard our cameras are tested and their EMVA data is generated. This document will give you an overview of the EMVA data of our cameras. Detailed measurement reports for each camera model can be downloaded from our website:
baslerweb.com/emva-downloads

Functioning of a Sensor

The sensor is the heart of a camera and therefore its most important component. A sensor consists of pixels with photodiodes that convert energy of the incoming photons to an electrical charge which is then converted and processed to generate an image.

Sensor or camera properties are measured with different parameters. For the following explanation of the most common parameters we use an example from bottle inspection.

Quantum Efficiency QE [%]

The incident photon to converted electron ratio is called quantum efficiency. The QE depends on the wavelength of the light. The bigger the number of electrons produced by a given number of photons, the higher the QE and the more information is available in an image. A high quantum efficiency is especially important in low light conditions.

Temporal Dark Noise [e-]

Even if no light hits the sensor, some electrons are captured by pixels and create a signal that is called dark noise. Those electrons result from the electronics that surround the sensor. The less dark noise, the clearer the image and the better the signals can be detected.

Saturation Capacity [ke-]

The number of electrons a pixel can hold is limited and given by the saturation capacity. In a saturated pixel no more photons can be converted into electrons and thus image information is lost.

In the example, the fill level of the bottle in fig. 4 is invisible as the saturation capacity of the camera is reached. At a shorter exposure time (fig. 3) the fill level is detectable but at the expense of the barcode visibility.

Dynamic Range [dB]

The ratio between maximum and minimum measurable light intensities is described as dynamic range. A high dynamic range is especially important when there are both, dark and bright details in an image, or when light conditions are changing.

A camera with a higher dynamic range is able to deliver more levels of grey in the images (fig. 2). Details as barcodes, labels or the bottle cap can be inspected more accurately.

Signal to Noise Ratio SNR [dB]

The SNR compares the level of a desired signal to the level of background noise. In the overview on the following pages the best possible SNR is given.

The barcode example shows the image of a camera with high SNR (fig. 2) and one with lower SNR (fig. 3). For a better result, this camera needs a longer exposure time (fig. 4) or a more efficient illumination.

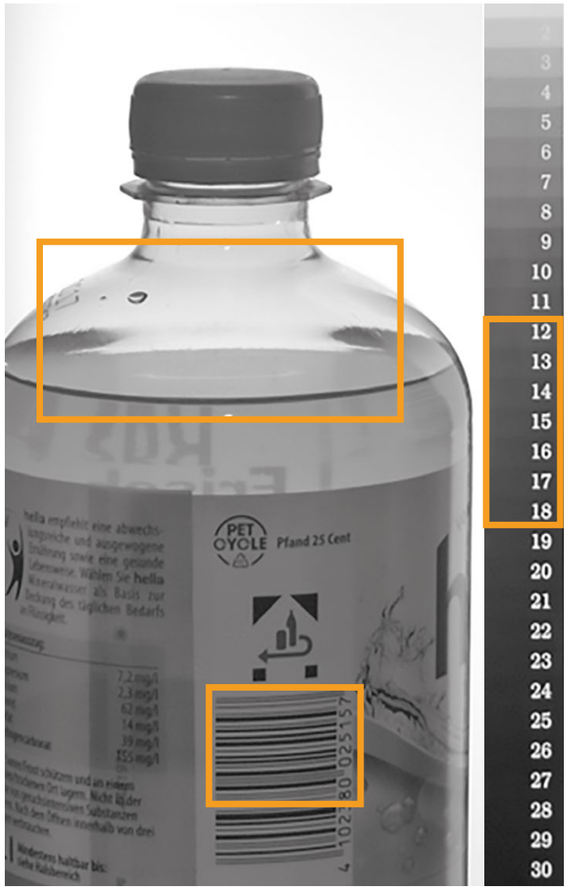


Fig. 1 Test Setup

How Does Basler Measure and Define Image Quality?

Basler is leading the effort to standardize image quality and sensitivity measurement for cameras and sensors. We are giving the EMVA 1288 standard our strongest support because it describes a unified method to measure, compute, and present the specification parameters for cameras and image sensors. Our cameras are characterized and measured in 100 % compliance with the EMVA 1288 standard.

1288
EMVA Standard Compliant

How Does Basler Ensure Superior Quality and Reliable High Performance?

