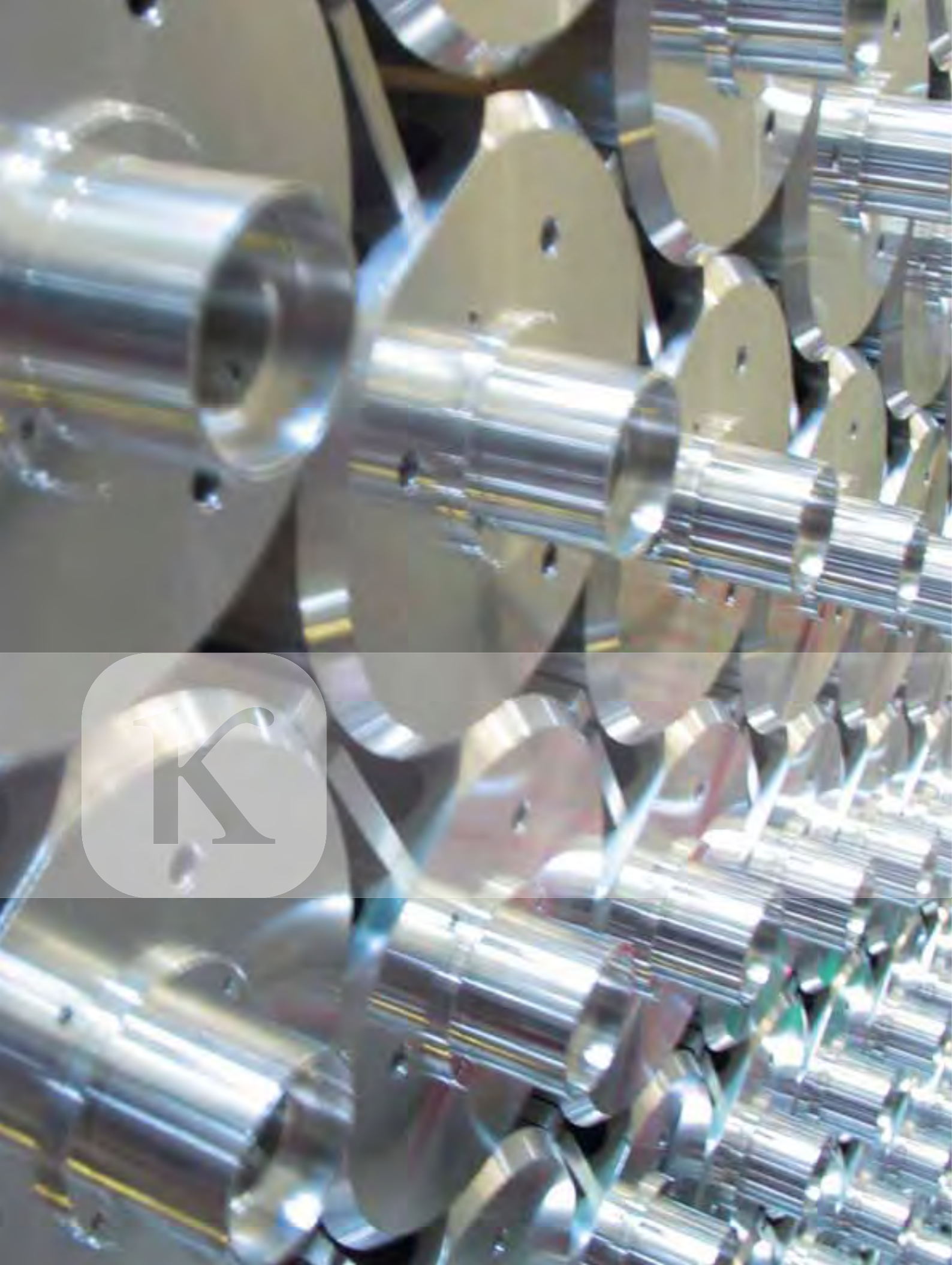


κappa 

# Handbook 2009



realize visions .



κappa 



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unique for everyone

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*"Managing and organizing customized production runs in a professional and intelligent way is our forte."*

**Marion Kasselmann**  
Head of Production & Procurement

*"We make innovation and development manageable and transparent for you."*

**Axel Zimmer**  
Head of Technical Operations

*"We offer you our services as a partner with three decades of experience in the development and manufacture of high-quality cameras."*

**Jürgen Haese**  
CEO, Owner

**Portfolio**

<b>Project Management</b>	07	Project Management
Transparency, planning reliability and long-term traceability		
<b>Technological Qualification</b>	13	Technology
Interfaces, sensors, signal processing, rugged design		
<b>Quality Management</b>	23	Quality Management
Organizational structures, certificates, procedures		
<b>Production and Logistics</b>	29	Production & Logistics
A high level of professionalism from disposition to after sales service		
<b>System Engineering</b>	35	System Engineering
Solutions for users		
<b>Your Contact Persons</b>	41	Contact Persons
Welcome to Kappa		
<b>Customized Camera Series</b>	45	Customer Series
Unique for everyone		
<b>Digital Cameras</b>	51	Digital Cameras
Camera electronics, megapixel resolution, functions, interfaces		
<b>Video Cameras</b>	65	Video Cameras
Rugged camera electronics, innovative circuit design, variety of applications		
<b>Software</b>	75	Software
Standard software, development tools, customized programming		
<b>General Terms and Conditions</b>	81	Terms & Conditions

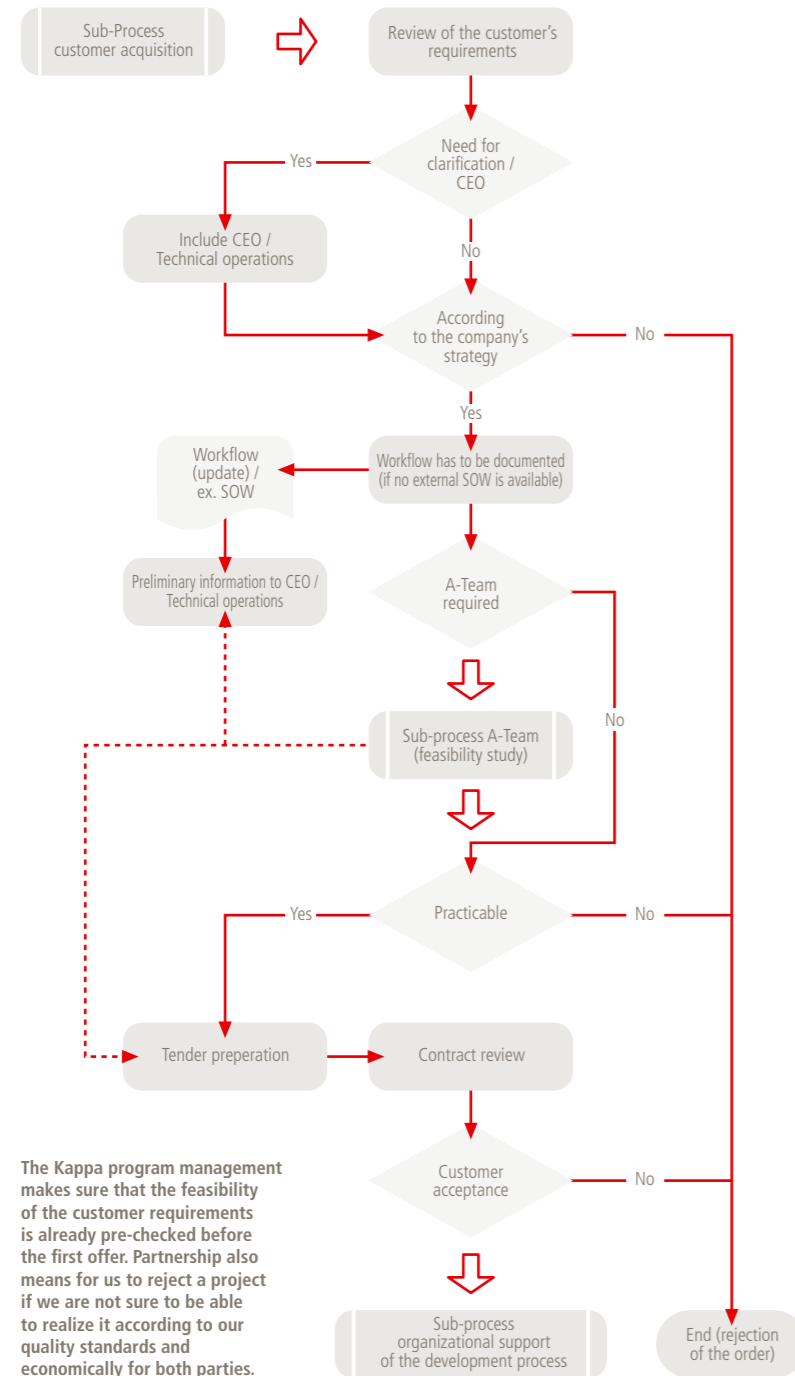
Kappa carries out projects of all kinds and all scales for its customers. This spectrum ranges from completely new developments to small modifications of our standard cameras into a customer series. Regardless of the scope of your project, you will benefit from comprehensive project management knowledge, our proficient use of standardized methods and instruments, and the experience gained in numerous development projects of all scales.





## Kappa Project Management

By using defined processes, we support development projects of different sizes. We provide transparency, planning security and long-term traceability.



Kappa opto-electronics develops, manufactures and distributes camera systems. Beyond our standard cameras, these camera systems include diverse customer-specific series which we develop in close cooperation with you.

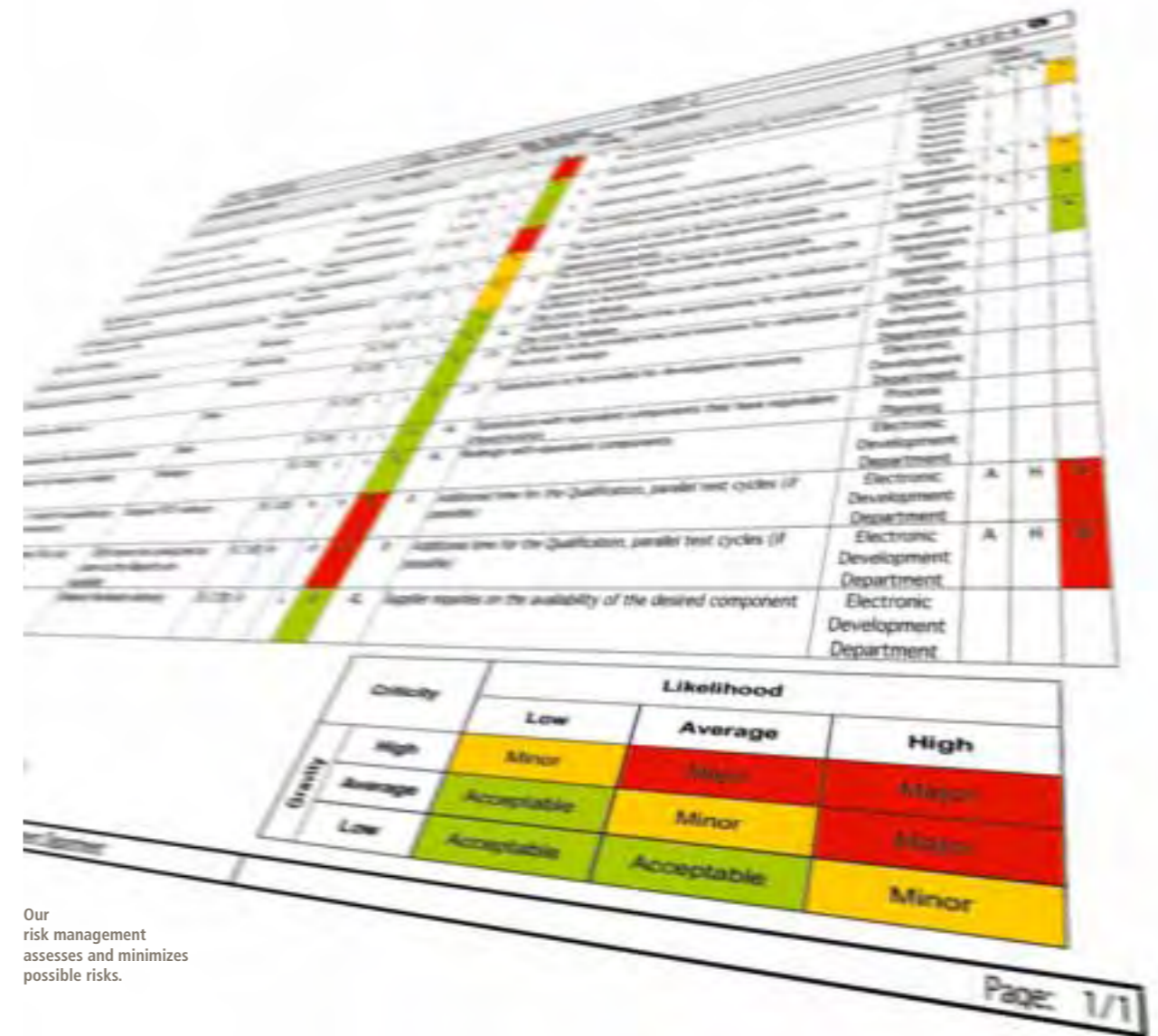
Kappa provides comprehensive expertise under one roof. The camera systems are developed by a team of experts in precision mechanics, circuit design, PCB design, firm ware, software, optical components and illumination.

The system engineering is supported by qualified project management procedures, technical analysis and technical qualification.

### Project Management Knowledge

Kappa realizes projects of all kinds and all scales for its customers along a spectrum ranging from completely new developments to small modifications of our standard cameras into a customer series.

Regardless of the scope of your project, you will benefit from the comprehensive project management knowledge and the experience gained in numerous development projects of all scales.



Our risk management assesses and minimizes possible risks.

In the simplest case, your requested modification has already been implemented in a similar form or is per se so straightforward that the completion can be handled directly by our production department. Needless to say, these product variants which we develop for you are also subject to our configuration management, just like our standard products. Through this, we guarantee not only long-term traceability and reproducibility, but we also establish the basis for a possible platform strategy.

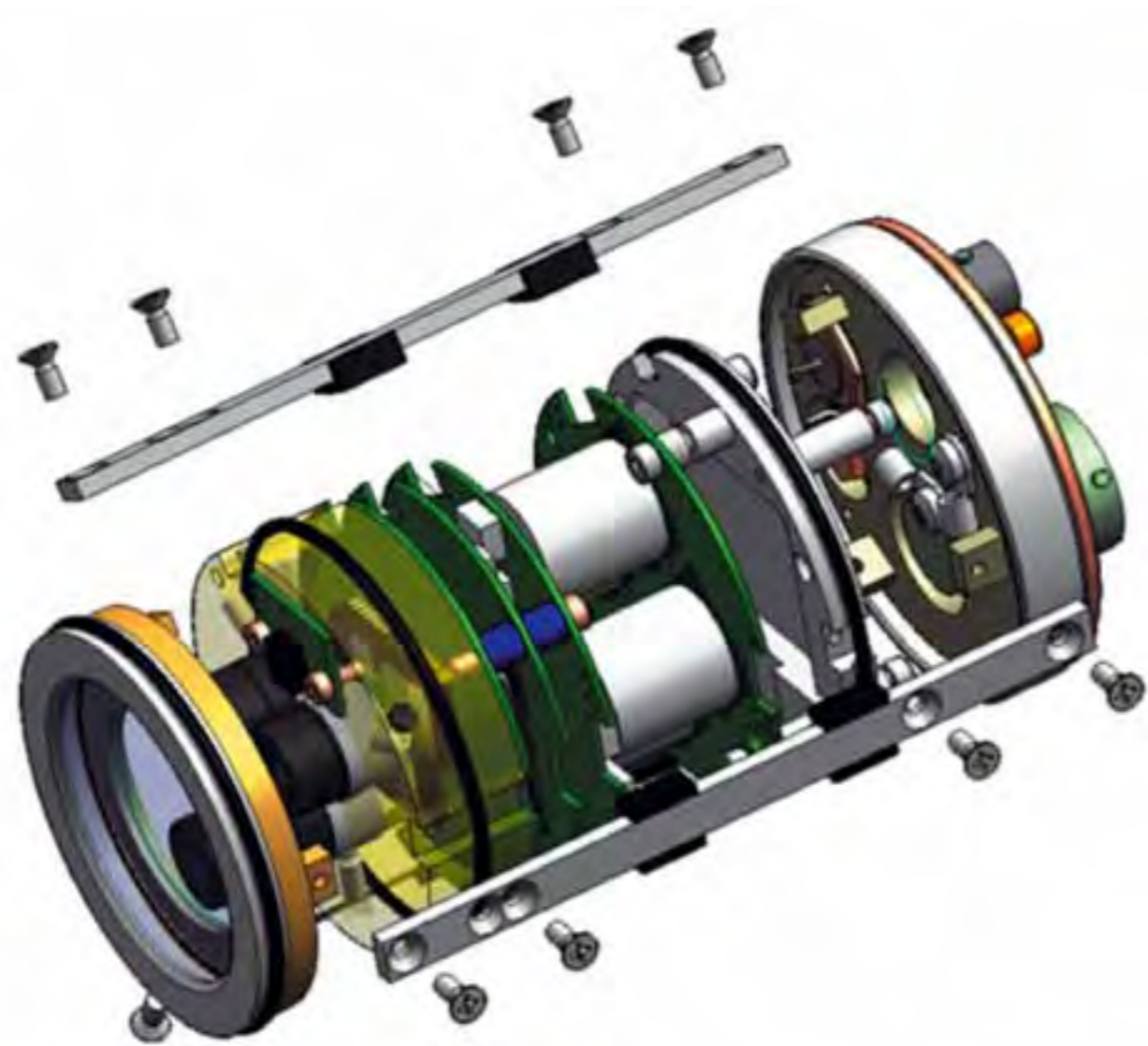
### Kappa A-Teams

If your development project is more complex, your contact person in the sales department convenes a team of experts (an A-Team) from all departments likely to be involved, who will then conduct a feasibility study of varying scope in relation to the complexity of your request.

In many cases, your requirements cannot be directly transformed into technical parameters of a camera, which is why it is crucial that we fully understand the environmental and operating conditions of your applications, so that we can then set about modifying or developing and designing a camera that suits your needs. This expert advice is the basis of our services.

In particular cases, the results of the A-Team analysis can lead us to reject a project in its original form. For us, this is an essential element of sincere customer orientation. We tell you honestly if we are not able to realize a project, if we think that it is technically not feasible, uneconomical or not achievable within the time frame.

If you decide to work with us, our project management structures can be expanded considerably according to your requirements. By using consistent requirements management, we assure that your product can be realized technically as well as organizationally with all its specifications and your general conditions met.



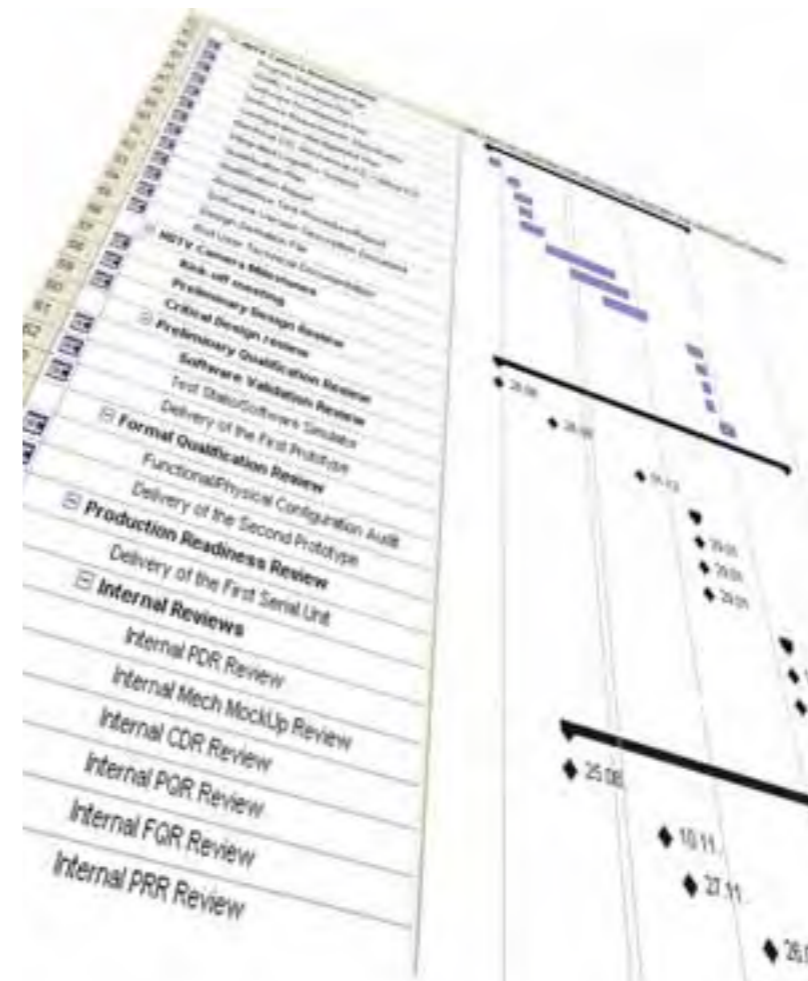
Our risk management makes it transparent so that you can see where possible project risks lie and how they can be minimized. We also check if your deadline schedule is realistic. For you, this means planning reliability.

On request, we also establish an appropriate test concept for you that meets all requirements of the future application context and includes optical and electrical test procedures as well as dynamic stress tests.

Moreover, requirements management assures that all your requirements - including all agreed changes and modifications introduced during the course of the project - are met. However trivial this may sound, it can be of crucial importance for complex projects.

These project services are usually implemented according to Kappa standards, but of course, we also adapt our project management processes to your standards if required or to other standards that apply to your business, e.g., EN 9100 for aviation and space industry suppliers or ISO/TS 16949 for automotive industry suppliers.

The process begins with the establishment of the requirements specification, which is based on the requirements you have regarding technology and procedures. After approval, we compile the design dossier which contains the concept for the technical



Our project management provides planning reliability for you – according to our standards or to your Statement of Work.

implementation and a statement of work which defines the scope of the following instruments and methods in the course of the project:

- ▣ Requirements management
- ▣ Risk management
- ▣ Analysis
- ▣ Test concepts
- ▣ Project plans

and other instruments.

After the preliminary design review (PDR) is conducted, the actual development begins. With the critical design review (CDR), the implementation of the results begins on the basis of defined processes and continuous requirements management.

## Configuration Management A Basis for Your Platform Strategies

In series production as well as in customer-specific projects the configuration management controls and supervises the product configuration and its conformity to the specific requirements during the product life cycle. Amongst other things this is the basis for systematically planned, controlled and documented modifications and their traceability.

This does not only ensure that you comply with legal requirements or norms, but you can also rely on our configuration management for platform strategies and realize further variants and versions. Besides different national and industry-specific norms, especially the following standards form the basis of configuration management systems:

- ▣ MIL-STD 973 (Military Standard – Configuration Management)
- ▣ ISO 10007 (Quality Management – Guidelines for Configuration Management)





## Technological Qualification

Kappa camera models can be freely defined with regard to their specifications. This flexibility enables extensions and adaptations to specific requirements and to your specific design. Selected freely programmable components and electronic assemblies, specific methods of mechanical implementation as well as logic concepts of functions and interfaces are part of the underlying platform strategy.

## Technological Qualification

Customer-oriented with more than 30 years experience

Kappa camera models can be freely defined with regard to their specifications. This flexibility enables extensions and adaptations to specific requirements and to your specific design. Selected freely programmable components and electronic assemblies, specific methods of mechanical implementation as well as logic concepts of functions and interfaces are part of the underlying platform strategy.

We continuously develop this platform to respond to our customers' needs. For that reason, we are proactive in numerous technological domains, such as

- ▣ Circuit design
- ▣ PCB design
- ▣ Firmware development
- ▣ Microcontroller development
- ▣ Camera software development
- ▣ PC software development
- ▣ Design
- ▣ Precision mechanics
- ▣ Optical components and illuminations
- ▣ Interface technologies
- ▣ Signal-processing/microcontroller programming
- ▣ Sensor technologies.

Moreover, Kappa stands out with extensive know-how in methods and procedures to maximize ruggedness against diverse environmental conditions.

### Interface Technologies

At Kappa, we always decide on camera interfaces with regard to the specific application. The interface selection is not only a technological choice, but it also affects the future safety and long-term reliability of the solution as well as the required efforts for integration into the infrastructure.

With more than 30 years of Kappa camera development, we know all about every significant interface. Today, the most significant interfaces are Composite Video, Y/C, RGB, Y-U-V component signal, SDI, HD-SDI, FireWire, Camera Link, USB and Gigabit Ethernet.

### Camera Interfaces

Interfaces	
Analog Video	50/60Hz (PAL/NTSC)
Depending on the application, customized interfaces	dose rate control for X-ray systems, for example
Camera Link	> 5000 Mbit/s
CAN, serial bus	camera control
Extern Sync	synchronization to an external signal of the same specification
FoD, Frame-On-Demand	exposure time control by external signal
GigE, Gigabit Ethernet	1000 Mbit/s
GPIO, General Purpose Input-Output	Input-output (e.g., optics)
Heating Control	heating of sensor windows
IEEE 1394, FireWire	IIDC compatibility
Iris Control	iris control within a lens
FOC fiber-optic cable	optical transmission of signals, e.g., Camera Link
RS232, serial communication interface	camera control
RS422/485, Serial communication interface	camera control
SDI, Serial Digital Interface	PAL/NTSC: 270 Mbit/s
USB 2, Universal Serial Bus 2.0	480 Mbit/s
Operating Voltage	
9-36V	standard power supply
MIL-STD-704D	power supply according to military standard
PoCL	power over Camera Link
PoGE	power over GigE
Micro power cut proof	maintenance of a continuous power supply during micro power cuts

### Signal Processing

The heart of camera electronics is signal processing. With its own FPGA-based procedure, Kappa operates independently of external components.

#### Camera-internal color processing, FPGA-based, independent of external components

Today the acquisition, processing and reproduction of color images is of increased importance for numerous industrial, medical and scientific applications. Many applications require color image acquisition



and reproduction systems that enable high color-fidelity in the reproduction of live images.

Thanks to the development of our own Kappa color processor for color-fidelity live images in digital and video cameras, we have gained independence for long-term customer projects! With future-oriented investments in digital technology as well as in the video domain, Kappa is a reliable camera developer that guarantees long-run customer series without the risk of discontinued external components.

#### Digital Color Processor (DCIP) for RGB Full-Frame Sensors

Kappa digital color cameras are based on progressive scan CCD sensors with primary color filtering in a Bayer mosaic pattern (RGB). They assure high fidelity of color reproduction and enable flexible adaptation of camera-internal color processing algorithms to the application-specific spectral power distribution of light and its characteristic object spectra.

Kappa color management is realized on a flexible FPGA platform with real-time image processing. Thus, we are independent of external components and suppliers. Moreover, this concept is perfect for specific adaptations and customer-specific extensions. Recently, we used our long experience with DCIP in diverse cameras and applications for the development of our own video color processor.

#### Video Color Image Processor for Color Mosaic Sensors

The video color processor is a component of new Kappa video cameras using proven Interline-CCD sensors (PAL or NTSC) with complementary color filtering in a color mosaic (CMYG). It is principally based on the same concept as DCIP and thus offers the same advantages for flexible adaptations. The main difference from DCIP is an interpolation module for the conversion of raw sensor data into a YUV data format and adapted processing for color correction and white balance.



The color artifacts at the edges, caused by interpolation, are minimized by an appropriate algorithm. Fine tuning allows you to adapt the color rendering to your needs.

The optimum parameterization of each color processor and the flexible adaptation to different conditions are based on a spectral modeling of the application system. The spectral characterization of the color sensors is an essential condition for the selection and the parameterization of the algorithms for color correction and color constancy. For this, a specific color camera measuring station has been designed.

The measuring station consists mainly of a stable Wolfram halogen light source, different filters for the modification of light source spectral power distribution, a step motor-driven filter wheel for the selected filter foils, and a beam splitter that enables spectral reference measurement synchronous with the acquisition of camera image data.



The acquired measuring results are used for model-based optimization of the camera's color reproduction in the application system. This approach allows the use of spectra from typical test charts – for example, the Macbeth Color Checker – as well as of characteristic objects such as tissue or other material samples to optimize the color balance of Kappa cameras for specific applications.



### Signal Processing: Automatic Contrast Control with Patented Technology

In live images with low contrasts, automatic contrast control (ACC/DRE) can considerably increase image quality, color reproduction, and edges for more image information. The luminance of the image is scaled to a minimum of 0 percent (black) and a maximum of 100 percent (white). The chrominance is not affected, and colors are thus preserved.



We use an algorithm which is especially optimized for scenes with extremely low contrasts – (e.g., fog or steam) and for LRO images. This algorithm is only partially useful for scenes containing bright areas as well as dark areas with low contrasts. For a better reproduction of these scenes, some of the current camera models feature the function “dynamic histogram stretching”. In contrast to the previous technology, this procedure uses non-linear contrast adaptation depending on the luminance distribution. Thus, the contrast is improved in the dark as well as in the bright image areas.

You can use the contrast control function for the entire image or you can freely select a window. The automatic contrast adaptation opens up new dimensions of visualization – it provides a clear view under extreme viewing conditions, e.g., rain, fog, haze or smog.

### Camera-Internal Electronic Signature for Tamper-Proof Digital Images

Electronic data processing today is standard in the most different processes and thus the importance of an electronic signature increases to guarantee the authenticity of data for all kinds of digital documentation.

For the first time, Kappa signature cameras provide the ability to sign digital images together with additional data (measuring data, QA data, batch number, etc.) directly with a camera-internal signature. This signature assures authenticity and integrity of the data and provides evidence that is admissible in a court of law. Any manipulation of the image data is evident and can be proven.

The digital signature generation is based on the RSA 1024-bit signature and the SHA 512-bit hash function. The generated signature, which is attached to the document, is encrypted by a private key. The actual data are not encrypted, so that the document remains readable in plain text after the signature operation.

The public key is used to verify signature accuracy. The decisive advantage of signing image data directly in the camera is the probative force. Contrary to subsequent encryption procedures, for example at a PC, image data and additional data cannot be manipulated before signing them. The user obtains the safety of reliable and manipulation-proof data, for example, for quality control or process control:

- ✎ In the context of product liability, you can prove the authenticity of production data, serial number, and reference images.
- ✎ You can prove forgeries by checking the signature.
- ✎ Surgical images and patient data can be signed together as one document.
- ✎ The integrity and authenticity of image data is proven for a multitude of applications: forensic applications, criminal prosecution, industrial QA laboratories, liability cases, etc.
- ✎ Image acquisition of traffic offenses.

## Processing

Signal-Processing	
ABC, Automatic Balance Control	e.g., function for dose rate control (X-Ray)
ACC/DRE	Automatic Contrast Control
AET	Automatic Exposure Time
AGC	Automatic Gain Control
AOI	Area of Interest
Background image subtraction	Subtraction of the reference image
Binning	Adjustable horizontal and vertical binning, reduction of noise by combining several pixel lines (rows)
Brightness	Increasing of image brightness (Offset)
Character generator	Programmable text and character overlay
Circular Blanking	Circular image window (X-Ray)
Color saturation	Adjustable color saturation
Contrast	Increasing of image contrast
Data compression	Compression of the image data by H.264 algorithm
DCIP CyMgYeG	Color processing for CCD with CyMgYeG pattern
DCIP RGB	Color processing for CCD with Bayer mosaic pattern
Defect pixel correction	Correction of defect pixels (Hot Spots) Automatic detection and correction of defect pixels
Distortion correction	Adjustable correction of pillow-shaped and barrel-shaped distortions
Double exposure	Different exposure of both fields using interlace modes
Edge enhancement	Increase contrasts at the edges
Freeze image	Save the last image and display
Gamma	Adjustable Gamma function
HDR, High Dynamic Range (16 Bit)	Extension of dynamic range using two sensors simultaneously
Histogram stretching	Contrast enhancement by histogram stretching
Horizontal image mirror	
Image shift	Adjustable X-Y shifting
Line generator	Adjustable line generator up to 4 adjustable crosshairs
LUT	Programmable lookup table
Recursive filter	Adjustable recursive filters Noise reduction by averaging images
SHA512	SHA512 Hash value calculation for digital signature
Shading correction	Adjustable correction of vignetting
Sharpness	Adjustable Edge Enhancement
Smear correction	Automatic correction of smear effects at short exposure times
Vertical image mirror	
White balance	Automatic white balance
Zoom	Adjustable digital zoom

## Sensors

Progressive Scan CCD (Sony, Kodak)	Image size	Frame Rate (fps)	Resolution   Pixel (HxV)	Pixel Size (µm)	Sensitivity (mV)	Technology	Pins	Color / Mono	HDTV
ICX 415 AQ	1/2"	50	782 x 582	8,3 x 8,3	720	HAD	22	Color	
KAI-1020 CBA	2/3"	30	1004 x 1004	7,4 x 7,4	-	-	68	Color	IS
KAI-01050 CBA	1/2"	64	1024 x 1024	5,5 x 5,5	-	-	68	Color	IS
ICX285 AQ	1/2"	15	1392 x 1040	6,45 x 6,45	1240	EXview HAD	20	Color	IS
ICX205 AK	1/2"	10	1392 x 1040	4,65 x 4,65	400	Wfine CCD	20	Color	
KAI-2020 CBA	1"	30	1600 x 1200	7,4 x 7,4	-	-	32	Color	IS
KAI-02050 CBA	2/3"		1600 x 1200	5,5 x 5,5				Color	IS
ICX274 AQ	1 1/8"	12	1628 x 1236	4,40 x 4,40	420	Wfine CCD	20	Color	
KAI-2093 CBA	1"	30	1920 x 1080	7,4 x 7,4	-	-	32	Color	IS
KAI-02150 CBA	2/3"	120	1920 x 1080	5,5 x 5,5	-	-	68	Color	IS
ICX-655 AQA	1"	9	2456 x 2058	3,45 x 3,45	420	Super HAD	28	Color	
ICX 415 AL	1/2"	50	782 x 582	8,3 x 8,3	820	HAD	22	Monochrome	
KAI-1020 ABB	2/3"	30	1004 x 1004	7,4 x 7,4	-	-	68	Monochrome	IS
KAI-01050 ABA	1/2"	64	1024 x 1024	5,5 x 5,5	-	-	68	Monochrome	IS
ICX285 AL	1/2"	15	1392 x 1040	6,45 x 6,45	1300	EXview HAD	20	Monochrome	IS
ICX205 AL	1/2"	10	1392 x 1040	4,65 x 4,65	450	Wfine CCD	20	Monochrome	
KAI-2020 ABA	1"	30	1600 x 1200	7,4 x 7,4	-	-	32	Monochrome	IS
KAI-02050 ABA	2/3"		1600 x 1200	5,5 x 5,5				Monochrome	IS
ICX274 AL	1 1/8"	12	1628 x 1236	4,40 x 4,40	420	Wfine CCD	20	Monochrome	
KAI-2093 ABA	1"	30	1920 x 1080	7,4 x 7,4	-	-	32	Monochrome	IS
KAI-02150 ABA	2/3"	120	1920 x 1080	5,5 x 5,5	-	-	68	Monochrome	IS
ICX-655 ALA	1"	9	2456 x 2058	3,45 x 3,45	420	Super HAD	28	Monochrome	

Progressive Scan CMOS (Aptina)	Image size	Frame Rate (fps)	Resolution   Pixel (HxV)	Pixel Size (µm)	Technology	Pins	Color / Mono	HDTV
MT9V023IA7XTC	1/3"	60	752 x 480	6,0 x 6,0	DigitalClarity, TrueSNAP	52	Color	
MT9T031P12STC	1/2"	12-93	2048 x 1536	3,2 x 3,2	DigitalClarity, ERS	48	Color	
MT9P031I12STC	1/2,5"	14-53	2592 x 1944	2,2 x 2,2	DigitalClarity, ERS	48	Color	IS
MT9V023IA7XTM	1/3"	60	752 x 480	6,0 x 6,0	DigitalClarity, TrueSNAP	52	Monochrome	
MT9M001C12STM	1/2"	30	1280 x 1024	5,2 x 5,2	DigitalClarity, ERS	48	Monochrome	



In a multitude of customer series, development projects and Kappa standard cameras, we use a wide range of CCD sensors as well, which we operate in our technological environment.

Video CCD (Sony)	Image size	System	Resolution   Pixel (HxV)	Pixel Size (µm)	Sensitivity (mV)	Technology	Pins	Color / Mono
ICX418AKB	1/2"	NTSC	768 x 494	8,4 x 9,8	1300		16	Color
ICX418AKL	1/2"	NTSC	768 x 494	8,4 x 9,8	1300		20	Color
ICX419AKB	1/2"	PAL	752 x 582	8,6 x 8,3	1300		16	Color
ICX419AKL	1/2"	PAL	752 x 582	8,6 x 8,3	1300		20	Color
ICX428AKL	1/2"	NTSC	768 x 494	8,4 x 9,8	1600	EXview HAD	20	Color
ICX429AKL	1/2"	PAL	752 x 582	8,6 x 8,3	1600	EXview HAD	20	Color
ICX258AK	1/3"	NTSC	768 x 494	6,35 x 7,4	1100	EXview HAD	16	Color
ICX259AK	1/3"	PAL	752 x 582	6,5 x 6,25	1100	EXview HAD	16	Color
ICX408AK	1/3"	NTSC	768 x 494	6,35 x 7,4	950		16	Color
ICX409AK	1/3"	PAL	752 x 582	6,5 x 6,25	950		16	Color
ICX638AKA	1/3"	NTSC	768 x 494	6,35 x 7,4	2250	Super HAD	16	Color
ICX639AKA	1/3"	PAL	752 x 582	6,5 x 6,25	2250	Super HAD	16	Color
ICX658AKA	1/3"	NTSC	768 x 494	6,35 x 7,4	1200	EXview HAD	16	Color
ICX659AKA	1/3"	PAL	752 x 582	6,5 x 6,25	1200	EXview HAD	16	Color
ICX228AK	1/4"	NTSC	768 x 494	4,75 x 5,75	450		14	Color
ICX229AK	1/4"	PAL	752 x 582	4,85 x 4,65	440		14	Color
ICX229AKB	1/4"	PAL	752 x 582	4,75 x 5,75	440		13	Color
ICX278AK	1/4"	NTSC	768 x 494	4,75 x 5,75	800	EXview HAD	14	Color
ICX279AK	1/4"	PAL	752 x 582	4,85 x 4,65	800	EXview HAD	14	Color
ICX238AKC	1/6"	NTSC	768 x 494	4,85 x 4,65	300		12	Color
ICX238AKE	1/6"	NTSC	768 x 494	3,2 x 3,725	300		12	Color
ICX239AKC	1/6"	PAL	752 x 582	3,275 x 3,15	300		12	Color
ICX239AKE	1/6"	PAL	752 x 582	3,275 x 3,15	300		12	Color
ICX256FKW	1/10"	NTSC	510 x 492	2,9 x 2,25	300		10	Color
ICX257FKW	1/10"	PAL	500 x 582	2,95 x 1,9	300		10	Color
ICX422AL	2/3"	EIA	768 x 494	11,6 x 13,5	1000		20	Monochrome
ICX423AL	2/3"	CCIR	752 x 582	11,6 x 11,2	1000		20	Monochrome
ICX418ALB	1/2"	EIA	768 x 494	8,4 x 9,8	1100		16	Monochrome
ICX418ALL	1/2"	EIA	768 x 494	8,4 x 9,8	1100		20	Monochrome
ICX419ALB	1/2"	CCIR	752 x 582	8,6 x 8,3	1100		16	Monochrome
ICX419ALL	1/2"	CCIR	752 x 582	8,6 x 8,3	1100		20	Monochrome
ICX428ALB	1/2"	EIA	768 x 494	8,4 x 9,8	1400	EXview HAD	20	Monochrome
ICX428ALL	1/2"	EIA	752 x 582	8,4 x 9,8	1400	EXview HAD	20	Monochrome
ICX429ALB	1/2"	CCIR	768 x 494	8,6 x 8,3	1400	EXview HAD	20	Monochrome
ICX429ALL	1/2"	CCIR	752 x 582	8,6 x 8,3	1400	EXview HAD	20	Monochrome
ICX258AL	1/3"	EIA	768 x 494	6,35 x 7,4	1000	EXview HAD	16	Monochrome
ICX259AL	1/3"	CCIR	752 x 582	6,5 x 6,25	1000	EXview HAD	16	Monochrome
ICX408AL	1/3"	EIA	768 x 494	6,35 x 7,4	850	Super HAD	16	Monochrome
ICX409AL	1/3"	CCIR	752 x 582	6,5 x 6,25	850	Super HAD	16	Monochrome
ICX658ALA	1/3"	EIA	768 x 494	6,35 x 7,4	1100	EXview HAD	16	Monochrome
ICX659ALA	1/3"	CCIR	752 x 582	6,5 x 6,25	1100	EXview HAD	16	Monochrome
ICX228AL	1/4"	EIA	768 x 494	4,75 x 5,75	450	Super HAD	14	Monochrome
ICX229AL	1/4"	CCIR	752 x 582	4,85 x 4,65	440	Super HAD	14	Monochrome
ICX278AL	1/4"	EIA	768 x 494	4,75 x 5,75	800	EXview HAD	14	Monochrome
ICX279AL	1/4"	CCIR	752 x 582	4,85 x 4,65	800	EXview HAD	14	Monochrome

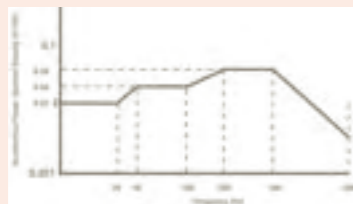


## Rugged Camera Technology

Kappa is one of the few camera manufacturers with comprehensive know-how in the development and manufacture of extremely robust cameras. We develop, design and manufacture camera systems for applications in extreme environmental conditions. For more than 15 years, Kappa cameras have been used in the aerospace industry, military vehicles and industrial machines. These environments require absolute resistance to mechanical, climatic and electromagnetic stress as well as to surrounding substances and environmental impacts.

### Random Vibration Test

The random vibration test uses a mixture of different frequencies within a specified frequency range to mechanically stimulate the test object. The applicable standard also defines amplitude and frequency for this test. For example, a device at the empennage of an aircraft with a turbofan engine has to be tested according to curve E of the following figure.



In many cases, we have to use industry-standard components for reasons of availability and costs. This makes it difficult to meet the requirements on EMC, resistance to temperature, shock and vibration. Thus, from the beginning, the technical design has to focus on these specific requirements, for example by using heat sinks or shock absorbers. Standard circuits or modules may hardly ever be used. Proof of origin is required for all components.

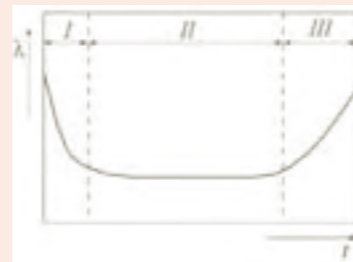
We prepare our special cameras to resist extreme stress such as:

- ✎ Temperature range from  $-55^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  with rapid fluctuations, also under negative pressure (e.g., 11.6 kPa corresponding to a height of 50,000 ft according to DO-160D)
- ✎ Simulated lightning strike with overvoltages and currents of up to 1600 V/107 A on all connection pins according to DO-160D.
- ✎ Mechanical shocks of up to 20 g acceleration for 11ms according to DO-160D.



All required technical characteristics are analytically defined and then verified at the object with measurement techniques. Specific knowledge and/or development environment is necessary, e.g. for MTBF calculations, thermic analysis or mechanical stress analysis. The prototype tests for verification of specific characteristics take place in specific installations. These are for example, shock and vibration tests on shakers, temperature and climate tests in climatic chambers, overvoltage, and EMC tests. We offer all these analytical methods and tests for our products and execute them either on our own or in cooperation with external partners.