Our approach to quality assurance is rigorous: we continually audit all facets of our business to ensure powerful performance, increase efficiency and reduce costs for our customers. We are compliant with all major quality standards including ISO 9001, CE, RoHS, and more. To ensure consistently high product quality, we employ several quality inspection procedures during manufacturing.

Every Basler camera is subjected to exhaustive optical and mechanical tests before leaving the factory. We have developed a unique combination of optics, hardware, and software tools that can quickly and efficiently calibrate a camera and measure its performance against a set of standard performance criteria. Regardless of what technology or camera model you choose you can be assured of consistent performance.

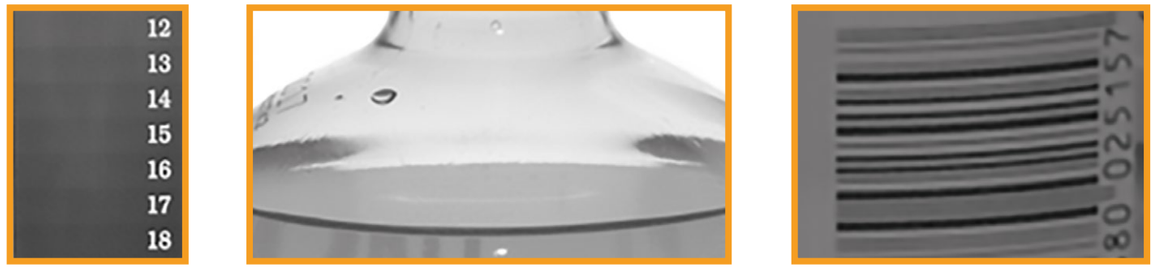


Fig. 2 Camera A with good EMVA properties

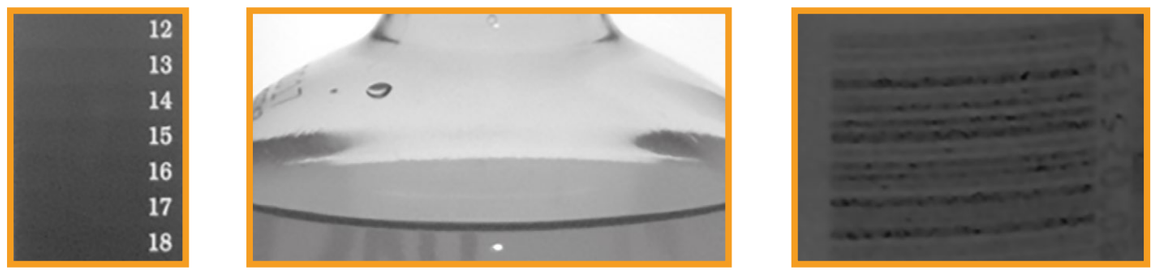


Fig. 3 Camera B with inferior EMVA properties



Fig. 4 Camera B with longer exposure time

SENSOR	TYPE	SHUTTER	RESOLUTION [MP]	PIXEL [H × V]	PIXEL SIZE [µm]	OPTICAL SIZE ["]	SERIES	FRAME RATE [fps] USB	GIGE	5GIGE	CXP-12	QE [%]	DARK NOISE [e⁻]	SAT. CAPACITY [ke⁻]	DYNAMIC RANGE [dB]	MAX. SNR [dB]
Sony																
ICX618 Replacement	CMOS	global	VGA	659 × 494	5.6	1/4	ace	–	134	–	–	63	5	28.0	75	45
IMX174	CMOS	global	2.3	1920 × 1200	5.86	1/1.2	ace	164	50	–	–	70	7	31.8	74	45
IMX178	CMOS	rolling	6	3088 × 2064	2.4	1/1.8	ace	59	16	–	–	81	3	14.3	73	42
IMX183	CMOS	rolling	20	5472 × 3648	2.4	1	ace	17	5	–	–	75	3	13.8	71	41
IMX226	CMOS	rolling	12	4024 × 3036	1.85	1/1.7	ace	31	8	–	–	83	3	11.0	70	40
IMX249	CMOS	global	2.3	1920 × 1200	5.86	1/1.2	ace	41	42	–	–	70	7	31.9	74	45
IMX250	CMOS	global	5	2448 × 2048	3.45	2/3	ace ace 2	75 –	– –	– 98	– –	68	2	10.7	73	40
IMX252	CMOS	global	3	2048 × 1536	3.45	1/1.8	ace	120	–	–	–	69	2	10.5	73	40
IMX253	CMOS	global	12	4096 × 3000	3.45	1.1	ace boost	30 –	– –	–	– 68	70	2	10.5	73	40