### Statistical Failure Probability



- I High failure rate at the beginning of the life cycle due to manufacturing quality
- II Almost constant and low failure rate during normal life cycle
- III Rising failure rate at the end of the product life cycle.

## Rugged High Definition Camera for the Aerospace Industry



Cameras that are installed on the outside of aircraft have to withstand extreme environmental conditions. One example is the Kappa HDTV-3D camera for visual control of air-to-air refueling using a stereo image. This camera system contains a color camera and a monochrome camera with appropriate optics. It provides an image signal of 1920 x 1080 pixels, 30 fps and 8bit RGB.

The HDTV-3D camera is one of our high-definition cameras with high-resolution sensors (Kodak KAI-2093, KAI-02150, KAI-2010, KAI-2020, KAI-02050). The camera transmits HDTV output signals which are defined in corresponding norms. It comes with the following features:

- ✎ Resolution/frame rate: 1920 x 1080 pixels / 25 or 30 Hz progressive RGB/BW
- ✎ Resolution/frame rate: 1024 x 768 pixels / 30 Hz progressive RGB/BW
- ✎ Camera Link output 8 bit RGB
- ✎ Optional optical transmission (FOC)
- ✎ HDTV-SDI output 1920 x 1080 10 bit YUV
- ✎ External synchronization to HD and VD
- ✎ FoD or external trigger modes (reset/restart) are possible with internal image memory.



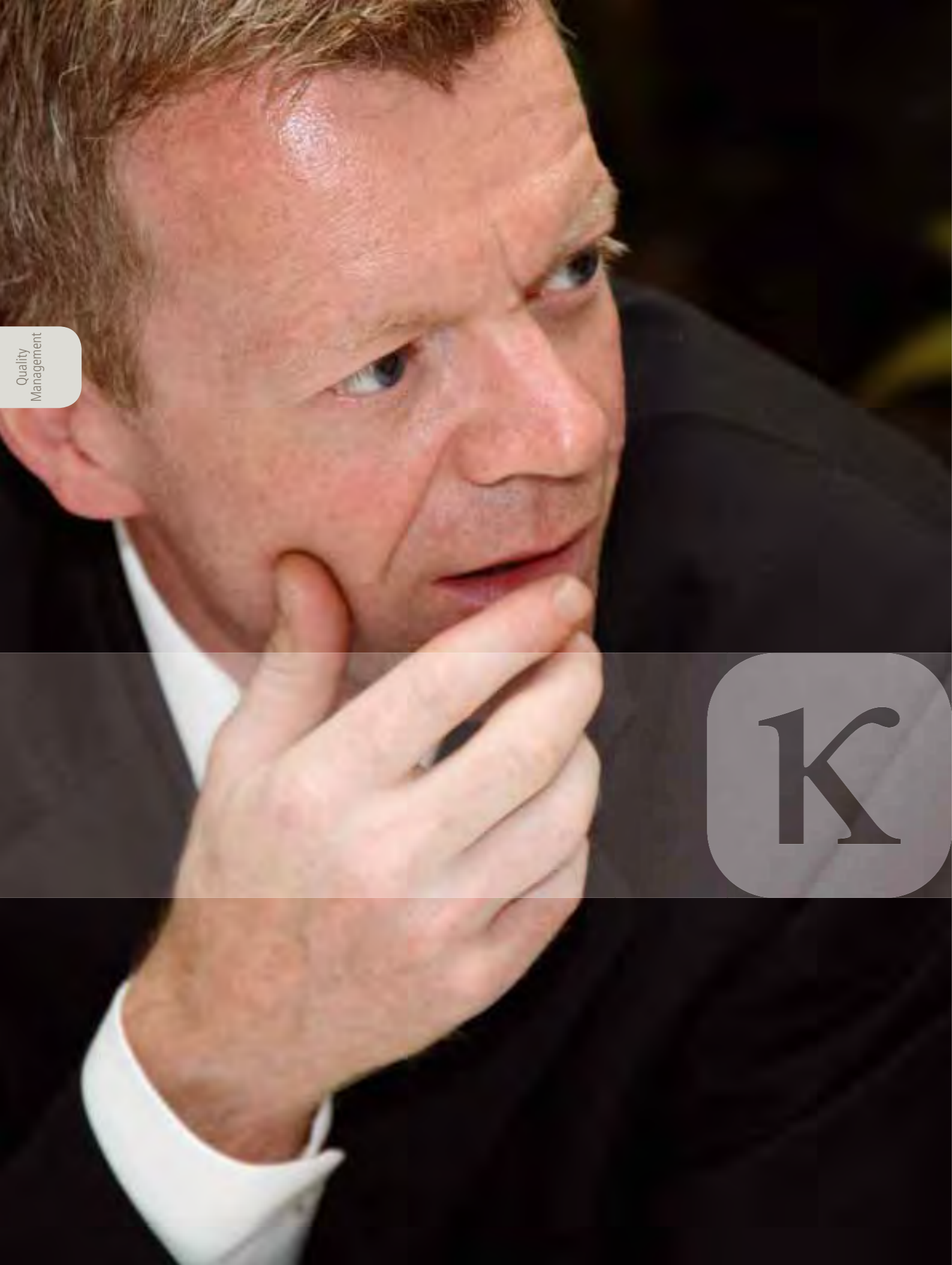
## Testing Laboratories

EMCC Dr. Rasek  
www.emcc.de

PHOENIX TESTLAB GmbH  
www.phoenix-testlab.de

German Aerospace Center DLR  
www.dlr.de/AE

GTN EMC Laboratory  
www.gtn-germany.de



## Quality Management

Our quality management shapes all processes at Kappa, from customer request to after-sales service. 15 years after introducing systematic quality management, we conclude that the processes and structures in our company have become more efficient and transparent to all employees. For that reason, practicing quality management today comes naturally to us.



Quality Management

Project Management  
Technology  
Quality Management  
Production & Logistics  
System Engineering  
Contact Persons  
Customer Series  
Digital Cameras  
Video Cameras  
Software  
Terms & Conditions



## Quality Management

Efficient and transparent structures ensure consistent implementation

We at Kappa feel that quality management comprises much more than just quality assurance for individual products. As early as 15 years ago, Kappa introduced systematic quality management and has been working on its optimization ever since. We have learned a great deal during these last 15 years, and in retrospect, it is safe to say that due to quality management that became more and more effective over time, the processes and structures in our company have become more efficient and more transparent for all employees. For that reason, practicing quality management today comes naturally to us.

### Product Qualification

Our quality management involves all departments. This is particularly the case in areas such as design and development.

During development, all Kappa products and even partial development results pass through different verification, validation and certification procedures – for customized cameras as well as standard cameras.

The verification procedure determines whether a specific requirement is met. The validation procedure checks the qualification for a specific purpose. The certification procedure confirms the conformity of the development processes and documentation with applicable norms.

Finally, the final qualification of the finished product verifies all initial requirements.

Kappa provides a broad and varied spectrum of qualification procedures the application of which is determined, first and foremost, by the future use of the product. Besides simple inspections and tests, Kappa offers extensive analyses, environmental tests and hardware certifications.

### Quality Assurance

For us, comprehensive quality management also includes quality of procurement. When we select our suppliers, we focus on their quality management and processes. Regular supplier ratings and above all long-term partnerships with a small number of reliable suppliers ensure constant high quality. Nevertheless, we conduct one-hundred-percent incoming inspection.

We also perform one-hundred-percent post-production verification. For our customers, this means operative support. This very high standard is anchored by our highly qualified, long-term employees who participate in regular training to maintain state-of-the-art knowledge.

## History of our Quality Management System

### 1994:

The quality management system is first introduced

### 1996:

DIN EN ISO 9001:1994 Certification

### 1998:

DIN EN 46001 Certification

### 2003:

DIN EN ISO 9001:2000 and DIN EN ISO 13485:2000 (Medical devices) Certification

### 2006:

DIN EN ISO 9001:2000 and DIN EN ISO 13485:2003 (Medical devices) Certification

Moreover, internal camera rejections are immediately recorded and evaluated. Systematic failures as well as insufficient material quality can thereby be promptly identified. Due to one-hundred-percent individual testing and an extremely low error rate, we know each failure individually, rather than having to rely on statistical evaluation.

Short lines of communication between departments and teams, comparatively few interfaces and a high degree of personal responsibility contribute to active quality assurance.

## Glossary

### Quality

The term quality describes an item's properties and condition in terms of quality requirements.

### Quality Management

Quality management is a management process used to lead and guide an organization in terms of quality.

### Quality Policy

The term quality policy refers to the general direction and goals of an organization related to quality.

### Quality Planning

Quality planning determines the quality objectives and specifies the necessary processes and resources essential to fulfill the quality objectives.

### Quality Control

Quality control refers to preemptive, administrative and corrective tasks aimed at ensuring compliance with quality requirements.

### Quality Assurance

Quality assurance focuses on providing confidence that quality requirements will be fulfilled.

### Q-Team

The term Q-Team refers to a specifically assembled team of Kappa employees whose aim and responsibility it is to ensure the continuous improvement of quality.

### 100 Percent Inspection

As opposed to random inspection, 100 percent testing and inspection means that all products are subject to quality inspection.

### Supplier Rating

Supplier rating is a systematic assessment of supplier performance in order to maintain high quality standards in the supply chain.

### Risk Management

Risk management is a management process used to identify, assess and minimize various business risks, e.g., project risks, product risks or general business risks.

### Configuration Management

Configuration management is a management process that focuses on establishing and maintaining consistency of a product's performance and its functional and physical attributes with its requirements, design, and operational information throughout its life.

### Complaint Management

Complaint management is a management process that focuses on the identification, recording and handling of customer complaints in order to maintain and, if necessary, restore customer satisfaction.

### Review

A review is an activity (usually performed by a team) undertaken to determine the sustainability, adequacy and effectiveness of the subject matter to achieve established objectives.

### Qualification Process

The qualification process demonstrates the ability to fulfill specified requirements, usually by running various test processes and procedures, from simple inspections to sophisticated environmental tests.

### Verification

The term verification refers to the confirmation that specified requirements have been fulfilled.

### Validation

The term validation refers to the confirmation, that the requirements for a specific intended use or application have been fulfilled.

### Hard- and Software Certification

The hard- and software certification evinces that the hardware and software have been developed in consideration of and in accordance with a pertinent standard.

### FMECA

Failure Mode, Effects and Criticality Analysis, or FMECA for short, is a procedure for analysis of potential failure modes within a system and aims to minimize product risks and maximize reliability.

### MTBF

Mean Time Between Failures, or MTBF for short, is a procedure for analysis of failure probability and therefore an assessment of a product's reliability during its life cycle.

### Maintainability Analysis

An analysis of maintenance parameters such as general maintainability, maintenance frequency, maintenance costs etc. Its aim is to establish preventive measures like maintenance planning and spare part stockpiling.

### Environmental Tests

Environmental tests is a generic term for test procedures used to verify a device's capability to withstand certain, most often adverse environmental conditions.

### Temperature Test

An environmental test that is performed in an environmental test chamber and runs for several days or weeks. Its purpose is to verify a device's functional capability in certain temperature conditions and under large or swift temperature variations.

### EMC Tests

Various environmental tests used to check to what extent a device's HF energy interferes with and influences other devices in its vicinity and to what extent the device itself is influenced by electromagnetic radiation from its surroundings.

### Lightning Test

Also called high voltage test, the lightning test simulates a device's exposure to direct and indirect lightning strokes to verify its safety.

### Explosion Test

An test procedure that is used to verify that a device can be used in explosive surroundings.

### Vibration Test

An environmental test procedure used to verify a device's capability to withstand long periods of exposure to vibration of varying frequencies.

### Shock Test

An environmental test procedure used to verify a device's capability to withstand mechanical stress, such as the landing of an airplane. To this end, the device is mounted on a so-called shaker and repeatedly exposed to shocks of varying acceleration and duration (often 20 g and 11ms).

### Salt Fog Test

An environmental test procedure in which a device is exposed to salt spray (fog) for a certain amount of time in a test chamber, and that is used to check corrosion resistance provided by the device's anti-corrosion coating.

## Certifications

Certifications confirm that products have been developed in compliance with corresponding standards and thus meet high reliability demands. The focus is on a controlled approach and uninterrupted documentation. This includes determinations concerning, among other things, planning, development, verification, configuration management, quality assurance, and qualification and certification processes. The following standards apply to the certification of hardware, camera software, and PC software:

- ☒ Hardware: RTCA/DO-254
- ☒ Camera software: MIL-STD 498, RTCA/DO-178, V-model
- ☒ PC software: MIL-STD 498, IEC 60601-1-4, V-model

## Kappa Quality Management Extended by Your Requirements

Domain	Capability / Competency / Service	Kappa Standard	Optional Service
Organization	Processes according to ISO 9001	For all products	
	Processes according to ISO 13485	For medical devices	
	Processes according to EN 9100		According to customer requirements
	Processes according to AQAP 2110		According to customer requirements
	Processes, flexible adaptable to customer needs		According to customer requirements
	High qualification of employees	☒	
	Low fluctuation of employees	☒	
	Technological independence	☒	
	Organizational independence	☒	
	Organizational independence	☒	
Marketing / Sales	Customer-oriented market analysis	☒	
	CRM	☒	
	Advisory competence	☒	
	Advisory competence	☒	
Development	Circuit design	☒	According to customer requirements
	PCB design	☒	According to customer requirements
	Mechanical design	☒	According to customer requirements
	µC software development	☒	According to customer requirements
	Firmware development	☒	According to customer requirements
	Application software	☒	According to customer requirements
	High supplier quality	☒	Supplier "follow-up" according to customer requirements
	Assurance of long product life cycles	☒	Product life cycle according to customer requirements
Manufacturing	Manufacturing of electronics	☒	According to customer requirements (procedure, welding standard, solder ...)
	Mechanics manufacturing	☒	According to customer requirements (materials, tolerances ...)
	Assembly	☒	According to customer requirements (adhesives, accuracy of adjustment ...)
	Capable of series production	☒	Production batch according to customer requirements
	High number of tests	☒	Tests according to customer requirements
	Extensive After-Sales-Service	☒	According to ILS requirements
	Complaints management	☒	According to ILS requirements (e.g., ISO 10002)
	Open service structures	☒	According to ILS requirements
Service / Support	Short response times	☒	According to ILS requirements
	Project related QM	☒	According to SOW requirements (e.g., ISO 10006)
	Project control	☒	According to SOW requirements (e.g., MIL-STD 1521)
	Configuration management	ISO 10007	According to SOW requirements (e.g., MIL-STD 973)
QM	Technical analyses	Reliability (MTBF)	According to SOW requirements (e.g., MIL-HDBK 217, IEC 62380, Telcordia SR-332)
		Failure mode, effects and criticality analysis (FME(C)A)	According to SOW requirements (e.g., DIN EN 60812, MIL-STD 1629)
		Maintainability	According to SOW requirements (e.g., MIL-STD 472)
		Structure analysis	According to SOW requirements
	Risk management	Product risks	for medical devices (ISO 14971)
		Project / organizational risks	According to SOW requirements (e.g., ISO/DIS 31000, ONR 49000)
Qualification competency	Environmental tests (e.g., electrical safety, EMC, temperature, humidity, pressure, watertightness, shock, vibration, acceleration, lightning protection, salt fog, fungal infestation, ...)	Industry: CE-labeling (DIN EN IEC 60605, DIN EN IEC 61010) Medical devices: CE-labeling (DIN EN IEC 60601-1, DIN EN IEC 60601-1-2)	According to specifications (e.g., MIL-STD 810, MIL-STD 461-464, RTCA/DO-160...)
	Camera software certification		According to SOW requirements (e.g., MIL-STD 498, RTCA/DO-178, V-model...)
	Computer software certification	☒	According to SOW requirements (e.g., MIL-STD 498, DIN EN IEC 60601-1-4, V-model...)
	Hardware certification	☒	According to SOW requirements (e.g. RTCA/DO-254...)





## Production and Logistics

Due to our centrally managed production and contract processes, we are highly flexible from the planning of materials up to the after-sales service. We make a point of responding quickly and flexibly to our customers' needs. You are always welcome to let us know if there is anything you would like to change or discuss and we will always try to accommodate you as long as it is not something we cannot guarantee or deliver.

Production & Logistics



Project Management  
Technology  
Quality Management  
Production & Logistics  
System Engineering  
Contact Persons  
Customer Series  
Digital Cameras  
Video Cameras  
Software  
Terms & Conditions



## Kappa Production and Logistics

Because we perceive our work as a part of our customers' value chain, we assume responsibility, from materials planning to after-sales services

At Kappa, production and contract management processes are centrally managed. Materials planning, production planning, order processing, purchasing, enterprise resource planning, shipping and service are all coordinated by a team located at our headquarters. Our customers benefit from this slightly unconventional model as optimum resource planning and direct, quick communication assure high flexibility and short production times while still providing excellent quality.

Thanks to the high levels of communication all the way through from materials planning to after-sales services, we can respond quickly and flexibly to the needs of our customers, which we always try to accommodate as long as it is not something we cannot guarantee or deliver. You are always welcome to let us know if there is anything you would like to change or talk about and we will find a solution that works for both sides.

Yet another advantage for our customers is our optimized supply management, which to us is not only about materials planning. Another and

equally important part of supply management is the communication and handling of discontinued components, since we see our supply chain management as a part of your value chain.

Our strategic and operative purchasing relies on long-term relationships with reliable suppliers, a selection of international suppliers and a well-cultivated procurement network.

In the actual manufacturing process we – and therefore our customers – benefit from our highly-qualified employees who undergo continuous training. Quick and often face-to-face



Kappa is expanding its premises. In the first quarter of 2009, the mechanics department will move into the new building in our headquarters. The improved room concept will make our production even more efficient.

communication between development and manufacturing assures that realistic objectives are set and that all those who are involved know what is important for each manufacturing step. At Kappa, the manufacturing department is involved in every step of the development phase, all the way through from prototype engineering with its diverse test phases to final customer approval.

In this way, an optimal conception of the production processes is established for each camera and each component, which is highly efficient, guarantees quality and is, like the configuration, part of the long-term documentation.

This conception, together with more than 30 years of experience, ensures that we identify and know all procedures and processes that are crucial to maintaining our standard. As a matter of principle, we don't outsource these procedures and processes. While, for example, most of the PCBs we use are actually manufactured by specialized partner companies, the final and crucial touches are always added by Kappa employees at Kappa's very own facilities.

This also applies to particularly demanding manufacturing tasks and, of course, to final inspection and testing. On request, we also perform specific test steps for you. This way we can guarantee absolute precision – from the individual item to the series product.

But our concept of service goes even further. In the area of logistics and distribution, we are ready to take care of the coordination of goods and documents, such as delivery notes, customs clearance and test protocols. Furthermore, for us, a customized logistics concept is a matter of course. This includes, for example:

- ✕ Labeling (including bar code labeling) and packaging according to customer specification
- ✕ Customized packaging design
- ✕ complete traceability
- ✕ Fulfillment
- ✕ Delivery to end customers
- ✕ Stockholding for customers (consignment stock)
- ✕ Management of provided parts





Production line: Alexander Herrmann, Alexander Otte, Cangiz Sahin

### Service and Support

Our configuration management also serves as an archive for our customers. The long life cycle of our products often has us looking for 20-year-old documentation to be able to provide professional support. Difficult as that may prove at times, it also makes us extremely proud to see that, after such a long time, our customers still rely on our products and our capability to provide maintenance and support for them.

Needless to say, our services are available at a much earlier stage. Our First Level Support (for hardware as well as software problems) is available to you, should minor difficulties occur during installation, which usually can be solved over the phone.

A professional complaints management team takes care of all your complaints, organizing troubleshooting, maintenance and repairs of components as well as products. This usually does not take more than a few days, including the initial phone call.

Should your camera have been damaged on-site, we are ready to carry out the repair – even after decades, as already mentioned.

## Live Quality ... ... the Kappa Mission

We want Kappa products and services to fully meet high quality and utility demands in a wide variety of applications. For this, we need to know the exact requirements of our customers and make them the center of our actions.

That's why we develop our solutions in close contact with you. Both sides benefit from a base of mutual trust. With many customers we have built long-term partnerships with a potential for results that often exceed the initial goals of the projects.

The Kappa Mission Statement mirrors our corporate philosophy. Its principles form the basis of our comprehensive quality management for manufacturing and all other departments.

### The Kappa mission statement

**We stand for expertise and innovation in opto-electronic system solutions.**  
We develop ...

- ▣ new products based on innovative ideas and open new areas of application
- ▣ our own creative ideas and those of our customers
- ▣ expertise in close cooperation with the customer
- ▣ and predict market needs

**The customer is our partner and is always made welcome.**  
Our cooperative national and international business relations ...

- ▣ are based on partnerships and cooperative solutions
- ▣ help our customers reach their goals rapidly and more efficiently
- ▣ guarantee outstanding customer benefits

**We achieve economic success with innovation and trust.**  
We ensure the company's independence by ...

- ▣ meeting deadlines and quality and cost consciousness
- ▣ continuous value enhancement
- ▣ maturing products
- ▣ trustworthiness

**Our performance is based on a spirit of teamwork and cooperation.**  
We communicate ...

- ▣ frankly, emphasizing goals
- ▣ using A-teams on the feasibility of new approaches
- ▣ in a network of support and knowledge
- ▣ the expertise of specialists
- ▣ ideas and develop integrated solutions for quality series production, all under one roof

**We realize leadership by trust and setting objectives.**  
The Kappa management ...

- ▣ sets clear and challenging objectives for the project teams
- ▣ leads through participation and trust in budgeted projects
- ▣ internalizes the role model function of executives
- ▣ allows employees scope for decision making
- ▣ pursues objectives systematically, consistently and in a forward-looking manner

**We achieve peak performance based on motivation and eagerness to learn.**  
The basis of our teamwork is characterized by ...

- ▣ respect and integrity
- ▣ continuous learning
- ▣ striving for continual improvement in performance
- ▣ cost consciousness
- ▣ adherence to schedules

**Integrity and responsibility are fundamental values for us.**

- ▣ We keep our word
- ▣ Customer satisfaction is our objective and we are therefore tied to product quality and on-schedule service
- ▣ For us social responsibility means environmental protection, sustainable use of resources and acceptance of cultural differences
- ▣ Our economic behaviour is governed by ecological and social responsibility



## System Engineering and Image Processing Solutions

Customer series have to meet specifications and fit seamlessly into the application environment. That's why we always ask: What exactly is your application you want to use the camera in? We want to understand your system in order to supply the appropriate camera and additional components. Our scalable engineering system can end with the cameras, but it doesn't need to end there. Depending on the scope of the particular task, it also covers illumination, lenses, cables, mechanical adaptation and PC software.

System Engineering

Project Management  
Technology  
Quality Management  
Production & Logistics  
System Engineering  
Contact Persons  
Customer Series  
Digital Cameras  
Video Cameras  
Software  
Terms & Conditions



## System Engineering and Image Processing Solutions

### From the Standard Camera to the Integrated Customer Series: Solutions for Users

#### System Integration

We don't always get sufficient specifications for all customer-specific series from the customer to be able to implement the requested modifications or new developments according to our quality requirements. That's why we always ask: What exactly is your application that you want to use the camera for?

We want to understand your system in order to supply the appropriate camera and further components. Therefore, we provide a scalable engineering system. It can end with the cameras, but it doesn't need to end there. Depending on the scope of the particular task, it can also cover illumination, lenses, cables, mechanical adaptation and PC software.

As data interfaces to the customer system, we can use images or video signals but also all other current methods (field bus systems, IO signals, serial interfaces, Ethernet, software...) All mechanical and electrical interfaces can be adapted to your needs.

We offer system engineering for Kappa cameras of all categories. System integrations or image processing projects are typical examples. In some cases, the customer provides no specifications at all, but only a task to solve. Especially in these cases, we are pleased to be your partner.

Just contact us!

The following examples give you a first impression of the scope of Kappa System Engineering.

#### Camera Control for Eyeglass Grinding



During the grinding process of eyeglasses, the grinding result is continually analyzed. The eyeglass is irradiated by a laser and the resulting image is surveyed by two cameras from different angles of vision. The Scheimpflug method (tilted planes of focus) is used for this application.

- ✎ Two standard CF8/5 cameras are used (description on page 71). The sensor is tilted and provided with a specific filter glass. Due to space restrictions, the connection of the camera is displaced from the rear side to the side panel.
- ✎ A frame grabber with an I/O trigger signal is installed for integration into the existing SPS control.
- ✎ A customized electronic device has been developed for the galvanic separation, control signal level adaptation and camera power supply.
- ✎ The camera system comprises customized cables and a specific SDK for the adaptation to the customer analysis software.

#### Camera System for Light Measurement System



For light measurement systems, we provide a specially adapted model of the DX4-285CL camera (description on page 56). This customer measures and selects the used CCD sensors himself.

- ✎ The housing design is adapted to the customer's requirements
- ✎ Specific functions for filter wheel control are added to the interface board.
- ✎ 100 % optically controlled filter glasses are used.
- ✎ The assembly is performed in a dust-reduced environment.

#### Camera Systems for Ophthalmology



For an ophthalmology application, the customer uses a specifically adapted DX4-1020CL (description on page 56). In this application, the focus is on the mechanical alignment of the laser.

- ✎ A specific housing has been developed which allows the positioning of the CCD to the optical interface. During the camera assembly, the sensor is accurately aligned at the pixel level to the x- and y-axis. The tilting of the sensor is identified and compensated by a specific laser measurement technology. Aligning pins prevent the turning of the sensor.
- ✎ The one-hundred percent final inspection is completed with additional measurements and an extended documentation. This reduces the reception inspection requirements for the customer.

#### Rear-View Camera



A rear-view camera for motor vehicle applications requires modifications and extensions in the areas of optics, mechanics and camera software. Depending on the configuration, a standard module CF 8/5 (description on page 71) or CF142 (description on page 68) is used.

- ✎ The specific housing design is specially encapsulated. It is dust- and waterproof and features a movable flap. If the camera is not in use, the viewing window is protected by the flap.
- ✎ The optics come equipped with an additional filter slider for dynamic range expansion.
- ✎ An additionally developed electronic device provides the following functions:
  - ✎ Control of flap and filter mechanics
  - ✎ Interface to the CAN-bus in the customer system according to the customer-specific CAN communication protocol
  - ✎ Specific power supply, conforming to industry standards

#### Image Processing / Machine Vision

Kappa offers specific image processing solutions. An interdisciplinary team understands the application context, assesses the task and defines the specific requirements together with you, the customer. Our data management system Kappa Xero includes engineering, installation, service and training.

But we don't always need to reinvent the wheel. Thanks to many years of experience and a broad spectrum of projects we can often use proven know-how. The interaction of new developments and standardized modules generates highly efficient results at an excellent price-performance ratio.

#### Centering of Filter Disks on Membrane Filters

During the production of membrane filters, round filter disks are welded onto the filter bodies by ultrasound. The centricity of the welded-in membrane is inspected by a Kappa system, which is based on a DX4-FW standard digital camera (description on page 57) with lens. It is completed with:

- ✎ Specific transmitted light and incident light illumination
- ✎ Complete PC with IO adapter
- ✎ Analysis software Xero

## Kappa XERO Interdisciplinary Development



Kappa Xero combines classical image analysis with the complex requirements of cross-linked data processing in modern industrial machinery. An interdisciplinary team is responsible for Kappa Xero. Key account manager Klemens Kresin puts the teams together depending on the character of the project, which could be an image processing component for system integrators or a complete machine vision system for an end customer.

Prominent members of the team are the experts for image processing software and camera electronics, Andreas Koch and Bernd Langer. For complex appliances, Ulrich Koch, design engineer, and Rüdiger Widera, responsible for precision mechanics, are involved. Dependent on the system requirements, the experts from our QA department with Stefan Ilse, head of Quality Management, join the team to deal with specific quality requirements and detailed documentation.

### Quality Assurance for Micro-Axles in the Automotive Industry



During the manufacturing of micro-axles for the automotive industry, length (approx. 18 mm), diameter (approx. 1 mm), bending and other values are measured with an accuracy of  $<10\mu\text{m}$ . The system is designed as a rotary table with several stations: feeding, three different testing stations, and IO/NIO kick-off. The first step for Kappa was to draw up a feasibility study in cooperation with the customer. After a positive conclusion, five standard version cameras DX4-FW (description on page 57) are provided and completed with additional equipment:

- ▣ Telecentric illumination and lenses
- ▣ Additional optical components such as prisms and mirrors
- ▣ Three complete PCs with a monitor and IO adapters
- ▣ Xero analysis software

### Measurement of Punched Holes in Cylinder Head Gaskets



During the manufacturing of cylinder head gaskets, the punched holes and drillings have to be measured with submillimeter accuracy. Kappa provides a complete QA measuring station. Two DX4-1020CL standard cameras (description on page 56) are adapted and completed as follows:

- ▣ The measuring station is equipped with a transmitted-light illumination and additional optical components such as prisms and mirrors.
- ▣ A mechanical appliance is designed for the two-dimensional positioning of the cameras.
- ▣ A complete PC with monitor and IO adapter enables machine control.
- ▣ Xero analysis software is adapted to process DXF drawings

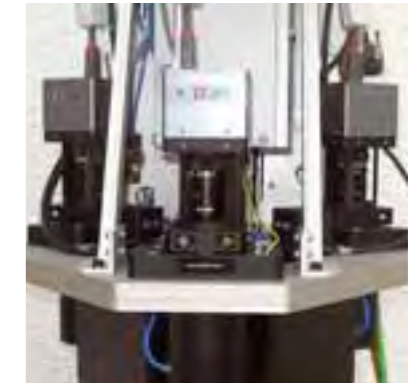
### Documentation of Wear in Precision Barrels



We developed a measurement system for the inspection and documentation of wear in precision barrels. It can be used for different barrel diameters. Two CF8/5 video cameras (description on page 71) are arranged in angles of 0 and 90° and tasked with the following:

- ▣ Laser measurement
- ▣ Depth measurement
- ▣ Angle measurement
- ▣ Electrical rotation left/right
- ▣ LED illumination 0° and 90°
- ▣ On-site image acquisition and documentation
- ▣ Customer-specific analysis software
- ▣ Optional: diameter measurement, loading space measurement
- ▣ Precision mechanical device

### Weld Seam Inspection on Stators for the Automotive Industry

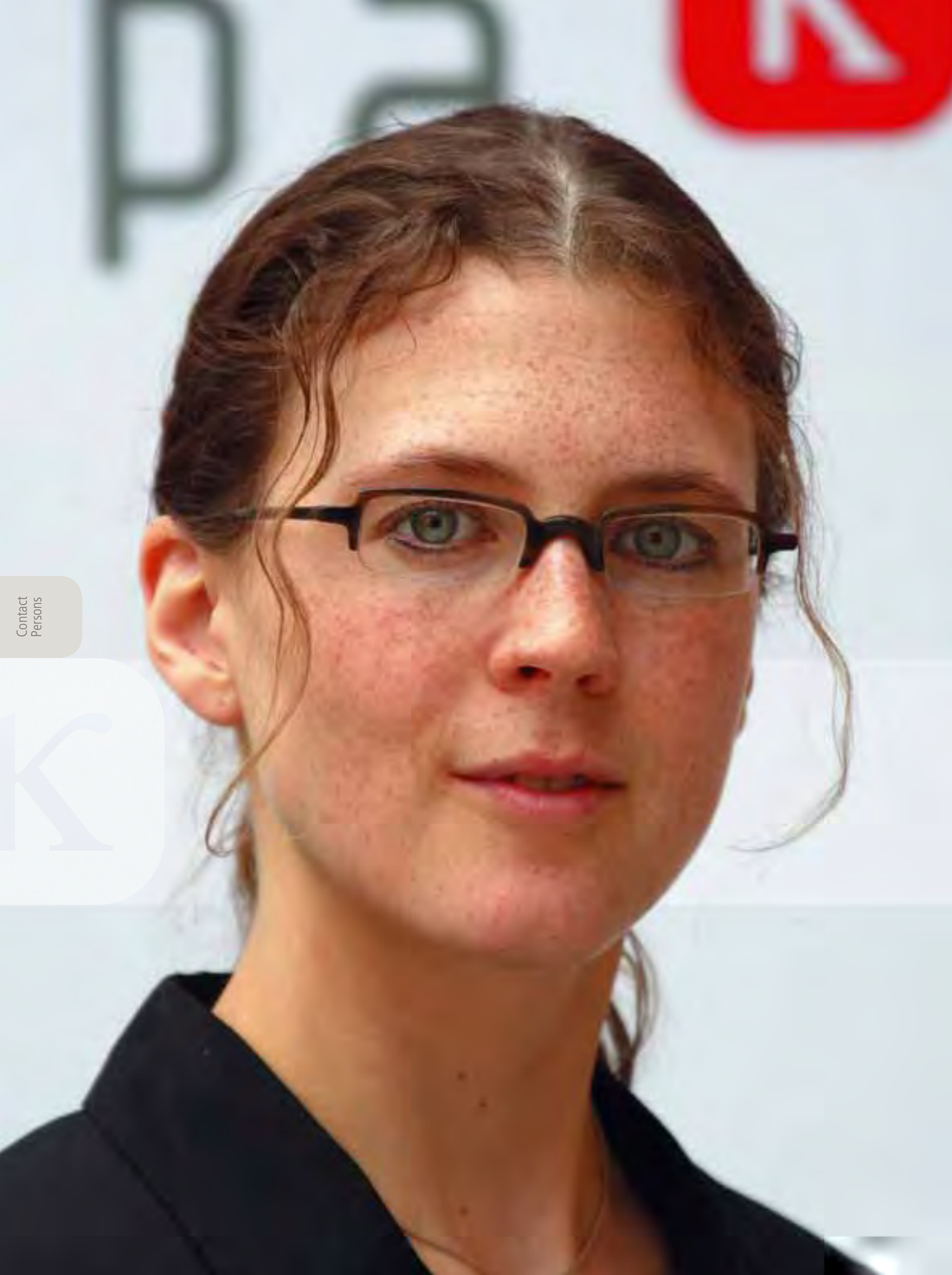


A customer who manufactures turning workpieces for the automotive industry wants to inspect the weld seams on stators for electric motors. These stators consist of a disk pack, which is fixed by three weld seams shifted by 120°. Three cameras acquire 12 images per test piece. The images are analyzed according to 10 different criteria such as seam thickness and cavities in the seam.

Following a feasibility study, three DX4-205FW standard digital cameras (description on page 57) were selected for the application. They were modified and completed with additional equipment as follows:

- ▣ Diffuse dome illumination
- ▣ Further optical elements such as prisms and mirrors
- ▣ A mechanical device for gripping and positioning the stators
- ▣ PC control of the device
- ▣ A complete PC with monitor and IO adapter
- ▣ Xero analysis software





## Contact Persons

„The customer is our partner and is always made welcome.“  
This is probably the most prominent statement from our mission statement – and for good reason. On the following pages we would like to introduce our sales and customer services staff to you, while at the same time stressing that you are always very welcome to visit our company and meet us in person.

- Project Management
- Technology
- Quality Management
- Production & Logistics
- System Engineering
- Contact Persons**
- Customer Series
- Digital Cameras
- Video Cameras
- Software
- Terms & Conditions

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**Dieter Gellrich**

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**Key Account Management**

**Dietmar Günther**

Key Account Manager

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**Alfons Rosenthal**

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**Doris Keil**

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unique for everyone

## Digital Cameras

### Versatile camera electronics

The range of our standard cameras forms the basis for customization. Through changes that range from small modifications to the development of new technology, we turn our digital or video cameras into customized versions which we then produce in the required quantities. This symbiosis of technological flexibility and know how and professional production planning is our core competence and forte.

The digital cameras are built upon variable camera electronics and advanced circuitry, yet at the same time they are extremely rugged and provide excellent signal quality. It offers a choice of monochrome and color cameras, CCD or CMOS sensors with megapixel resolution from Sony, Kodak and Aptina, and GigE, Camera Link, FireWire or USB interfaces. The cameras come with either the full monty package, i.e., as ready-to-use systems, or as high-performance basic cameras with our state-of-the-art software development kit (SDK3), especially designed to be integrated into all kinds of measuring and testing machines. The digital cameras are available in the standard cuboid housing or the striking hexagonal design.

The following pages are intended to give you an idea of how flexibly the standard cameras prove their worth in customized production runs.



Versatile camera electronics

Color and monochrome

Progressive scan

CCD and CMOS sensors

CameraLink, FireWire, Gigabit Ethernet, USB

12-bit or 10-bit digital signal processing

Megapixel resolution

External trigger, Reset/Restart

Partial scan | Binning

Automatic functions

Camera-internal color processing

...

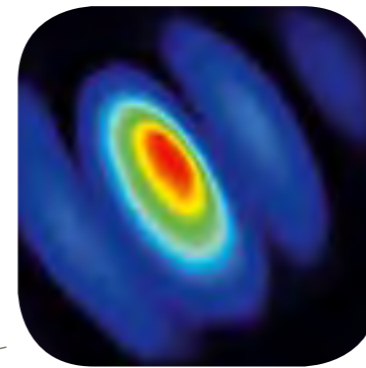




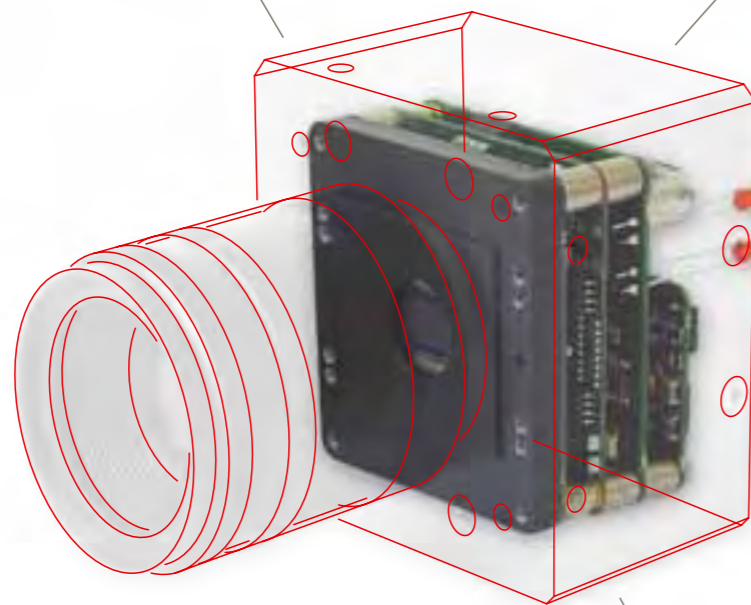
- Automotive:**  
Customized camera series for integration on vehicles
- ⊗ HD resolution
  - ⊗ Real-time / 30 Fps
  - ⊗ Control via vehicle on-board computer
  - ⊗ Separated Head



- Traffic:**  
Customized camera series for traffic imaging
- ⊗ 16-bit HDR output signal / 96 dB Dynamics
  - ⊗ Camera-internal digital signature
  - ⊗ Embedded PC
  - ⊗ Viewer software



- Laser Application:**  
Customized camera series for laser beam profiling
- ⊗ Removal of the micro lens array from the CCD
  - ⊗ Pixel-accurate adjustment of the sensor
  - ⊗ Camera controls integrated into customer application software
  - ⊗ Comprehensive OEM customized design



- Optical Measurement Technology:**  
Customized camera series for photometry
- ⊗ Specialized interface board to allow control of a filter wheel
  - ⊗ Specially calibrated sensors
  - ⊗ Housing especially designed to meet application requirements



- Defence:**  
Customized mobile vision system
- ⊗ Flexible printed circuit board
  - ⊗ Stiffened, space-saving housing to withstand extreme mechanical stresses
  - ⊗ LVDS interface
  - ⊗ 50 fps
  - ⊗ Comprehensive self-test functions



- Defence:**  
Customized vision system for vehicles
- ⊗ Rugged Design to withstand extreme thermal stresses
  - ⊗ CAN Bus interface
  - ⊗ Additional analog signal output
  - ⊗ Comprehensive self-test functions



- Ophthalmology:**  
Customized camera series for ophthalmological diagnostics
- ⊗ Pixel-accurate adjustment of the sensor
  - ⊗ Customized housing with special optical flange
  - ⊗ Camera parameters adapted to application-specific illumination environment

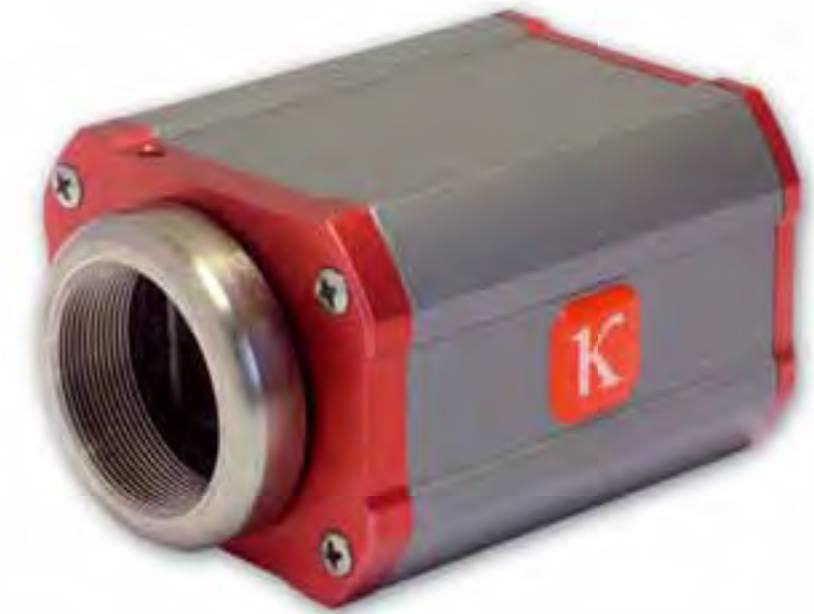
## Video

at its most advanced.

The range of our standard cameras forms the basis for customization. Through changes that range from small modifications to the development of new technology, we turn our digital or video cameras into customized versions which we then produce in the required quantities. This symbiosis of technological flexibility and know how and professional production planning is our core competence and strong suit.

The video format is still going strong, as demonstrates Kappa with its various performance-optimized rugged design video cameras. The series consists of high-quality, low-noise, high-sensitivity CCD video cameras (PAL and NTSC) with up to 12-bit digital signal processing, which come in various shapes and sizes: low-light level versions, color cameras with image memory, histogram equalization, double-exposure mode, camera-internal Kappa color processing – with a range of functions contingent on price, adaptable to your needs and budget – and remote/split head versions.

The following pages are intended to give you an idea of how flexibly the standard cameras prove their worth in customized production runs.