IMX255	CMOS	global	9	4096 × 2160	3.45	1	ace boost	40 –	– –	–	– 93	70	2	10.5	73	40
IMX264	CMOS	global	5	2448 × 2048	3.45	2/3	ace	35	20	–	–	68	2	10.4	73	40
IMX265	CMOS	global	3	2048 × 1536	3.45	1/1.8	ace	55	35	–	–	68	2	10.5	73	40
IMX267	CMOS	global	9	4096 × 2160	3.45	1	ace	30	12	–	–	69	2	10.2	73	40
IMX273	CMOS	global	1.6	1440 × 1080	3.45	1/2.9	ace	227	73	–	–	63	3	10.5	71	40
IMX287	CMOS	global	VGA	720 × 540	6.9	1/2.9	ace	525	291	–	–	63	7	21.0	74	43
IMX304	CMOS	global	12	4096 × 3000	3.45	1.1	ace	20	8	–	–	69	2	10.2	73	40
IMX334	CMOS	rolling	5 8.3	2592 × 1944 3840 × 2160	2.0 2.0	1/2.8 1/1.8	ace 2 ace 2	60 45	22 13	–	–	73	2	7.2	69	39
IMX392	CMOS	global	2.3	1920 × 1200	3.45	1/2.3	ace 2	160	51	168	–	62	3	10.5	72	40
IMX421	CMOS	global	3	1936 × 1464	4.5	2/3	boost	–	–	–	400	69	6	24.6	72	44
IMX530	CMOS	global	24.4	5328 × 4608	2.74	1.2	boost	–	–	–	100	66	2	9.6	71	40
IMX531	CMOS	global	20	4504 × 4504	2.74	1.1	boost	–	–	–	100	67	2	9.7	71	40
IMX532	CMOS	global	16.1	5320 × 3032	2.74	1.1	boost	–	–	–	150	65	2	9.6	71	40
IMX535	CMOS	global	12	4096 × 3000	2.74	1/1.1	boost	–	–	–	180	66	3	10	70	40
IMX536	CMOS	global	8	2832 × 2840	2.74	2/3	boost	–	–	–	190	66	3	9.6	70	40
IMX537	CMOS	global	5	2448 × 2048	2.74	1/1.8	ace 2 boost	– –	– –	– –	212 250	66	3	9.8	70	40
IMX540	CMOS	global	24.4	5328 × 4608	2.74	1.2	ace 2	15	4	22	35	66	2	9.7	71	40
IMX541	CMOS	global	20.2	4504 × 4504	2.74	1.1	ace 2	18	5	27	42	66	2	9.7	71	40
IMX542	CMOS	global	16.1	5320 × 3032	2.74	1.1	ace 2	23	7	34	52	66	2	9.7	71	40
IMX545	CMOS	global	12.3	4096 × 3000	2.74	1/1.1	ace 2	30	9	44	67	67	3	9.9	70	40
IMX546	CMOS	global	8	2840 × 2840	2.74	2/3	ace 2	48	14	67	86	66	2	9.8	70	40
IMX547	CMOS	global	5	2448 × 2048	2.74	1/1.8	ace 2	75	23	106	122	66	2	9.9	70	40
IMX676	CMOS	rolling	12.5	3536 × 3536	2	1/1.6	ace 2	31	9	42	–	92	4	11.2	68	40
IMX900	CMOS	global	3.2	2048 × 1536	2.25	1/3.1	ace 2	114	37	114	–	87	5	11.3	65	40

Please note that only monochrome area scan cameras are listed in this overview. Specifications are subject to change without notice.