Rugged design

Color and monochrome

8-bit, 10-bit digital signal processing

Low-light level technology

Camera-internal color processing

Automatic contrast control (ACC/DRE)

Histogram equalization

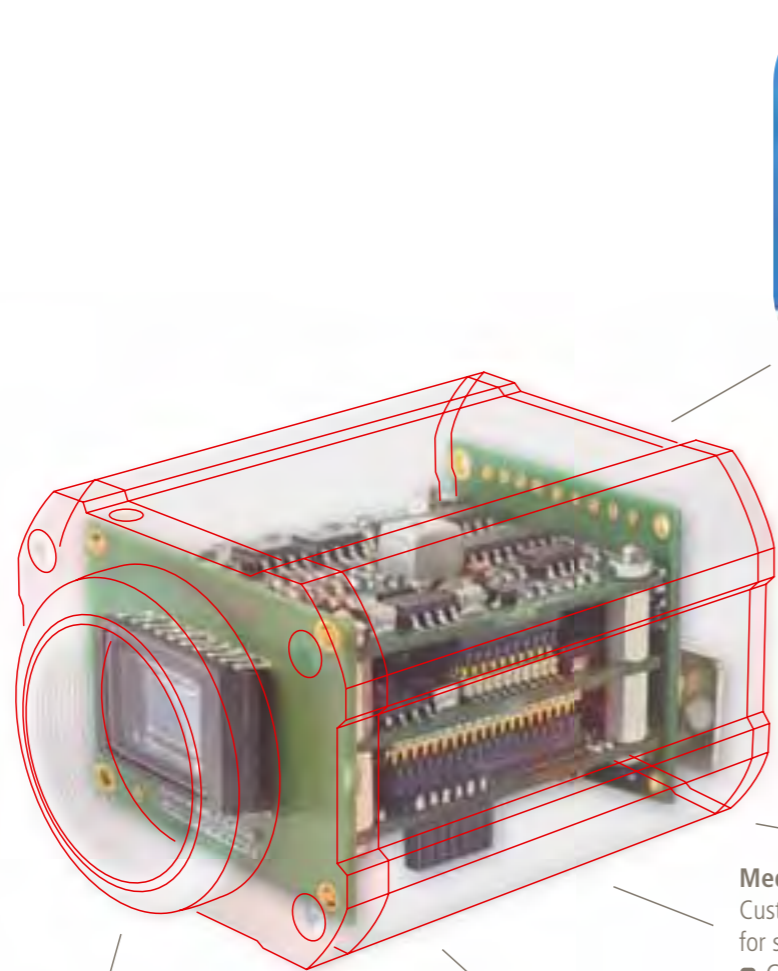
Image memory

RS 232 serial communication interface

Video (Y/C, CVBS), Digital (SDI)

...





**Optics:**

- Customized camera series for ophthalmic lens grinding machines
- ☒ Sensor tilted according to Scheimpflug principle
  - ☒ Integrated into SPS control system used by customer
  - ☒ Auto adaptation for galvanic isolation and level adjustment of control signal



**Night Vision:**

- Customized day and night vision cameras (24/7)
- ☒ Low-light-level technology
  - ☒ integrated infrared LED ring light operating in non-visible light spectrum
  - ☒ Wireless transmission
  - ☒ Water and sand proof
  - ☒ Battery operation



**Medical:**

- Customized camera series for minimally invasive surgery
- ☒ EN 13485 certification
  - ☒ Remote-head camera technology
  - ☒ Automatic contrast control and color optimization for medical applications
  - ☒ Xenon, Halogen und LED illumination
  - ☒ Comprehensive handling of OEM product lines, support and logistics

**Medical:**

- Customized camera series for surgical field monitoring
- ☒ Combination of camera and pan-tilt
  - ☒ Image and control signal transmission via bracket-integrated wiring
  - ☒ Integrated in OR light



**Aviation:**

- Camera series to aid taxiing of airplanes
- ☒ Deicing system
  - ☒ Rugged design for use in aircraft undercarriage
  - ☒ SDI interface
  - ☒ Low-light-level technology



**Laser Technology:**

- Camera series for adjustment of and positioning in laser welding machines
- ☒ Superimposable reticles via integrated line generator
  - ☒ Stand-alone control unit
  - ☒ Extremely variable product planning, batch as well as mass production



**Defence:**

- Customized rear-view camera for vehicles
- ☒ Heated
  - ☒ Nitrogen-filled
  - ☒ Self-cleaning window
  - ☒ CAN Bus interface
  - ☒ Rugged design

The digital cameras are built upon variable camera electronics and advanced circuitry, yet at the same time they are extremely rugged and provide excellent signal quality. It offers a choice of monochrome and color cameras, CCD or CMOS sensors with megapixel resolution from Sony, Kodak and Aptina, and GigE, CameraLink, FireWire or USB interfaces.

The cameras come with either the full monty package, i.e., as ready-to-use systems, or as high-performance basic cameras with our state-of-the-art software development kit (SDK3), especially designed to be integrated into all kinds of measuring and testing machines.



# Digital Cameras

## Color

### GigE

This camera series is built upon variable camera electronics, low power consumption, advanced circuitry, extreme ruggedness and excellent signal quality. It offers a choice of high-quality CCD sensors with mega pixel resolution from Sony and Kodak, and you can choose between the distinctive hexagonal design housing and the standard cubic design. These digital Kappa cameras meet the highest standards and offer additional special Kappa features, among them rugged mechanical design, highly sensitive linear signal quality, outstanding signal-to-noise ratio, time exposure and a second serial interface with customizable configuration. Binning and partial scan allow for high refresh rates, while image size remains freely adjustable.



	PS 40 - 285 GigE	PS 40 - 274 GigE	PS 40 - 205 GigE	PS 40 - 1020 GigE
<b>Highlights</b>	High sensitivity, max. dynamic range	High resolution	Small sensor surface	Speed
<b>Sensor Interline Transfer CCD</b>	2/3" progressive scan with micro lenses (Sony ICX285AQ, EXview HAD)	1/1.8" progressive scan with micro lenses (Sony ICX274AQ, EXview HAD)	1/2" progressive scan with micro lenses (Sony ICX205AQ, EXview HAD)	2/3" progressive scan with micro lenses (Kodak KAI 1020 CM)
<b>Pixel (H x V)</b>	1434 x 1050, total	1688 x 1248, total	1434 x 1050, total	1028 x 1008, total
<b>Spectral sensitivity</b>	320 - 1100 nm (B470/G540/R630 nm)	320 - 1100 nm (B460/G535/R620 nm)	320 - 1100 nm (B470/G540/R630 nm)	320 - 1000 nm (B470/G535/R620 nm)
<b>Sensitivity</b>	0.35 lux at 100 ms	0.69 lux at 100 ms	0.61 lux at 100 ms	0.65 lux at 100 ms
<b>Dynamic range</b>	> 63 dB	> 52 dB	> 55 dB	> 57 dB
<b>System</b>	12 bit	12 bit	12 bit	12 bit
<b>Frame rate</b>	15 fps (max. 62 fps)	12 fps (max. 40 fps)	15 fps (max. 62 fps)	30 fps (max. 90 fps)
<b>Interfaces</b>	Gigabit Ethernet	Gigabit Ethernet	Gigabit Ethernet	Gigabit Ethernet
<b>Exposure time</b>	1 µs to 120 s, AE 1 µs to 66 ms	1 µs to 120 s, AE 1 µs to 115 ms	1 µs to 120 s, AE 1 µs to 66 ms	1 µs to 120 s, AE 1 µs to 33 ms
<b>Gain</b>	0 to 18 dB	0 to 18 dB	0 to 18 dB	0 to 18 dB
<b>Signal processing functions</b>	Color processing, enhancement, binning, partial scan, gamma, line generator, measurement window, camera diagnostics	Color processing, enhancement, binning, partial scan, gamma, line generator, measurement window, camera diagnostics	Color processing, enhancement, binning, partial scan, gamma, line generator, measurement window, camera diagnostics	Color processing, enhancement, binning, partial scan, gamma, line generator, measurement window, camera diagnostics
<b>Synchronization</b>	intern/extern, reset/restart, hardware/software trigger	intern/extern, reset/restart, hardware/software trigger	intern/extern, reset/restart, hardware/software trigger	intern/extern, reset/restart, hardware/software trigger
<b>Lens mount</b>	C-mount	C-mount	C-mount	C-mount
<b>Power supply</b>	9 - 16 V DC, 5 W	9 - 16 V DC, 5 W	9 - 16 V DC, 5 W	9 - 16 V DC, 4.8 W
<b>Temperature</b>	0°C to +70°C	0°C to +70°C	0°C to +70°C	0°C to +70°C
<b>Dimensions / Weight</b>	65 x 65 x 56 mm; 320 g	65 x 65 x 56 mm; 320 g	65 x 65 x 56 mm; 320 g	65 x 65 x 56 mm; 320 g
<b>Order-no.</b>	963-1735	963-1736	963-1737	963-1706
<b>Equipment / Options</b>	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3
<b>Complete system</b>	DX 40 - 285 GigE: camera, Ethernet cable, power supply cable, power supply, KCC software	DX 40 - 274 GigE: camera, Ethernet cable, power supply cable, power supply, KCC software	DX 40 - 205 GigE: camera, Ethernet cable, power supply cable, power supply, KCC software	DX 40 - 1020 GigE: camera, Ethernet cable, power supply cable, power supply, KCC software

# Digital Cameras

## Color

### CameraLink



	PS 40 - 285 CL	PS 40 - 274 CL	PS 40 - 205 CL	PS 40 - 1020 CL
<b>Highlights</b>	High sensitivity, max. dynamic range	High resolution	Small sensor surface	Speed
<b>Sensor Interline Transfer CCD</b>	2/3" progressive scan with micro lenses (Sony ICX285AQ, EXview HAD)	1/1.8" progressive scan with micro lenses (Sony ICX274AQ, EXview HAD)	1/2" progressive scan with micro lenses (Sony ICX205AQ, EXview HAD)	2/3" progressive scan with micro lenses (Kodak KAI 1020 CM)
<b>Pixel (H x V)</b>	1434 x 1050, total	1688 x 1248, total	1434 x 1050, total	1028 x 1008, total
<b>Spectral sensitivity</b>	320 - 1100 nm (B470/G540/R630 nm)	320 - 1100 nm (B460/G535/R620 nm)	320 - 1100 nm (B470/G540/R630 nm)	320 - 1000 nm (B470/G535/R620 nm)
<b>Sensitivity</b>	0.35 lux at 100 ms	0.69 lux at 100 ms	0.61 lux at 100 ms	0.65 lux at 100 ms
<b>Dynamic range</b>	> 63 dB	> 52 dB	> 55 dB	> 57 dB
<b>System</b>	12 bit	12 bit	12 bit	12 bit
<b>Frame rate</b>	15 fps (max. 62 fps)	16 fps (max. 40 fps)	15 fps (max. 62 fps)	30 fps (max. 90 fps)
<b>Interface</b>	CameraLink	CameraLink	CameraLink	CameraLink
<b>Exposure time</b>	1 µs to 120 s, AE 1 µs to 66 ms	1 µs to 120 s, AE 1 µs to 66 ms	1 µs to 120 s, AE 1 µs to 66 ms	1 µs to 120 s, AE 1 µs to 33 ms
<b>Gain</b>	0 to 18 dB	0 to 18 dB	0 to 18 dB	0 to 18 dB
<b>Signal Processing Functions</b>	Color processing, enhancement, binning, partial scan, gamma, line generator, measurement window, camera diagnostics	Color processing, enhancement, binning, partial scan, gamma, line generator, measurement window, camera diagnostics	Color processing, enhancement, binning, partial scan, gamma, line generator, measurement window, camera diagnostics	Color processing, enhancement, binning, partial scan, gamma, line generator, measurement window, camera diagnostics
<b>Synchronization</b>	internal/external, reset/restart hardware/software trigger	internal/external, reset/restart hardware/software trigger	internal/external, reset/restart hardware/software trigger	internal/external, reset/restart hardware/software trigger
<b>Lens mount</b>	C-mount	C-mount	C-mount	C-mount
<b>Power supply</b>	9 - 36 V DC, 3.2 W	9 - 36 V DC, 3.2 W	9 - 36 V DC, 3.2 W	9 - 36 V DC, 3 W
<b>Temperature</b>	-20°C to +60°C	-20°C to +60°C	-20°C to +60°C	-20°C to +60°C
<b>Dimensions / Weight</b>	60 x 60 x 47 mm; 235 g	60 x 60 x 47 mm; 235 g	60 x 60 x 47 mm; 235 g	60 x 60 x 47 mm; 235 g
<b>Order-no.</b>	963-1710	963-1714	963-1711	963-1700
<b>Equipment / Options</b>	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3, design housing yellow	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3, design housing yellow	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3, design housing yellow	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3, design housing yellow
<b>Complete system</b>	DX 40 - 285 CL: camera, CL grabber, CL cable, power supply cable, power supply, KCC software	DX 40 - 274 CL: camera, CL grabber, CL cable, power supply cable, power supply, KCC software	DX 40 - 205 CL: camera, CL grabber, CL cable, power supply cable, power supply, KCC software	DX 40 - 1020 CL: camera, CL grabber, CL cable, power supply cable, power supply, KCC software

We are constantly checking the accuracy of the technical data. We will provide more detailed information on request. Technical data is subject to change without notice.

Project Management  
Technology  
Quality Management  
Production & Logistics  
System Engineering  
Contact Persons  
Customer Series  
Digital Cameras  
Video Cameras  
Software  
Terms & Conditions

Digital Cameras

Digital Cameras

## Digital Cameras

### Color



This camera series is built upon variable camera electronics, low power consumption, advanced circuitry, extreme ruggedness and excellent signal quality. It offers a choice of high-quality CCD sensors with mega pixel resolution from Sony and Kodak, and you can choose between the distinctive hexagonal design housing and the standard cubic design. These digital Kappa cameras meet the highest standards and offer additional special Kappa features, among them rugged mechanical design, highly sensitive linear signal quality, outstanding signal-to-noise ratio, time exposure and a second serial interface with customizable configuration. Binning and partial scan allow for high refresh rates, while image size remains freely adjustable.



	PS 40 - 285 FW	PS 40 - 274 FW	PS 40 - 205 FW	PS 40 - 1020 FW
<b>Highlights</b>	High sensitivity, max. dynamic range	High resolution	Small sensor surface	Speed
<b>Interline transfer CCD sensor</b>	2/3" progressive scan with micro lenses (Sony ICX285AQ, EXview HAD)	1/1.8" progressive scan with micro lenses (Sony ICX274AQ, EXview HAD)	1/2" progressive scan with micro lenses (Sony ICX205AQ, EXview HAD)	2/3" progressive scan with micro lenses (Kodak KAI 1020 CM)
<b>Pixel (H x V)</b>	1434 x 1050, total	1688 x 1248, total	1434 x 1050, total	1028 x 1008, total
<b>Spectral sensitivity</b>	320 - 1100 nm (B470/G540/R630 nm)	320 - 1100 nm (B460/G535/R620 nm)	320 - 1100 nm (B470/G540/R630 nm)	320 - 1000 nm (B470/G535/R620 nm)
<b>Sensitivity</b>	0.35 lux at 100 ms	0.96 lux at 100 ms	0.61 lux at 100 ms	0.65 lux at 100 ms
<b>Dynamic range</b>	> 63 dB	> 52 dB	> 55 dB	> 57 dB
<b>System</b>	12 bit	12 bit	12 bit	12 bit
<b>Frame rate</b>	11 fps (max. 62 fps)	8 fps (max. 40 fps)	11 fps (max. 62 fps)	16 fps (max. 90 fps)
<b>Interfaces IIDC 1394-based Specification, Vers. 1.3</b>	FireWire, 2 ports (6 pin) with 400 Mbit/s	FireWire, 2 ports (6 pin) with 400 Mbit/s	FireWire, 2 ports (6 pin) with 400 Mbit/s	FireWire, 2 ports (6 pin) with 400 Mbit/s
<b>Exposure time</b>	1 µs to 120 s, AE 1 µs to 66 ms	1 µs to 120 s, AE 1 µs to 115 ms	1 µs to 120 s, AE 1 µs to 66 ms	1 µs to 120 s, AE 1 µs to 33 ms
<b>Gain</b>	0 to 18 dB	0 to 18 dB	0 to 18 dB	0 to 18 dB
<b>Signal processing functions</b>	Color processing, enhancement, binning, partial scan, gamma, line generator, measurement window, camera diagnostics	Color processing, enhancement, binning, partial scan, gamma, line generator, measurement window, camera diagnostics	Color processing, enhancement, binning, partial scan, gamma, line generator, measurement window, camera diagnostics	Color processing, enhancement, binning, partial scan, gamma, line generator, measurement window, camera diagnostics
<b>Synchronization</b>	intern/extern, reset/restart, hardware/software trigger	intern/extern, reset/restart, hardware/software trigger	intern/extern, reset/restart, hardware/software trigger	intern/extern, reset/restart, hardware/software trigger
<b>Lens mount</b>	C-mount	C-mount	C-mount	C-mount
<b>Power supply</b>	9 - 36 V DC, 3.6 W	9 - 36 V DC, 3.6 W	9 - 36 V DC, 3.6 W	9 - 36 V DC, 3.4 W
<b>Temperature</b>	-20°C to +60°C	-20°C to +60°C	-20°C to +60°C	-20°C to +60°C
<b>Dimensions / Weight</b>	60 x 60 x 55 mm; 275 g	60 x 60 x 55 mm; 275 g	60 x 60 x 55 mm; 275 g	60 x 60 x 55 mm; 275 g
<b>Order-no.</b>	963-1719	963-1723	963-1718	963-1703
<b>Equipment / Options</b>	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3, design housing red	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3, design housing red	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3, design housing red	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3, design housing red
<b>Complete system</b>	DX 40 - 285 FW: camera, FW cable, KCC software	DX 40 - 274 FW: camera, FW cable, KCC software	DX 40 - 205 FW: camera, FW cable, KCC software	DX 40 - 1020 FW: camera, FW cable, KCC software

## Digital Cameras

### Monochrome III

### GigE



	PS 4 - 285 GigE	PS 4 - 274 GigE	PS 4 - 205 GigE	PS 4 - 1020 GigE
<b>Highlights</b>	High sensitivity, max. dynamic range	High resolution	Small sensor surface	Speed
<b>Sensor Interline Transfer CCD</b>	2/3" progressive scan with micro lenses (Sony ICX285AL, EXview HAD)	1/1.8" progressive scan with micro lenses (Sony ICX274AL, EXview HAD)	1/2" progressive scan with micro lenses (Sony ICX205AL, EXview HAD)	2/3" progressive scan with micro lenses (Kodak KAI 1020 M)
<b>Pixel (H x V)</b>	1434 x 1050, total	1688 x 1248, total	1434 x 1050, total	1028 x 1008, total
<b>Spectral sensitivity</b>	320 - 1100 nm	320 - 1100 nm	320 - 1100 nm	320 - 1000 nm
<b>Sensitivity</b>	0.02 lux at 100 ms	0.05 lux at 100 ms	0.04 lux at 100 ms	0.06 lux at 100 ms
<b>Dynamic range</b>	> 63 dB	> 56 dB	> 55 dB	> 60 dB
<b>System</b>	12 bit	12 bit	12 bit	12 bit
<b>Frame rate</b>	15 fps (max. 62 fps)	12 fps (max. 40 fps)	15 fps (max. 62 fps)	30 fps (max. 90 fps)
<b>Interfaces</b>	Gigabit Ethernet	Gigabit Ethernet	Gigabit Ethernet	Gigabit Ethernet
<b>Exposure time</b>	1 µs to 120 s, AE 1 µs to 66 ms	1 µs to 120 s, AE 1 µs to 115 ms	1 µs to 120 s, AE 1 µs to 66 ms	1 µs to 120 s, AE 1 µs to 115 ms
<b>Gain</b>	0 to 18 dB	0 to 18 dB	0 to 18 dB	0 to 18 dB
<b>Signal processing functions</b>	Binning, partial scan, gamma, line generator, measurement window, camera diagnostics	Binning, partial scan, gamma, line generator, measurement window, camera diagnostics	Binning, partial scan, gamma, line generator, measurement window, camera diagnostics	Binning, partial scan, gamma, line generator, measurement window, camera diagnostics
<b>Synchronization</b>	intern/extern, reset/restart, hardware/software trigger	intern/extern, reset/restart, hardware/software trigger	intern/extern, reset/restart, hardware/software trigger	intern/extern, reset/restart, hardware/software trigger
<b>Lens mount</b>	C-mount	C-mount	C-mount	C-mount
<b>Power supply</b>	9 - 16 V DC, 5 W	9 - 16 V DC, 5 W	9 - 16 V DC, 5 W	9 - 16 V DC, 4.8 W
<b>Temperature</b>	0°C to +70°C	0°C to +70°C	0°C to +70°C	0°C to +70°C
<b>Dimensions / Weight</b>	65 x 65 x 56 mm; 320 g	65 x 65 x 56 mm; 320 g	65 x 65 x 56 mm; 320 g	65 x 65 x 56 mm; 320 g
<b>Order-no.</b>	953-1735	953-1736	953-1737	953-1706
<b>Equipment / Options</b>	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3
<b>Complete system</b>	DX 4 - 285 GigE: camera, Ethernet cable, power supply cable, power supply, KCC software	DX 4 - 274 GigE: camera, Ethernet cable, power supply cable, power supply, KCC software	DX 4 - 205 GigE: camera, Ethernet cable, power supply cable, power supply, KCC software	DX 4 - 1020 GigE: camera, Ethernet cable, power supply cable, power supply, KCC software

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## Digital Cameras

### III Monochrome



This camera series is built upon variable camera electronics, low power consumption, advanced circuitry, extreme ruggedness and excellent signal quality. It offers a choice of high-quality CCD sensors with mega pixel resolution from Sony and Kodak, and you can choose between the distinctive hexagonal design housing and the standard cubic design. These digital Kappa cameras meet the highest standards and offer additional special Kappa features, among them rugged mechanical design, highly sensitive linear signal quality, outstanding signal-to-noise ratio, time exposure and a second serial interface with customizable configuration. Binning and partial scan allow for high refresh rates, while image size remains freely adjustable.



	PS 4 - 285 CL	PS 4 - 274 CL	PS 4 - 205 CL	PS 4 - 1020 CL
<b>Highlights</b>	High sensitivity, max. dynamic range	High resolution	Small sensor surface	Speed
<b>Sensor Interline Transfer CCD</b>	2/3" progressive scan with micro lenses (Sony ICX285AL, EXview HAD)	1/1.8" progressive scan with micro lenses (Sony ICX274AL, EXview HAD)	1/2" progressive scan with micro lenses (Sony ICX205AL, EXview HAD)	2/3" progressive scan with micro lenses (Kodak KAI 1020 M)
<b>Pixel (H x V)</b>	1434 x 1050, total	1688 x 1248, total	1434 x 1050, total	1028 x 1008, total
<b>Spectral sensitivity</b>	320 - 1100 nm	320 - 1100 nm	320 - 1100 nm	320 - 1000 nm
<b>Sensitivity</b>	0.02 lux at 100 ms	0.05 lux at 100 ms	0.04 lux at 100 ms	0.06 lux at 100 ms
<b>Dynamic range</b>	> 63 dB	> 56 dB	> 55 dB	> 60 dB
<b>System</b>	12 bit	12 bit	12 bit	12 bit
<b>Frame rate</b>	15 fps (max. 62 fps)	12 fps (max. 40 fps)	15 fps (max. 62 fps)	30 fps (max. 90 fps)
<b>Interfaces</b>	CameraLink	CameraLink	CameraLink	CameraLink
<b>Exposure time</b>	1 µs to 120 s, AE 1 µs to 66 ms	1 µs to 120 s, AE 1 µs to 115 ms	1 µs to 120 s, AE 1 µs to 66 ms	1 µs to 120 s, AE 1 µs to 33 ms
<b>Gain</b>	0 to 18 dB	0 to 18 dB	0 to 18 dB	0 to 18 dB
<b>Signal processing functions</b>	Binning, partial scan, gamma, line generator, measurement window, camera diagnostics	Binning, partial scan, gamma, line generator, measurement window, camera diagnostics	Binning, partial scan, gamma, line generator, measurement window, camera diagnostics	Binning, partial scan, gamma, line generator, measurement window, camera diagnostics
<b>Synchronization</b>	intern/extern, reset/restart, hardware/software trigger	intern/extern, reset/restart, hardware/software trigger	intern/extern, reset/restart, hardware/software trigger	intern/extern, reset/restart, hardware/software trigger
<b>Lens mount</b>	C-mount	C-mount	C-mount	C-mount
<b>Power supply</b>	9 - 36 V DC, 2.6 W	9 - 36 V DC, 2.6 W	9 - 36 V DC, 2.6 W	9 - 36 V DC, 2.5 W
<b>Temperature</b>	-20°C to +60°C	-20°C to +60°C	-20°C to +60°C	-20°C to +60°C
<b>Demensions / Weight</b>	60 x 60 x 47 mm; 235 g	60 x 60 x 47 mm; 235 g	60 x 60 x 47 mm; 235 g	60 x 60 x 47 mm; 235 g
<b>Order-no.</b>	953-1710	953-1714	953-1711	953-1700
<b>Equipment / Options</b>	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3, design housing yellow	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3, design housing yellow	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3, design housing yellow	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3, design housing yellow
<b>Complete system</b>	DX 4 - 285 CL: camera, CL grabber, CL cable, power supply cable, power supply, KCC software	DX 4 - 274 CL: camera, CL grabber, CL cable, power supply cable, power supply, KCC software	DX 4 - 205 CL: camera, CL grabber, CL cable, power supply cable, power supply, KCC software	DX 4 - 1020 CL: camera, CL grabber, CL cable, power supply cable, power supply, KCC software

## Digital Cameras

### Monochrome III



	PS 4 - 285 FW	PS 4 - 274 FW	PS 4 - 205 FW	PS 4 - 1020 FW
<b>Highlights</b>	High sensitivity, max. dynamic range	High resolution	Small sensor surface	Speed
<b>Sensor Interline Transfer CCD</b>	2/3" progressive scan with micro lenses (Sony ICX285AL, EXview HAD)	1/1.8" progressive scan with micro lenses (Sony ICX274AL, EXview HAD)	1/2" progressive scan with micro lenses (Sony ICX205AL, EXview HAD)	2/3" progressive scan with micro lenses (Kodak KAI 1020 M)
<b>Pixel (H x V)</b>	1434 x 1050, total	1688 x 1248, total	1434 x 1050, total	1028 x 1008, total
<b>Spectral sensitivity</b>	320 - 1100 nm	320 - 1100 nm	320 - 1100 nm	320 - 1000 nm
<b>Sensitivity</b>	0.002 lux at 100 ms	0.05 lux at 100 ms	0.04 lux at 100 ms	0.06 lux at 100 ms
<b>Dynamic range</b>	> 63 dB	> 56 dB	> 55 dB	60 dB
<b>System</b>	12 bit	12 bit	12 bit	12 bit
<b>Frame rate</b>	11 fps (max. 62 fps)	8 fps (max. 40 fps)	11 fps (max. 62 fps)	16 fps (max. 90 fps)
<b>Interfaces</b>	FireWire, 2 ports (6 pin) with 400 Mbit/s	FireWire, 2 ports (6 pin) with 400 Mbit/s	FireWire, 2 ports (6 pin) with 400 Mbit/s	FireWire, 2 ports (6 pin) with 400 Mbit/s
<b>Exposure time</b>	1 µs to 120 s, E 1 µs to 66 ms	1 µs to 120 s, AE 1 µs to 115 ms	1 µs to 120 s, AE 1 µs to 66 ms	1 µs to 120 s, AE 1 µs to 33 ms
<b>Gain</b>	0 to 18 dB	0 to 18 dB	0 to 18 dB	0 to 18 dB
<b>Signal processing functions</b>	Binning, partial scan, gamma, line generator, measurement window, camera diagnostics	Binning, partial scan, gamma, line generator, measurement window, camera diagnostics	Binning, partial scan, gamma, line generator, measurement window, camera diagnostics	Binning, partial scan, gamma, line generator, measurement window, camera diagnostics
<b>Synchronization</b>	intern/extern, reset/restart, hardware/software trigger	intern/extern, reset/restart, hardware/software trigger	intern/extern, reset/restart, hardware/software trigger	intern/extern, reset/restart, hardware/software trigger
<b>Lens mount</b>	C-mount	C-mount	C-mount	C-mount
<b>Power supply</b>	9 - 36 V DC, 3 W	9 - 36 V DC, 3 W	9 - 36 V DC, 3 W	9 - 36 V DC, 2.9 W
<b>Temperature</b>	-20°C to +60°C	-20°C to +60°C	-20°C to +60°C	-20°C to +60°C
<b>Demensions / Weight</b>	60 x 60 x 55 mm; 275 g	60 x 60 x 55 mm; 275 g	60 x 60 x 55 mm; 275 g	60 x 60 x 55 mm; 275 g
<b>Order-no.</b>	953-1719	953-1723	953-1718	953-1703
<b>Equipment / Options</b>	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3, design housing red	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3, design housing red	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3, design housing red	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3, design housing red
<b>Complete system</b>	DX 4 - 285 FW: camera, FW cable, KCC software	DX 4 - 274 FW: camera, FW cable, KCC software	DX 4 - 205 FW: camera, FW cable, KCC software	DX 4 - 1020 FW: camera, FW cable, KCC software

We are constantly checking the accuracy of the technical data. We will provide more detailed information on request. Technical data is subject to change without notice.

Kappa Signature Cameras allow the authentication of digital images and accompanying additional data (e.g., measurement values, QS information, batch numbers) via camera-internal digital signature, making manipulation identifiable and provable. They are available as Kappa PS and DX, black-and-white or color models, fitted with high-quality Sony or Kodak sensors and equipped with either CameraLink or GigE interface. The signature rate is two frames per second in trigger mode.



<b>PS 40S - 285</b> <b>PS 4S - 285</b> <b>[Color   Mono]</b>	<b>PS 40S - 274</b> <b>PS 4S - 274</b> <b>[Color   Mono]</b>	<b>PS 40S - 205</b> <b>PS 4S - 205</b> <b>[Color   Mono]</b>	<b>PS 40S - 1020</b> <b>PS 4S - 1020</b> <b>[Color   Mono]</b>
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Highlights	High sensitivity, max. dynamic range	High resolution	Small sensor surface	Speed
<b>Signature method</b>	RSA, 1024 bit, SHA-512	RSA, 1024 bit, SHA-512	RSA, 1024 bit, SHA-512	RSA, 1024 bit, SHA-512
<b>Signature generation</b>	Security Controller Chip with key management	Security Controller Chip with key management	Security Controller Chip with key management	Security Controller Chip with key management
<b>Software</b>	Signature viewer software	Signature viewer software	Signature viewer software	Signature viewer software
<b>Sensor Interline Transfer CCD</b>	2/3" progressive scan with micro lenses	1/1.8" progressive scan with micro lenses	1/2" progressive scan with micro lenses	2/3" progressive scan with micro lenses
<b>Pixel (H x V)</b>	1434 x 1050, total	1688 x 1248, total	1434 x 1050, total	1028 x 1008, total
<b>Spectral sensitivity</b>	320 - 1100 nm (B470/G540/R630 nm)	320 - 1100 nm (B460/G535/R620 nm)	320 - 1100 nm (B470/G540/R630 nm)	320 - 1000 nm (B470/G535/R620 nm)
<b>Sensitivity</b>	lux 0.35   0.02 at 100 ms	lux 0.69   0.05 at 100 ms	lux 0.61   0.04 at 100 ms	lux 0.65   0.06 at 100 ms
<b>Dynamic range</b>	> 63 dB	> 52 dB   > 56 dB	> 55 dB	> 57 dB   > 60 dB
<b>System</b>	12 bit	12 bit	12 bit	12 bit
<b>Frame Rate</b>	15 fps (max. 62 fps)	12 fps (max. 40 fps)	15 fps (max. 62 fps)	30 fps (max. 90 fps)
<b>Trigger mode / Sig.-Rate</b>	2 fps	2 fps	2 fps	2 fps
<b>Interfaces</b>	CameraLink, Gigabit Ethernet	CameraLink, Gigabit Ethernet	CameraLink, Gigabit Ethernet	CameraLink, Gigabit Ethernet
<b>Exposure time</b>	1 µs to 120 s, AE 1 µs to 66 ms	1 µs to 120 s, AE 1 µs to 115 ms	1 µs to 120 s, AE 1 µs to 66 ms	1 µs to 120 s, AE 1 µs to 33 ms
<b>Gain</b>	0 to 18 dB	0 to 18 dB	0 to 18 dB	0 to 18 dB
<b>Signal processing functions</b>	color processing, enhancement, binning, partial scan, gamma, line generator, measurement window	color processing, enhancement, binning, partial scan, gamma, line generator, measurement window	color processing, enhancement, binning, partial scan, gamma, line generator, measurement window	color processing, enhancement, binning, partial scan, gamma, line generator, measurement window
<b>Synchronization</b>	intern/extern, reset/restart, hardware/software trigger	intern/extern, reset/restart, hardware/software trigger	intern/extern, reset/restart, hardware/software trigger	intern/extern, reset/restart, hardware/software trigger
<b>Lens mount</b>	C-mount	C-mount	C-mount	C-mount
<b>Order-no.</b>				
<b>Color, CL</b>	963-1710S	963-1714S	963-1711S	963-1700S
<b>Mono, CL</b>	953-1710S	953-1714S	953-1711S	953-1700S
<b>Color, GigE</b>	963-1735S	963-1736S	963-1737S	963-1706S
<b>Mono, GigE</b>	953-1735S	953-1736S	953-1737S	953-1706S
<b>Equipment / Options</b>	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3
<b>Complete system</b>	available	available	available	available

Kappa cooled cameras with controlled, double-stage peltier cooling excel in all kinds of areas, but especially in low-light applications such as fluorescence microscopy, astronomy, electrophoresis or gel documentation, where time exposure is extremely important. These low-noise cameras, which are fitted with a high-quality 2/3" CCD sensor featuring extreme sensitivity, high resolution and excellent quantum efficiency, operate with 12-bit pixel depth. There is a choice of three interfaces available: FireWire, Camera Link (also as PCMCIA) and Gigabit Ethernet. The binning mode, which reduces exposure time, can be especially useful in difficult applications, e.g. quickly fading samples or objects. Virtually noise free: at room temperature, the controlled two-stage peltier cooling system cools the sensor down to -15°C (unregulated max. Delta T = 42°K), allowing virtually noise-free (SNR 66 dB) time exposures of several minutes, by reducing thermal noise substantially. Additionally, the employment of high-quality components and sophisticated circuitry and the switchable slow scan mode further contribute to noise reduction, the former two by minimizing electrical noise, the latter by minimizing read-out noise.



<b>PS 40C - 285</b> <b>[Color]</b>	<b>PS 4C - 285</b> <b>[Mono]</b>
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Highlights	High sensitivity, max. dynamic range	High sensitivity, max. dynamic range
<b>Double-stage Peltier cooling</b>	switchable by software: on/regulated/max.(Slow Scan Mode)	switchable by software: on/regulated/max.(Slow Scan Mode)
<b>Temperature of the sensor</b>	unregulated delta T 42°K regulated -15°C (ambient temperature from 15°C up to 27°C)	unregulated delta T 42°K regulated -15°C (ambient temperature from 15°C up to 27°C)
<b>Sensor Interline Transfer CCD</b>	2/3" progressive scan with micro lenses (Sony ICX285AQ, EXview HAD)	2/3" progressive scan with micro lenses (Sony ICX285AL, EXview HAD)
<b>Pixel (H x V)</b>	1434 x 1050, total	1434 x 1050, total
<b>Spectral sensitivity</b>	320 - 1100 nm (B470/G540/R630 nm)	320 - 1100 nm
<b>Sensitivity</b>	0.000029 lux at 20 min.	0.0000017 lux at 20 min.
<b>Dynamic Slow Scan Modus</b>	> 63 dB > 66 dB (switchable on/off, fps 25%)	> 63 dB > 66 dB (switchable on/off, fps 25%)
<b>System</b>	12 bit	12 bit
<b>Frame rate</b>	up to 15 fps, max. 62 fps (depending on interface)	up to 15 fps, max. 62 fps (depending on interface)
<b>Interfaces</b>	CameraLink, FireWire, Gigabit Ethernet	CameraLink, FireWire, Gigabit Ethernet
<b>Exposure time</b>	1 µs to 20 min, AE 1 µs to 66 ms	1 µs to 20 min, AE 1 µs to 66 ms
<b>Gain</b>	0 to 18 dB	0 to 18 dB
<b>Signal processing functions</b>	color processing, enhancement, binning, partial scan, gamma, line generator, measurement window, camera diagnostics	binning, partial scan, gamma, line generator, measurement window, camera diagnostics
<b>Synchronization</b>	intern/extern, reset/restart, hardware/software trigger	intern/extern, reset/restart, hardware/software trigger
<b>Lens mount</b>	C-mount	C-mount
<b>Order-no.</b>		
<b>CL</b>	963-1716	953-1716
<b>FW</b>	963-1725	953-1725
<b>GigE</b>	963-1738	953-1738
<b>Equipment / Options</b>	control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3, remodelling electrical signature camera	control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3, remodelling electrical signature camera
<b>Complete system</b>	available	available

We are constantly checking the accuracy of the technical data. We will provide more detailed information on request. Technical data is subject to change without notice.



CMOS  
Cameras  
USB

Kalypso 023-USB is the first CMOS camera series by Kappa. Its strong points are special Kappa features such as rugged design and high signal quality. The operating temperature is between -20°C and +80°C. The 1/3" cameras with global shutters come equipped with an USB 2.0 interface and offer 10-bit digitization depth at a resolution of 752 x 480 pixel (WVGA). With linear sensor characteristics, the cameras achieve more than 55 dB, and in the High Dynamic Range Mode they achieve more than 80 dB. Kalypso is used for industrial and non-industrial image processing applications. Even with dynamic scenes, under difficult light conditions and in rough ambient conditions, Kalypso cameras deliver reliable performance and high image quality. An ultra-compact construction (50 mm diameter and 29 mm width) allows them to be used for machine vision in extremely confined spaces.



**Kalypso 023C-USB  
[Color]**

**Kalypso 023M-USB  
[Mono]**

Highlights	High performance, rugged design	High performance, rugged design
Sensor CMOS	1/3", Aptina MT9V023	1/3", Aptina MT9V023
Pixel (H x V)	752 x 480, effectiv (WVGA)	752 x 480, effectiv (WVGA)
Senitivity	< 5 lux	< 0.1 lux
Dynamic range	> 55 dB, > 80 dB (High Dynamic Range)	> 55 dB, > 80 dB (High Dynamic Range)
System	10 bit	10 bit
Bitdepth	RGB 24 bit (raw 10 bit)	8   10 bit (raw 10 bit)
Frame rate	50 fps	50 fps
Interfaces	USB 2.0	USB 2.0
Exposure time	manual/auto 50 µs to 30 ms	manual/auto 50 µs to 30 ms
Gain control	manual/auto x1 to x4	manual/auto x1 to x4
Pixelclock	24 MHz	24 MHz
Lens mount	C-mount	C-mount
Interface	Standard Mini-USB B socket	Standard Mini-USB B socket
Power supply	5 V DC, 250mA via USB	5 V DC, 250 mA via USB
Temperature	-20°C to +80°C	-20°C to +80°C
Dimensions / Weight	50 mm diameter x 29 mm (incl. C-mount)	50 mm diameter x 29 mm (incl. C-mount)
Order-no.	961-1760	951-1760
Equipment / Options	Control software KCC Kalypso, measurement/archiving software Kappa ImageBase (KIB), USB cable	Control software KCC Kalypso, measurement/archiving software Kappa ImageBase (KIB), USB cable

High Dynamics  
Cameras



With 16-bit signal output and 92 dB SNR, the PS 4 HDR CL camera offers maximum dynamics. It features a high-sensitivity 2/3" CCD sensor, CameraLink interface and megapixel resolution. Thanks to the great dynamic range, image contrast is excellent in extremely bright or dark areas of the image, resulting in perfect pictures of the driver and license plate for traffic imaging applications.



**High dynamics camera  
PS 4 - 285 HDR CL  
[Mono]**

**Fast digital camera  
PS 40 - 285 CL Plus  
[Color]**

**Fast digital camera  
PS 4 - 285 CL Plus  
[Mono]**

Highlights	16 bit output signal	25 fps	25 fps
Sensor Interline Transfer CCD	2/3" progressive scan with micro lenses (Sony ICX285AI, EXview HAD)	2/3" progressive scan with micro lenses (Sony ICX285AQ, EXview HAD)	2/3" progressive scan with micro lenses (Sony ICX285AL, EXview HAD)
Pixel (H x V)	1434 x 1050, total	1434 x 1050, total	1434 x 1050, total
Spectral sensitivity	320 - 1100 nm	320- 1100 nm (B470/G540/R630 nm)	320 - 1100 nm
Sensitivity	0.03 lux at 100 ms	0.35 lux at 100 ms	0.02 lux at 100 ms
Dynamic range	> 92 dB (freeze image)	> 63 dB	> 63 dB
System	16 bit HDR output signal	12 bit	12 bit
Frame rate	15 fps (preview mode)	25 fps	25 fps
Interfaces	CameraLink RS 232 (control/trigger signals)	CameraLink	CameraLink
Exposure time	1 µs to 120 s, AE 1 µs to 66 ms	1 µs to 120 s, AE 1 µs to 66 ms	1 µs to 120 s, AE 1 µs to 66 ms
Gain	0 to 18 dB	0 to 18 dB	0 to 18 dB
Signal processing functions	intern electrical signature (optional), camera diagnostics	color processing, enhancement, binning, partial scan, gamma, line generator, measurement window, camera diagnostics	Binning, partial scan, gamma, line generator, measurement window, camera diagnostics
Synchronization	intern/extern, reset/restart, hardware/software trigger	intern/extern, reset/restart, hardware/software trigger	intern/extern, reset/restart, hardware/software trigger
Lens mount	F-mount	C-mount	C-mount
Power supply	12 V DC, 3 W	9 - 36 V DC, 3.2 W	9 -36 V DC, 2.6 W
Temperature	-20°C to +60°C	-20°C to +60°C	-20°C to +60°C
Dimensions	100 x 80 x 80 mm	60 x 60 x 47 mm; 235 g	60 x 60 x 47 mm; 235 g
Order-no.	953-1730	963-1710+	963-1710+
Equipment / Options	Vison Box/Embedded (PC independend) internal electrical signature communication ICD software development tool AFS2	Control software Kappa Camera Control (KCC), measurement/archiving software, Kappa ImageBase (KIB), software development kit SDK3	Control software Kappa Camera Control (KCC), measurement/archiving software Kappa ImageBase (KIB), software development kit SDK3
Complete system	DX 4 - 285 HDR CL: camera, CL grabber, CL cable, power supply cable, power supply, KCC software	DX 40 - 285 CL Plus: camera, CL grabber, CL cable, power supply cable, power supply, KCC software	DX 4 - 285 CL Plus: camera, CL grabber, CL cable, power supply cable, power supply, KCC software

We are constantly checking the accuracy of the technical data. We will provide more detailed information on request. Technical data is subject to change without notice.

## Digital X-Ray Camera Module

The HiRes2-XR(S) x-ray camera module can be adapted to all x-ray amplifiers. Low background noise, better sensitivity, bigger gain, 20 percent more contrast transmittance, no defective pixels and integrated lens control are the most important features of this camera. The HiRes2-XR(S) offers megapixel resolution, real-time operation, digital outputs (Camera Link, RS 422, RS 644) and various image processing functions like blanking, anti-shading, fine adjustment of image sharpness and recursive filters, to name but a few.