SENSOR	TYPE	SHUTTER	RESOLUTION [MP]	PIXEL [H × V]	PIXEL SIZE [µm]	OPTICAL SIZE ["]	SERIES	FRAME RATE [fps] USB	GIGE	5GIGE	CXP-12	CL	QE [%]	DARK NOISE [e⁻]	SAT. CAPACITY [ke⁻]	DYNAMIC RANGE [dB]	MAX. SNR [dB]
ams																	
CMV2000	CMOS	global	2	2048 × 1088	5.50	2/3	ace	165	50	–	340	–	63	14	9.3	57	40
CMV4000	CMOS	global	4	2048 × 2048	5.50	1	ace	90	25	–	180	–	62	14	11.9	59	41
CMV4000 NIR-enhanced	CMOS	global	4	2048 × 2048	5.50	1	ace	90	25	–	180	–	62	14	12.4	59	41
CMV12000	CMOS	global	12	4096 × 3072	5.50	1.75	beat	–	–	–	–	62	45	14	11.6	59	41
e2V																	
EV76C560	CMOS	rolling switchable	1.3 1.3	1282 × 1026 1282 × 1026	5.30 5.30	1/1.8 1/1.8	ace ace	– –	60 60	– –	– –	– –	55 54	10 25	9.5 9.5	60 52	40 40
EV76C570	CMOS	switchable	2	1602 × 1202	4.50	1/1.8	ace	–	60	–	–	–	47	22	6.8	50	38
EV76C661 NIR-enhanced	CMOS	switchable	1.3	1280 × 1024	5.30	1/1.8	ace	–	60	–	–	–	59	23	7.4	50	39
onsemi																	
MT9J003	CMOS	rolling	10	3840 × 2748	1.67	1/2.3	ace	14	10	–	–	–	46	6	2.8	54	34
MT9P031	CMOS	rolling	2 5	1920 × 1080 2592 × 1944	2.20 2.20	1/3.7 1/2.5	ace ace	25 14	25 14	– –	– –	– –	57	6	6.7	60	38
PYTHON 300	CMOS	global	VGA	640 × 480	4.80	1/4	ace	751	376	–	–	–	52	11	7.1	57	39
PYTHON 500	CMOS	global	CCIR	800 × 600	4.80	1/3.6	ace	511	240	–	–	–	54	11	7.8	57	39
PYTHON 1300	CMOS	global	1.3	1280 × 1024	4.80	1/2	ace	203	88	–	–	–	53	11	6.9	56	38
PYTHON 2000	CMOS	global	2.3	1920 × 1200	4.80	2/3	ace	150	50	–	–	–	54	11	7.8	57	39
PYTHON 5000	CMOS	global	5	2590 × 2048	4.80	1	ace	60	21	–	–	–	55	12	8.2	57	39
XGS 20000	CMOS	global	20	4500 × 4500	3.2	1.3	boost	–	–	–	45	–	55	4	9.2	66	40
XGS 32000	CMOS	global	32.4	6580 × 4935	3.2	APS-C	boost	–	–	–	35	–	57	4	9.3	66	40
XGS 45000	CMOS	global	44.7	8192 × 5460	3.2	35 mm	boost	–	–		15	–	55	5	9.0	65	40
Gpixel																	
GMAX0505	CMOS	global	25	5120 × 5120	2.5	1.1	boost	–	–	–	150	–	51	4	4.3	60	36
GMAX2505	CMOS	global	5.6	2600 × 2160	2.5	1/2	ace 2	64	20	–	–	–	53	1	4.8	70	37
GMAX2509	CMOS	global	9.1	4200 × 2160	2.5	2/3	ace 2	12	40	–	–	–	53	1	4.6	69	37
GMAX2518	CMOS	global	18	4508 × 4096	2.5	1	ace 2	20	6	–	–	–	56	3	6.7	66	38
GMAX3265	CMOS	global	65	9344 × 7000	3.2	2.3	boost	–	–	–	30 or 70	–	52	8	10.4	61	40
GSPRINT4521	CMOS	global	21	5120 × 4096	4.5	APS-C	boost	–	–	–	230	–	53	33	31.6	59	45

Please note that only monochrome area scan cameras are listed in this overview. Specifications are subject to change without notice.

The **UV sensor** listed below should not be diretly compared to other CMOS sensors since it is sensitive in another spectral range.
If you have any questions, please contact our sales team: *baslerweb.com/sales*.

SENSOR	TYPE	SHUTTER	RESOLUTION [MP]	PIXEL [H × V]	PIXEL SIZE [µm]	OPTICAL SIZE ["]	SERIES	FRAME RATE [fps] USB	GIGE	5GIGE	CXP-12	QE [%]	DARK NOISE [e⁻]	SAT. CAPACITY [ke⁻]	DYNAMIC RANGE [dB]	MAX. SNR [dB]
Sony																
IMX487	CMOS	global	8.1	2856 × 2848	2.74	2/3	ace 2	48	14	67	–	51	3	9.9	70	40

Contrary to the requirements of the EMVA1288 standard, the wavelength of 541 nm may not meet the sensitivity maximum for sensors that are also sensitive outside the visible spectral range.