	HiRes2-XR	HiRes2-XRS
<b>Highlights</b>	X-Ray imaging functionalities	X-Ray imaging functionalities, image memory
<b>Sensor interline transfer CCD</b>	2/3" progressive scan with micro lenses (Kodak KAI 1020 M)	2/3" progressive scan with micro lenses (Kodak KAI 1020 M)
<b>Pixel (H x V)</b>	1000 x 1000, effective	1000 x 1000, effective
<b>Quantum efficiency</b>	max. 42% at 490 nm	max. 42% at 490 nm
<b>Dynamic range</b>	> 61 dB	> 61 dB
<b>System</b>	12 bit	12 bit
<b>Frame rate</b>	30 Fps	30 Fps
<b>Interfaces</b>	Video output: Camera Link, 12 bit parallel RS 644/RS422 Control: RS 232, digital I/Os Optocoupler and TTL	Video output: Camera Link, 12 bit parallel RS 644/RS422 Control: RS 232, digital I/Os Optocoupler and TTL
<b>Exposure time</b>	AE 10 µs to 33 ms	AE 10 µs to 33 ms
<b>Signal processing functions</b>	Shading correction, circular blanking, gamma, edge enhancement, negativ image, defectiv pixel compensation, image indentation / redout asynchron	like HiRes-XR, additionally image memory, recursive filter (factor 2, 4, 8, 16), image flip, image subtraction
<b>Sensor position</b>	+/- 5 pixel	+/- 5 pixel
<b>Lens mount</b>	C-mount	C-mount
<b>Power supply</b>	12 - 32 V DC, 4 W	12 - 32 V DC, 4 W
<b>Temperature</b>	-20°C to +60°C	-20°C to +60°C
<b>Order -no.</b>	951-1095	951-1199
<b>Equipment / Options</b>	PC control software AFS	PC control software AFS

## Star Sensor

Star Tracker is an inexpensive, lightweight modular solution for position measurement in space, especially developed for nano-satellites. In order to upgrade Star Tracker into an autonomous star sensor system the following equipment is required.\*

- ❑ Identification and correction of defective pixels on the CCD sensor
- ❑ Determination of X/Y coordinates of all stars with pixel accuracy
- ❑ Determination of apparent magnitude of all stars with 12-bit accuracy
- ❑ 6m marginal magnitude if used with a f/1.6 lens
- ❑ List display of 30 brightest stars with 10hz



	Star Tracker
<b>Highlights</b>	Algorithm to detect stars
<b>Sensor Interline Transfer CCD</b>	2/3" progressive scan with micro lenses (Sony ICX285AL, EXview HAD)
<b>Frame rate</b>	10 fps
<b>Interfaces</b>	RS 232 (control/triger signales, datas)
<b>Exposure time</b>	100 ms
<b>Gain</b>	0 to 18 dB
<b>Signal processing functions</b>	algorithm to detect stars
<b>Output</b>	position of the 30 brightest stars in the image
<b>Synchronization</b>	intern
<b>Lens mount</b>	C-mount
<b>Power supply</b>	9 - 36 V DC, 2.6 W
<b>Temperature</b>	-20°C to +60°C
<b>Dimensions / Weight</b>	60 x 60 x 47 mm; 235 g
<b>Order-no.</b>	953-1743
<b>* Aerospace equipment for the star sensor system (Institute for Aerospace Electronics, IRE)</b>	lens, lens screen, processing electronics

We are constantly checking the accuracy of the technical data. We will provide more detailed information on request. Technical data is subject to change without notice.





## Video Cameras

Video at its most advanced. The video format is still going strong, as Kappa demonstrates with its various performance-optimized rugged design video cameras. This series consists of high-quality, low-noise, high-sensitivity CCD video cameras (PAL and NTSC) with up to 12-bit digital signal processing, which come in various shapes and sizes: low-light level versions, color cameras with image memory, histogram equalization, double-exposure mode, camera-internal Kappa color processing – with a range of functions contingent on price, adaptable to your needs and budget – and remote/split head versions.

## Rugged Video Cameras

Color



SDC312C cameras are fitted with 1/2" CCD sensors with a resolution of 752 x 582 pixels. As an option, the sensors are also available with enhanced sensitivity in the near-infrared (NIR) range of the light spectrum. The cameras feature full video resolution, 12-bit digital signal processing and comprehensive signal processing functions such as Automatic Contrast Control (ACC/DRE) and histogram equalization. The line generator function offers fully adjustable reticles.



This camera is fitted with 1/6" CCD sensors with a resolution of either 752 x 582 pixels (PAL) or 768 x 494 pixels (NTSC), and features full video resolution, 12-bit digital signal processing and comprehensive signal processing functions such as Automatic Contrast Control (ACC/DRE) and histogram equalization. The line generator function offers fully adjustable reticles. An integrated image memory provides further signal processing functions like digital zoom or double exposure mode for dynamic range enhancement. The range of available interfaces encompasses composite video (CVBS), S-video (Y/C) and digital (SMPTE 259M).

### Argon SDC 312C

Highlight	Rugged video camera, upgradable, SMPRT-259M (SDI)	Argon SDC 516C	Rugged split head video camera, SMPTE-259M (SDI), integrated image memory
<b>Video Standard</b>	PAL/NTSC		PAL/NTSC
<b>Sensor interline transfer CCD</b>	1/2" NIR CCD		1/6" CCD
<b>Pixel (H x V)</b>	752 x 582 (PAL) 768 x 494 (NTSC)		752 x 582 (PAL) 768 x 494 (NTSC)
<b>Sensitivity</b>	0.2 lux at 14 dB 0.05 lux at max. gain (High Sensitivity Mode 0,0125 lux at max. gain)		1.2 lux at 14 dB 0.3 lux at max. gain
<b>Dynamic range</b>	> 50 dB		> 50 dB
<b>System</b>	FPGA: 12 bit Controller 32 bit ARM7TDMI		FPGA: 12 bit Controller 32 bit ARM7TDMI
<b>Resolution</b>	440 lines (horizontal)		440 lines (horizontal)
<b>Signal output / Interfaces</b>	S-Video (Y/C), Video (FBAS), SMPTE-259M (SDI)		S-Video (Y/C), Video (composite), SMPTE-259M (SDI)
<b>Exposure time</b>	1/50s (PAL), 1/60s (NTSC) to 1/100 000s		1/50s (PAL), 1/60s (NTSC) to 1/100 000s
<b>Gain</b>	0 to 26 dB		0 to 26 dB
<b>Adjustments</b>	RS 232 (RS 422/485 available on request): AIT, AGC, gamma, white set, measurement window, automatic contrast control (ACC/DRE), edge enhancement, line generator, built-in test		RS 232 (RS 422/485 available on request): AIT, AGC, gamma, white set, measurement window, automatic contrast control (ACC/DRE), edge enhancement, line generator, doppel exposure, digital zoom, built-in test
<b>Firmware update</b>	FPGA Firmware Microcontroller Software		FPGA Firmware Microcontroller Software
<b>Integrated image memory</b>	--		doppel exposure mode electrical zoom
<b>Synchronization</b>	intern/extern (composite sync.)		intern/extern (composite sync.)
<b>Lens mount</b>	C-Mount		C-Mount
<b>Power supply</b>	9 - 36 V DC, > 3 W		9 - 36 V DC, < 4 W
<b>Temperature</b>	-20°C to +60°C		-30°C to +70°C
<b>Dimensions / Weight</b>	55 x 55 x 71 mm (without connectors), 310 g		25 x 48 x 120 mm (control board without connectors), 24 x 31 x 26 mm (sensor board without C-mount), distance til 300 mm, 250 g
<b>Order-no.</b>	963-3120 (PAL) 963-3120N (NTSC)		
<b>Equipment / Options</b>	PC Software camera controll KDC-A, USB connection		PC Software camera controll KDC-A, USB connection

## Rugged Video Cameras

Color



Our CCD color cameras with digital signal processing are a family of compact cameras for industrial applications. Complicated extras were deliberately excluded from the design. All signal processing functions are automated. White set can be performed with a switch on the camera. These cameras are equipped with 1/2", 1/3" or 1/4" CCD sensors and offer full video resolution at 752 x 582 pixels (PAL) or 768 x 494 pixels (NTSC). Equipped with a C-Mount and a single cable connection, this all-around camera can be used in endoscopy, macroscopy and microscopy. A 10-pin Hirose connector supplies variable voltage of 9-36 V DC (3 W). The design is small, light and extremely rugged.

### CF 112

### CF 113

### CF 114

Highlight	Rugged video camera	Rugged video camera	Rugged video camera
<b>Video standard</b>	PAL/NTSC	PAL/NTSC	PAL/NTSC
<b>Sensor interline transfer CCD</b>	1/2" CCD with complementary color filter	1/3" HAD CCD with complementary color filter	1/4" CCD with complementary color filter
<b>Pixel (H x V)</b>	752 x 582 (PAL) 768 x 494 (NTSC)	752 x 582 (PAL) 768 x 494 (NTSC)	752 x 582 (PAL) 768 x 494 (NTSC)
<b>Spectral sensitivity</b>	380 to 780 nm	380 to 780 nm	380 to 780 nm
<b>Sensitivity</b>	0.12 lux at 14 dB 0.03 lux at max. gain	0.17 lux at 14 dB 0.04 lux at max. gain	0.36 lux at 14 dB 0.09 lux at max. gain
<b>Dynamic range</b>	> 48 dB	> 48 dB	> 48 dB
<b>System</b>	8 bit	8 bit	8 bit
<b>Resolution</b>	480 lines (horizontal)	480 lines (horizontal)	480 lines (horizontal)
<b>Signal output / Interfaces</b>	S-Video (Y/C), Video (composite)	S-Video (Y/C), Video (composite)	S-Video (Y/C), Video (composite)
<b>Exposure time</b>	1/50s (PAL), 1/60s (NTSC) to 1/100 000 s auto (AIT)	1/50s (PAL), 1/60s (NTSC) to 1/100 000 s auto (AIT)	1/50s (PAL), 1/60s (NTSC) to 1/100 000s auto (AIT)
<b>Gain</b>	0 to 14 dB (AGC), 0 to 26 dB (RS 232 adjustable)	0 to 14 dB (AGC), 0 to 26 dB (RS 232 adjustable)	0 to 14 dB (AGC), 0 to 26 dB (RS 232 adjustable)
<b>Synchronization</b>	intern	intern	intern
<b>Lens mount</b>	C-mount	C-mount	C-mount
<b>Vibration (20Hz to 2KHz)</b>	random 7.5g rms	random 7.5g rms	random 7.5g rms
<b>Shock</b>	100g (0.5ms halfsine)	100g (0.5ms halfsine)	100g (0.5ms halfsine)
<b>Power supply</b>	9 - 36 V DC, 3 W	9 - 36 V DC, 3 W	9 - 36 V DC, 3 W
<b>Temperature</b>	-20°C to +45°C	-20°C to +45°C	-20°C to +45°C
<b>Dimensions / Weight</b>	32 mm diameter x 70 mm, approx. 87 g	32 mm diameter x 70 mm, approx. 87 g	32 mm diameter x 70 mm, approx. 87 g
<b>Order-no.</b>	961-1110 PAL 961-1111 N (NTSC)	961-1111 (PAL) 961-1111 N (NTSC)	961-1112 (PAL) 961-1112 N (NTSC)
<b>Equipment/Options</b>	USB connection	USB connection	USB connection

We are constantly checking the accuracy of the technical data. We will provide more detailed information on request. Technical data is subject to change without notice.



## Rugged Video Cameras Color

The cameras of this rugged video color camera family are equipped with 1/2", 1/3" or 1/4" CCD sensors and offer full video resolution at 752 x 582 pixel (PAL) or 768 x 494 pixel (NTSC). 10 bit digital signal processing and a signal-to-noise ratio of 50 dB are the main characteristics of these cameras. Due to their Super HAD sensors and maximum gain the sensitivity is exceptionally high (optionally the cameras can be fitted with EX-view HAD Sensor). The 15pin Kappa CSI plug supplies variable voltage of 9-36 V DC (3 W). The housing design is extremely rugged. The camera is pressure, vibration and temperature resistant. The exceptional image signal quality and the rugged characteristics are the reasons for the camera family's great success in aviation applications. In customer specific guises, for example specific system designs with outboard-deicing housing or with wide angle optics [130° „FOV“ Field of View], they have proved a perfect match for the use in aircraft at maximum altitudes.



	CF 142	CF 143	CF 144
<b>Highlight</b>	1/2" Rugged video camera	1/3" Rugged video camera	1/4" Rugged video camera
<b>Video standard</b>	PAL/NTSC	PAL/NTSC	PAL/NTSC
<b>Sensor interline transfer CCD</b>	1/2" CCD with complementary color filter	1/3" HAD CCD with complementary color filter	1/4" CCD with complementary color filter
<b>Pixel (H x V)</b>	752 x 582 (PAL) 768 x 494 (NTSC)	752 x 582 (PAL) 768 x 494 (NTSC)	752 x 582 (PAL) 768 x 494 (NTSC)
<b>Spectral sensitivity</b>	380 to 780 nm	380 to 780 nm	380 to 780 nm
<b>Sensitivity</b>	0.12 lux at 14 dB 0.03 lux at max. gain	0.17 lux at 14 dB 0.04 lux at max. gain	0.36 lux at 14 dB 0.09 lux at max. gain
<b>Dynamic range</b>	> 50 dB	> 50 dB	> 50 dB
<b>System</b>	10 bit	10 bit	10 bit
<b>Resolution</b>	480 lines (horizontal)	480 lines (horizontal)	480 lines (horizontal)
<b>Signal output / Interfaces</b>	S-Video (Y/C), Video (composite)	S-Video (Y/C), Video (composite)	S-Video (Y/C), Video (composite)
<b>Exposure time</b>	1/50s (PAL), 1/60s (NTSC) to 1/100 000 s auto (AIT)	1/50s (PAL), 1/60s (NTSC) to 1/100 000 s auto (AIT)	1/50s (PAL), 1/60s (NTSC) to 1/100 000 s auto (AIT)
<b>Gain</b>	0 to 14 dB (AGC), 0 to 26 dB (RS 232 adjustable)	0 to 14 dB (AGC), 0 to 26 dB (RS 232 adjustable)	0 to 14 dB (AGC), 0 to 26 dB (RS 232 adjustable)
<b>Adjustments by RS 232</b>	Exposure time, gain, AIT, AGC, gamma, white-ste, backlight compensation	Exposure time, gain, AIT, AGC, gamma, white-ste, backlight compensation	Exposure time, gain, AIT, AGC, gamma, white-set, backlight compensation
<b>Switch</b>	AIT on/off, AGC on/off, white-set set/lock	AIT on/off, AGC on/off, white-set set/lock	AIT on/off, AGC on/off, white-set set/lock
<b>Synchronization</b>	intern	intern	intern
<b>Lens mount</b>	C-mount	C-mount	C-mount
<b>Vibration (20Hz to 2KHz)</b>	random 7.5g rms	random 7.5g rms	random 7.5g rms
<b>Shock</b>	100g (0.5ms halfsine)	100g (0.5ms halfsine)	100g (0.5ms halfsine)
<b>Power supply</b>	9 - 36 V DC, 3 W	9 - 36 V DC, 3 W	9 - 36 V DC, 3 W
<b>Temperature</b>	-20°C to +60°C	-20°C to +60°C	-20°C to +60°C
<b>Dimensions / Weight</b>	50 x 40 x 77 mm, 200g	50 x 40 x 77 mm, 200g	50 x 40 x 77 mm, 200g
<b>Order-no.</b>	961-1400 (PAL) 961-1400 N (NTSC)	961-1401 (PAL) 961-1401 N (NTSC)	961-1402 (PAL) 961-1402 N (NTSC)
<b>Equipment/Options</b>	USB Connection	USB Connection	USB Connection

## Micro Camera Family Color

The micro camera family by Kappa combines high-quality signal processing with miniaturized design and various sensor sizes (miniaturized remote heads fitted with either a 1/6", 1/4", 1/3" or 1/2" CCD sensor). The micro cameras are available as a complete system with control unit (CVR multi-purpose or CVR micro), camera head including camera cable (CH) and power supply. Battery operation is also possible. The camera cable has a length of up to 30 m. The micro cameras are designed for various tasks. Typical applications are industrial endoscopy and minimally invasive surgery with fixed or flexible endoscopes. Their small and light design also makes them suitable for applications in the area of robotics, assembly- and mounting devices or manipulators.



	CVR multi-purpose	CVR multi-purpose	CVR multi-purpose	CVR multi-purpose
<b>Highlight</b>	1/6" Remote camera head	1/4" Remote camera head	1/3" Remote camera head	1/2" Remote camera head
<b>Video standard</b>	PAL/NTSC	PAL/NTSC	PAL/NTSC	PAL/NTSC
<b>Sensor interline transfer CCD</b>	1/6" CCD with complementary color filter	1/4" CCD with complementary color filter	1/3" HAD CCD with complementary color filter	1/2" CCD with complementary color filter
<b>Pixel (H x V)</b>	752 x 582 (PAL) 768 x 494 (NTSC)	752 x 582 (PAL) 768 x 494 (NTSC)	752 x 582 (PAL) 768 x 494 (NTSC)	752 x 582 (PAL) 768 x 494 (NTSC)
<b>Spectral sensitivity</b>	380 to 780 nm	380 to 780 nm	380 to 780 nm	380 to 780 nm
<b>Sensitivity</b>	2.67 lux at 0 dB 0.53 lux at 14 dB	1.82 lux at 0 dB 0.36 lux at 14 dB	0.84 lux at 0 dB 0.17 lux at 14 dB	0.62 lux at 0 dB 0.12 lux at 14 dB
<b>Dynamic range</b>	> 50 dB	> 50 dB	> 50 dB	> 50 dB
<b>System</b>	10 bit	10 bit	10 bit	10 bit
<b>Resolution</b>	480 lines (horizontal)	480 lines (horizontal)	480 lines (horizontal)	480 lines (horizontal)
<b>Signal output / Interfaces</b>	S-Video (Y/C), Video (composite) optional two outputs	S-Video (Y/C), Video (composite) optional two outputs	S-Video (Y/C), Video (composite) optional two outputs	S-Video (Y/C), Video (composite) optional two outputs
<b>Exposure time</b>	1/50s (PAL), 1/60s (NTSC) to 1/100 000 s auto (AIT)	1/50s (PAL), 1/60s (NTSC) to 1/100 000 s auto (AIT)	1/50s (PAL), 1/60s (NTSC) to 1/100 000 s auto (AIT)	1/50s (PAL), 1/60s (NTSC) to 1/100 000 s auto (AIT)
<b>Gain</b>	0 to 14 dB (AGC), 0 dB fixed	0 to 14 dB (AGC), 0 dB fixed	0 to 14 dB (AGC), 0 dB fixed	0 to 14 dB (AGC), 0 dB fixed
<b>Gamma</b>	0.45 / 1	0.45 / 1	0.45 / 1	0.45 / 1
<b>Edge Enhancement</b>	low / high	low / high	low / high	low / high
<b>White set</b>	set / lock	set / lock	set / lock	set / lock
<b>Adjustments</b>	RS 232 or control unit (multi-purpse): AIT, AGC, gamma, edge enhancement, backlight compensation, exposure time, measurement window	RS 232 or control unit (multi-purpse): AIT, AGC, gamma, edge enhancement, backlight compensation, exposure time, measurement window	RS 232 or control unit (multi-purpse): AIT, AGC, gamma, edge enhancement, backlight compensation, exposure time, measurement window	RS 232 or control unit (multi-purpse): AIT, AGC, gamma, edge enhancement, backlight compensation, exposure time, measurement window
<b>Synchronization</b>	intern/extern	intern/extern	intern/extern	intern/extern
<b>Lens mount</b>	--	1/4" x 48 UNS	C-mount	C-mount
<b>Power supply</b>	9 - 36 V DC, > 5 W	9 - 36 V DC, > 5 W	9 - 36 V DC, > 5 W	9 - 36 V DC, > 5 W
<b>Temperature</b>	-10°C to +45°C	-10°C to +45°C	-10°C to +45°C	-10°C to +45°C
<b>Dimensions / Weight control unit multi-purpose</b>	125 x 57 x 35 mm, approx. 200 g	125 x 57 x 35 mm, approx. 200 g	125 x 57 x 35 mm, approx. 200 g	125 x 57 x 35 mm, approx. 200 g
<b>Dimensions camera head</b>	1 x 30 mm, approx. 12 g	10 x 50 mm, approx. 20 g	23 x 39 mm, 50 g	29 x 53 mm, approx. 60 g
<b>Order-no.</b>	962-5004 (PAL) 962-5004 N (NTSC)	962-5003 (PAL) 962-5003 N (NTSC)	962-5002 (PAL) 962-50002 N (NTSC)	962-5000 (PAL) 962-5000 N (NTSC)
<b>Equipment/Options</b>	Software for serial control (RS 232), battery operation, measure/archiving software Kappa ImageBase (KIB), control unit CVR-micro (basic functions), USB connection	Software for serial control (RS 232), battery operation, measure/archiving software Kappa ImageBase (KIB), control unit CVR-micro (basic functions), USB connection	Software for serial control (RS 232), battery operation, measure/archiving software Kappa ImageBase (KIB), control unit CVR-micro (basic functions), USB connection	Software for serial control (RS 232), battery operation, measure/archiving software Kappa ImageBase (KIB), control unit CVR-micro (basic functions), USB connection

We are constantly checking the accuracy of the technical data. We will provide more detailed information on request. Technical data is subject to change without notice.

## MultiFocal Camera

Color

MultiFocal SDI-Camera: Three cameras in one!

The MultiFocal camera is the epitome of multitasking: one camera provides the performance of three high-quality cameras. Three high-quality color sensors (2x 1/3", 1x 1/4") with three different lenses (tele, medium and wide angle) are operated by one set of camera electronics. Sensor switching and camera control is performed via PC and RS 485. Compared to systems with mechanical zoom lenses, the camera is an extremely shock-proof and space-saving system solution with short switching times. But there is more to this camera than just performance; even the price is convincing since only one set of camera electronics is needed and due to the lack of a pricy zoom lens. The MultiFocal camera is based on a new video technology platform with SDI output (additionally, composite video and Y/C output).

The very robust camera is used especially for outdoor surveillance and protection of property. The heated front window assures a clear view even at altitudes of up to 15 km (approx. 50,000 feet). The horizontal angle of vision of the camera ranges from approx. 9 to 72°. The lenses can be adapted to customer requirements.



### MultiFocal SDI-Camera

<b>Highlight</b>	Three cameras in one, SMPTE-259M (SDI)
<b>Video standard</b>	PAL/NTSC
<b>Sensor interline transfer CCD</b>	2x 1/3" CCD and 1x 1/4" CCD with complementary color filter and IR - filter
<b>Pixel (H x V)</b>	752 x 582
<b>Dynamic range</b>	> 50 dB
<b>System</b>	10 bit
<b>Resolution</b>	480 lines (horizontal)
<b>Signal putput / Interfaces</b>	S-Video (Y/C), Video (composite), SMPTE-259M (SDI)
<b>Exposure time</b>	1/50s (PAL) to 1/100 000 s auto (AIT) adjustable via RS 485
<b>Gain</b>	0 to 14 dB (AGC), 0 to 27 dB (adjustable via RS 485)
<b>Gamma</b>	0.37 - 1 (adjustable RS 485)
<b>Measurement window (AIT/AGC)</b>	integral/spot (adjustable RS 485)
<b>Edge enhancement</b>	Low, high (adjustable RS 485)
<b>White set</b>	Auto, push, lock, manual, 3200 K and 5600 K (adjustable RS 485)
<b>RS 485</b>	Half-Duplex
<b>Power supply</b>	12 V DC, 5 W
<b>Temperature</b>	-55°C to +70°C
<b>Dimensions</b>	Ø 60 x 90 mm
<b>Order-no.</b>	961-5203 (PAL), 961-5203N (NTSC)
<b>Equipment / Options</b>	USB Connection

## Rugged Video Cameras

Monochrome

SDC312M cameras are fitted with 1/2" CCD sensors with a resolution of either 752 x 582 pixels (PAL) or 768 x 494 pixels (NTSC). As an option, the sensors are also available with enhanced sensitivity in the near-infrared (NIR) range of the spectrum.