SENSOR	TYPE	SHUTTER	RESOLUTION [MP]	PIXEL [H × V]	PIXEL SIZE [µm]	OPTICAL SIZE ["]	SERIES	FRAME RATE [fps] USB	GIGE	5GIGE	CXP-12	QE [%]	DARK NOISE [e⁻]	SAT. CAPACITY [ke⁻]	DYNAMIC RANGE [dB]	MAX. SNR [dB]
Basler specific																
E2525A	CMOS	global	25	5060 × 5060	2.5	1.1	ace 2	15	4	21	35	66	3	8.1	68	39

Please note that only monochrome area scan cameras are listed in this overview. Specifications are subject to change without notice.

SONY

ICX618 Replacement
acA640-121gm

IMX174
acA1920-50gm
acA1920-155um

IMX178
acA3088-16gm
acA3088-57um

IMX183
acA5472-5gm
acA5472-17um

IMX226
acA4024-8gm
acA4024-29um

IMX249
acA1920-40gm
acA1920-40um

IMX250
acA2440-75um
a2A2440-98g5mBAS

IMX252
acA2040-120um

IMX253
acA4112-30um
boA4112-68cm

IMX255
acA4096-40um
boA4096-93cm

IMX264
acA2440-20gm
acA2440-35um

IMX265
acA2040-35gm
acA2040-55um

IMX267
acA4096-11gm
acA4096-30um

IMX273
acA1440-73gm
acA1440-220um

IMX287
acA720-290gm
acA720-520um

IMX304
acA4112-8gm
acA4112-20um

IMX334
a2A2590-22gmBAS/PRO
a2A2590-60umBAS/PRO
a2A3840-13gmBAS/PRO
a2A3840-45umBAS/PRO

IMX392
a2A1920-51gmBAS/PRO
a2A1920-51gmIP67
a2A1920-160umBAS/PRO
a2A1920-165g5mBAS

SONY

IMX421
boA1936-400cm

IMX530
boA5328-100cm

IMX531
boA4504-100cm

IMX532
boA5320-150cm

IMX535
boA4096-180cm

IMX536
boA2832-190cm

IMX537
boA2448-250cm
a2A2448-210cm

IMX540
a2A5328-4gmBAS/PRO
a2A5328-4gmIP67
a2A5328-15umBAS/PRO
a2A5328-22g5mBAS
a2A5328-35cm

IMX541
a2A4504-5gmBAS/PRO
a2A4504-5gmIP67
a2A4504-18umBAS/PRO
a2A4504-27g5mBAS
a2A4504-42cm

IMX542
a2A5320-7gmBAS/PRO
a2A5320-7gmIP67
a2A5320-23umBAS/PRO
a2A5320-34g5mBAS
a2A5320-52cm

IMX545
a2A4096-9gmBAS/PRO
a2A4096-9mIP67
a2A4096-30umBAS/PRO
a2A4096-44g5mBAS
a2A4096-67cm

IMX546
a2A2840-14gmBAS/PRO
a2A2840-14gmIP67
a2A2840-48umBAS/PRO
a2A2840-67g5mBAS
a2A2840-86cm

IMX547
a2A2448-23gmBAS/PRO
a2A2448-23gmIP67
a2A2448-75umBAS/PRO
a2A2448-105g5mBAS
a2A2448-120cm

IMX676
a2A3536-9gmBAS/PRO
a2A3536-31umBAS/PRO
a2A3536-42g5mBAS

SONY

IMX900
a2A2048-37gmBAS/PRO
a2A2048-114umBAS/PRO
a2A2048-114g5mBAS

SONY UV

IMX487
a2A2840-14gmUV
a2A2840-48umUV
a2A2840-67g5mUV

BASLER SPECIFIC

E2525A
a2A5060-4gmBAS
a2A5060-15umBAS
a2A5060-21g5mBAS
a2A5060-35cm

AMS

CMV2000
acA2000-165um
acA2000-340km
acA2000-50gm

CMV4000
acA2040-180km
acA2040-25gm
acA2040-90um

CMV4000 NIR
acA2040-180kmNIR
acA2040-25gmNIR
acA2040-90umNIR

CMV12000
beA4000-62km

GPIXEL

GMAX0505
boA5120-150cm

GMAX2505
a2A2600-20gmBAS/PRO
a2A2600-64umBAS/PRO

GMAX2509
a2A4200-12gmBAS/PRO
a2A4200-40umBAS/PRO

GMAX2518
a2A4508-6gmBAS/PRO
a2A4508-20umBAS/PRO

GMAX3265
boA9344-30cm
boA9344-70cm

GSPRINT4521
boA5120-230cm

E2V

EV76C560
acA1280-60gm
acA1300-60gm

EV76C570
acA1600-60gm

EV76C661
acA1300-60gmNIR

ONSEMI

MT9J003
acA3800-10gm
acA3800-14um

MT9P031
acA1920-25gm
acA1920-25um
acA2500-14gm
acA2500-14um

PYTHON 300
acA640-750um
acA640-300gm

PYTHON 500
acA800-510um
acA800-200gm

PYTHON 1300
acA1300-200um
acA1300-75gm

PYTHON 2000
acA1920-150um
acA1920-48gm

PYTHON 5000
acA2500-60um
acA2500-20gm

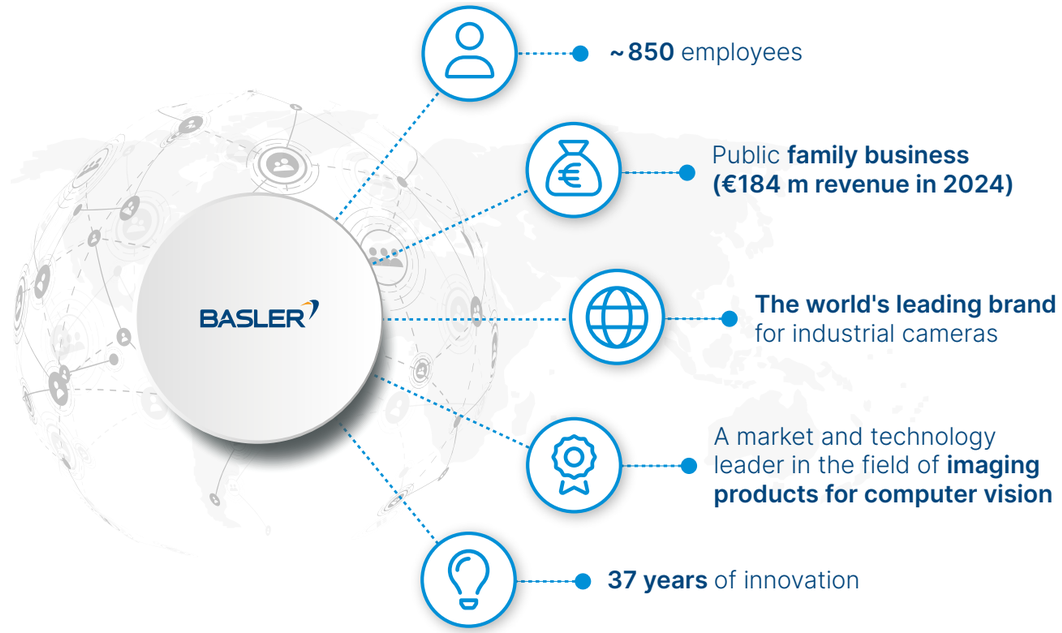
XGS 20000
boA4500-45cm

XGS 32000
boA6500-36cm

XGS 45000
boA8100-16cm

About Basler

Basler AG is an international leader and experienced expert in computer vision. The company offers a broad coordinated portfolio of vision hardware and software. In addition, it enables customers to solve their vision application issues by developing customer-specific products or solutions. Founded in 1988, the Basler Group employs around 850 people at its headquarters in Ahrensburg, Germany, as well as other sales and development locations throughout Europe, Asia, and North America.



How to Read Our Camera Model Names

ac	A	2040	180	k	m	NIR
Model	**Type**	**Resolution**	**Frame Rate**	**Interface**	**Color**	**Spectrum**
a2 = ace 2 ac = ace bo = boost da = dart dm = dart M pu = pulse ra = racer r2 = racer 2	A = Area scan L = Line scan	Horizontal pixels	Number of frames per second (fps) at full AOI	k = CL c = CoaXPress g = GigE g5 = 5GigE u = USB 3.0 m = BCON for MIPI	m = mono c = color	NIR = Near Infrared SWIR = Short Wavelength Infrared UV = Ultraviolet **Product Line** BAS = Basic PRO = Pro **ISP** i = Internal ISP for MIPI cameras **IP67** IP67 = Ingress Protection 67

Specifications are subject to change without notice.

NOTES



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