The cameras feature full video resolution, 12-bit digital signal processing and comprehensive signal processing functions such as Automatic Contrast Control (ACC/DRE) and histogram equalization. The line generator function offers fully adjustable reticles.



### Argon SDC 312M

<b>Highlight</b>	Rugged video camera, upgradable, SMPTE-259M (SDI)	<b>CF 8/5 MX</b>	Rugged video camera
<b>Video standard</b>	CCIR/EIA		CCIR/EIA
<b>Sensor interline transfer CCD</b>	1/2" NIR CCD		1/2" CCD
<b>Pixel (H x V)</b>	752 x 582 (CCIR) 768 x 494 (EIA)		752 x 582 (CCIR) 768 x 494 (EIA)
<b>Sensitivity</b>	0.05 lux at 14 dB 0.0125 lux at max. gain (High Sensitivity Mode 0,003 lux at max. gain)		0.06 lux at 14 dB 0.015 lux at max. gain
<b>Dynamic range</b>	> 58 dB		> 58 dB
<b>System</b>	FPGA: 12 bit Controller 32 bit ARM7TDMI		12 bit
<b>Resolution</b>	700 lines (horizontal)		740 (CCIR) / 750 lines (EIA) (horizontal)
<b>Signal output / Interfaces</b>	composite video SMPTE-259M (SDI)		composite video
<b>Exposure time</b>	1/50s (CCIR), 1/60s (EIA) to 1/100 000s		1/50s (CCIR), 1/60s (EIA) to 1/100 000 s auto (AIT)
<b>Gain</b>	0 to 26 dB		0 to 26 dB
<b>Adjustments</b>	RS 232 (RS 422/485 aviability on request): AIT, AGC, gamma, measurement window, automatically contrast control (ACC/DRE), edges enhancement, line generator, built-in test		RS 232: AIT, AGC, gamma, measurement window, backlight compensation, automatically contrast control (DRE/ACC), line generator
<b>Firmware update</b>	FPGA Firmware Microcontroller Software		
<b>Synchronization</b>	intern/extern (composite sync)		intern/extern (composite sync.)
<b>Lens mount</b>	C-mount		C-mount
<b>Power supply</b>	9 - 36 V DC, < 3 W		9 - 36 V DC, 2 W
<b>Temperature</b>	-20°C to +60°C		-20°C to +60°C
<b>Dimensions / weight</b>	55 x 55 x 69 mm (without connector assembly) , 310 g		67 x 50 x 40 mm, approx. 170g
<b>Order-no.</b>	953-3120 (CCIR) 953-3120N (EIA)		951-1114 (CCIR) 951-1114 (EIA)
<b>Equipment/options</b>	PC camera controlling software KDC-A, USB connection		camera controlling software (KDC-A), measuring and archiving software Kappa ImageBase (KIB), control unit / PC independend (MXC 200), stand plate, USB connection

The main features of the black-and-white video camera CF 8/5 MX are its rugged design with 12-bit signal processing, its signal-to-noise ratio of more than 58 dB and its manifold signal processing functions. Numerous functions are available via RS 232: Fine adjustment of AIT, AGC, Gamma, horizontal image mirror and selectable measuring windows. Automatic Contrast Control (ACC/DRE) and integrated line generator top off the functions. With the Reset/Restart function the camera can be synchronized to external events.

Self tests for operating temperature, working voltage and test pattern generator assure a controlled operation.



We are constantly checking the accuracy of the technical data. We will provide more detailed information on request. Technical data is subject to change without notice.



## Rugged Video Cameras III Monochrome

The 12-bit black-and-white camera CF 8 HS needs virtually no light, such is its sensitivity. Utilizing a high-sensitivity sensor in combination with intelligent low-noise circuits raises sensitivity by some 400 %, making the CF 8 HS the perfect solution for the surveillance of objects, rooms and scenes where there is little or no illumination at all. The camera is also ideal for sophisticated CCTV setups, long-range observation tasks and low light applications. Its range of function includes automatic iris control, which allows 24-hour operation in any lighting conditions – day or night – and automatic contrast control (DRE/ACC). The CF 8 HS avoids image streaking, blurring and high noise. It excels even in areas where usually residual light amplifiers are used.



**CF 8 HS**

**CF 8 HSX**



**NVS**

The NVS is a professional high-end camera system that features 12 bit digital signal processing, high resolution, excellent signal-to-noise ratio and extremely high sensitivity. The system is designed for sophisticated surveillance tasks and as an optical aid (for general orientation or while reversing) in vehicles for special purposes such as hazardous materials transporters or ambulances. Designed as a system, the NVS comes with an automatically controlled lens, enabling it to operate around the clock, in pitch darkness as well as in bright sunlight. The integrated infrared LED ring light uses non-visible light waves (940 nm, zero lux) and makes for impressive images without drawing attention.

Highlight	Low light level rugged video camera	Low light level rugged video camera with iris control	Night vision system
<b>Video standard</b>	CCIR/EIA	CCIR/EIA	CCIR/EIA
<b>Sensor interline transfer CCD</b>	1/2" NIR CCD	1/2" NIR CCD	1/2" NIR CCD
<b>Pixel (H x V)</b>	752 x 582 (CCIR) 768 x 494 (EIA)	752 x 582 (CCIR) 768 x 494 (EIA)	752 x 582 (CCIR) 768 x 494 (EIA)
<b>Sensitivity</b>	0.025 lux at 14 dB 0.00625 lux at max. gain (High Sensitivity Mode 0.00312 lux at max. gain)	0.025 lux at 14 dB 0.00625 lux at max. gain (High Sensitivity Mode 0.00312 lux at max. gain)	0 lux at max. gain and IR illumination
<b>Dynamic range</b>	> 58 dB	> 58 dB	> 58 dB
<b>System</b>	12 bit	12 bit	12 bit
<b>Resolution</b>	740 (CCIR) / 750 (EIA) lines (horizontal)	740 (CCIR) / 750 lines (EIA) (horizontal)	740 (CCIR) / 750 lines (EIA) (horizontal)
<b>Signal output / Interfaces</b>	composite video	composite video	composite video
<b>Exposure time</b>	1/50s (CCIR), 1/60s (EIA) to 1/100 000 s auto (AIT)	1/50s (CCIR), 1/60s (EIA) to 1/100 000 s auto (AIT)	1/50s (CCIR), 1/60s (EIA) to 1/100 000 s auto (AIT)
<b>Gain</b>	0 to 26 dB	0 to 26 dB	0 to 26 dB
<b>Adjustments</b>	RS 232: exposure time, gain, AIT, AGC, gamma, measurement window, automatically contrast control (DRE/ACC), line generator	RS 232: exposure time, gain, AIT, AGC, gamma, measurement window, automatically contrast control (DRE/ACC), line generator	RS 232: exposure time, gain, AIT, AGC, gamma, measurement window, automatically contrast control (DRE/ACC), line generator
<b>Synchronization</b>	intern, extern (composite sync.)	intern, extern (composite sync.)	intern
<b>Lens mount</b>	C-mount	C-mount, iris control	lens-focal length 12mm, (IR optimized), 30° horizontal optic angle, auto iris control, switchable LED's (940 nm)
<b>Power supply</b>	9 - 36 V DC, 2 W	9 - 36 V DC, 2 W	10 - 36 V DC, 5 W
<b>Temperature</b>	-20°C to +60°C	-20°C to +60°C	-20°C to +60°C
<b>Dimensions / weight</b>	67 x 50 x 40 mm, ca. 170g	67 x 50 x 40 mm, ca. 170g	Ø 66 x 128 mm, ca. 690g
<b>Order-no.</b>	951-1153 (CCIR) 951-1153N (EIA)	951-1156 (CCIR) 951-1156N (EIA)	951-1140 (CCIR) 951-1140 N (EIA)
<b>Equipment / Options</b>	Camera control software (KDC-A), measuring and archiving software Kappa Image Base (KIB), control unit / PC independent operation (MXC 200) stand plate, USB connection	Camera control software (KDC-A), measuring and archiving software Kappa Image Base (KIB), control unit / PC independent operation (MXC 200) stand plate, USB connection	Camera control software (KDC-A), measuring and archiving software Kappa Image Base (KIB), control unit / PC independent operation (MXC 200) stand plate, USB connection

The Video XR(S) x-ray camera module can be adapted to all x-ray amplifiers. Low background noise, better sensitivity, bigger gain, 20 percent more contrast transmittance, no defective pixels and integrated lens control are the most important features of this camera. The Video XR(S) is a video version with maximum gray scale performance (12-bit DSP) and a multitude of image processing functions. With integrated self test function and remote maintenance via software, the camera is upgradable and parameterizable.



**Video-XR**

**Video-XRS**

Highlight	X-ray imaging functions	X-ray imaging functions, image memory
<b>Video standard</b>	CCIR/EIA	CCIR/EIA
<b>Sensor CCD</b>	1/2" CCD (position accuracy +/- 5 pixel)	1/2" CCD (position accuracy +/- 5 pixel)
<b>Pixel (H x V)</b>	752 x 582 (CCIR), 768 x 494 (EIA)	752 x 582 (CCIR), 768 x 494 (EIA)
<b>Dynamic range</b>	> 60 dB	> 60 dB
<b>System</b>	12 bit	12 bit
<b>Signal output/Interfaces</b>	composite video	composite video
<b>Frame rate</b>	25 fps (CCIR), 30 fps (EIA)	25 fps (CCIR), 30 fps (EIA)
<b>Gain</b>	0 to 18 dB (AGC), 0 to 26 dB (adjustable RS 232)	0 to 18 dB (AGC), 0 to 26 dB (adjustable RS 232)
<b>Adjustments</b>	RS 232 (digital I/Os via optocoupler and TTL): shading correction, circular blanding, gamma correction, line generator, defect pixel compensation	RS 232 (digital I/Os via optocoupler and TTL): shading correction, circular blanding, gamma, line generator, defect pixel correction, image memory, image flip, recursive filter, edges enhancement, negativ image, gamma correction
<b>Synchronization</b>	Pulsed mode (synchronized with X-ray generator)	Pulsed Mode (synchronisiert with X-ray generator)
<b>Lens mount</b>	C-mount	C-mount
<b>Power supply</b>	18 - 32 V DC, 3 W	18 - 32 V DC, 3 W
<b>Temperature</b>	-20°C to +60°C	-20°C to +60°C
<b>Dimensions</b>	150 x 42 (D x H)	150 x 42 (D x H)
<b>Order-no.</b>	951-1102 (CCIR), 951-1102N (EIA)	951-1103 (CCIR), 951-1103N (EIA)
<b>Zubehör / Optionen</b>	PC control software AFS, USB connection	PC control software AFS, USB connection

## X-Ray Camera Module Monochrome III



Kappa offers a control unit for PC-independent operation of the digital video cameras with RS 232 interface. All camera functions can be operated by remote control and saved in the camera and in the control unit as a user adjustment. The MXC is a "must-have" wherever video cameras are installed in locations that are not easily accessible, as is often the case in industrial QA inspections.

**MXC 200**

Highlight	PC independent operation
<b>Type</b>	RS 232 control unit for Kappa video cameras
<b>Power supply</b>	9 - 36 V DC, < 2 W
<b>Connectors</b>	Power supply, video out, Kappa system connector
<b>Dimension / weight</b>	164 x 106 x 32 mm, 435g
<b>Order-no.</b>	953-1115
<b>Equipment</b>	Power supply unit

The video processing unit VC 300 works with all established video cameras (b/w, color) and offers numerous additional functions for industrial, scientific and medical applications. It features, among other things, automatic contrast control (ACC/DRE), measurement reticles that can be freely positioned, seven-stage edge enhancement, horizontal image mirror and image inversion. The VC 300 can be controlled via keyboard or via PC using the RS 232 interface.

**VC 300**

Highlight	Multi-norm image processing
<b>Type</b>	video-processor
<b>System</b>	12 bit
<b>Dynamic range</b>	> 50 dB
<b>Resolution</b>	720 pixel per line, 10 bit YUV 4:2:2
<b>Automatic contrast control</b>	Offset 0 to 50 %, gain 0 to 18 dB (AAC/DRE)
<b>signal output / input</b>	Y/C (S-VHS), EIA/NTSC and CCIR/PAL (auto detect)
<b>Control</b>	RS 232
<b>Power supply</b>	9 - 36 VDC, < 2 W

We are constantly checking the accuracy of the technical data. We will provide more detailed information on request. Technical data is subject to change without notice.

Kappa offers you a choice of standardized software, but we will also help you program specific software for image processing projects (Kappa Xero) or interfaces if you wish to use our cameras with third-party software.





## Kappa Camera Software

Standardized Software, Development Tools and Customer-specific Programming

The term camera control software may refer to either device software, which is integrated in the camera itself, or PC software, which is software that is used to control the camera via computer and to process image data.

Kappa offers you a choice of standardized software, but we will also help you program specific software for image processing projects (Kappa Xero) or interfaces if you wish to use our cameras with third-party software.

### User Software (PC)

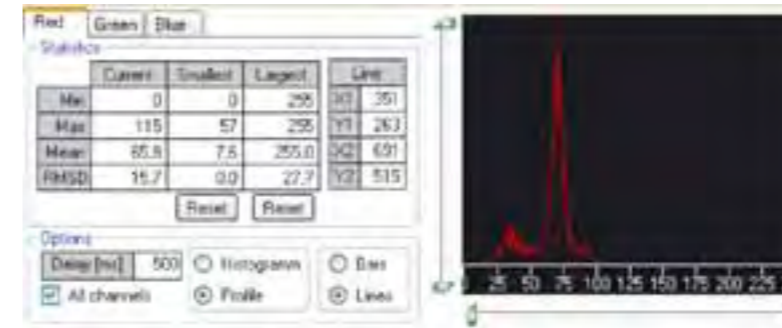
#### Kappa CameraControl (KCC)

Kappa CameraControl (KCC) allows the user to control our digital cameras via PC. It is an integral part of all DX camera systems.



### Parameters that can be set via KCC:

- ☒ Exposure
- ☒ Gain
- ☒ Automatic (AET, AGC)
- ☒ Gamma
- ☒ Enhancement
- ☒ White balance
- ☒ Color saturation
- ☒ Binning / Partial Scan
- ☒ Measuring window
- ☒ Line generator
- ☒ Time-lapse trigger
- ☒ Adjustment of Peltier cooling (cooled versions)
- ☒ Loading and storing of images in standard formats or RAW
- ☒ Live preview (scaling 50%, 100%, 200%)
- ☒ Administration of camera parameters (via data file or save button)
- ☒ Live image measurement: Distance measurements (horizontal, vertical and diagonal)
- ☒ Statistics: min. / max. / average / standard deviation / histogram / profile line
- ☒ Diagnostic tools (built-in test, log-data files)
- ☒ Viewer for RAW data and standard formats
- ☒ Language settings (English, German, French and Italian)
- ☒ Flexible user interface



KCC makes setting and handling of the camera parameters child's play. The clear structure allows the user simple and fast control of exposure, gain, gamma and color as well as numerous additional functions.

Control over binning and partial scans for higher frame rates or individually adjustable reticles are included in KCC as well as recordings via timer, which can be triggered externally or by software.

Besides mean value and standard deviation, the live statistics feature also provides information about brightness and color distribution (histogram) and profile lines. The images can be stored in all established image formats like BMP, TIF or JPG, or as raw data (RAW format). The user can store the complete set of camera parameters and recall and load it back into the camera. The viewer that comes with the software accepts standard image formats and raw data equally. Various diagnostic tools add to the versatility of KCC.

#### Kappa DeviceControl (KDC-A)

Kappa DeviceControl – Applications (KDC-A) enables the control of our video cameras via PC. As it is necessary to adapt KDC-A to the different types of camera hardware, there is no such thing as the KDC-A but various versions of it.

Like KCC, KDC-A allows the user to set, optimize and control all camera parameters and functions via RS 232 interface. Its clear and well-organized user interface enables easy and quick handling of exposure, gain, gamma, color matching and various other functions – depending on the respective camera hardware, of course. Image capture is carried out by frame grabber and respective software.

#### Kappa ImageBase (KIB)

Kappa ImageBase (KIB) is aimed at basic industrial measurement and archiving tasks. A holistic user oriented system for image management, its intuitive operation allows the user to work with it right away, without training or practice.

### Overview of functions of the KIB modules:

#### Control

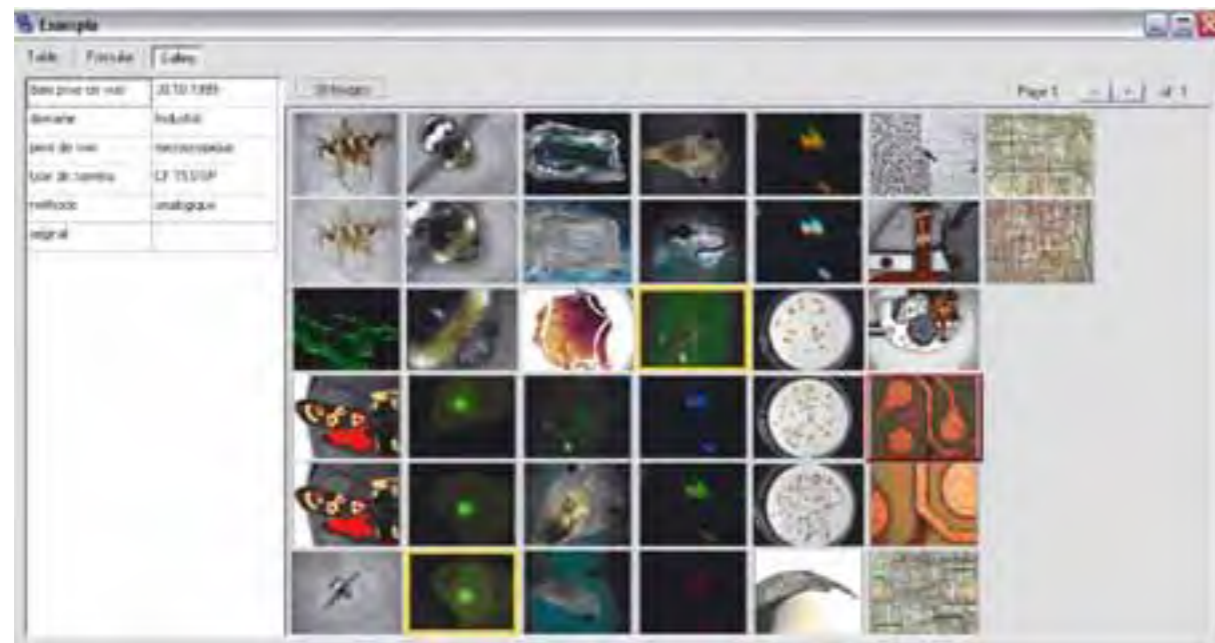
- ☒ Import/export of all common data formats
- ☒ Reporting system (Word ®)
- ☒ Infinite focus imaging
- ☒ Image processing

#### Noah

- ☒ Central archiving
- ☒ User-specific database structure, freely configurable
- ☒ Comprehensive search and sort functions
- ☒ Display of image data in single records, tables or galleries

#### Metreo

- ☒ Various measurement methods
- ☒ Freely adjustable calibrations
- ☒ Multiple overlay and labeling functions
- ☒ Various additional functions like magnifying glass, zoom, measurement report

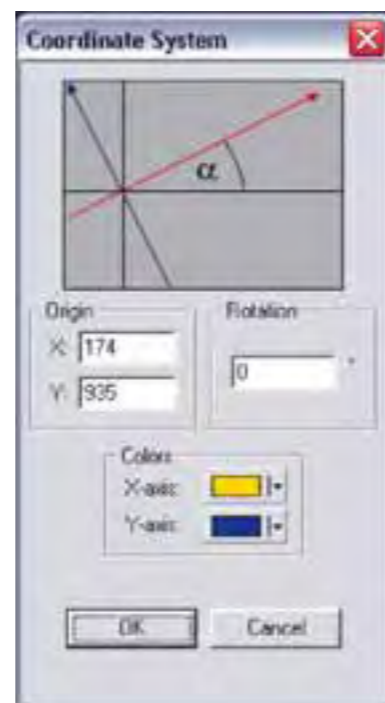


KIB consists of the modules "Control", "Noah" and "Metro", wherein "Control" provides the basic functionalities and serves as an interface to "Noah" and "Metro".

"Control" handles functions for image processing and image overlays as well as the creation of videos (AVIs) from still images and comes with a comprehensive reporting system. In addition to established image formats like BMP, TIF and JPG, the software offers a Kappa ImageBase-specific file format (kib), which contains not only the actual image but also all corresponding camera parameters and information. This guarantees that image acquisition is one hundred percent reproducible.

The "Noah" module with its comprehensive image database functions serves as an administrative and archiving tool for all images and image data. Images, camera parameters, measurement results, overlays, general information and comments can be recalled (mein Vorschlag: called up again) from an image data base with freely configurable data fields.

The "Metro" module takes care of all measurement, annotation and labeling tasks. Various measurement methods guarantee the greatest possible flexibility. "Metro" shows the measurement results clearly arranged in table form. The data can be directly imported into Excel®.



## Development Tools

Standardized interfaces have one indisputable advantage: All you have to do is plug the camera in and you are ready to go. The main drawback of standardized interfaces is that they always constitute a conglomeration of various standards by various providers and therefore do not allow much latitude in terms of integration of specific functions. Kappa offers you both full access to all functionalities via development tools as well as standardized interfaces.

### Software Development Kit SDK3

For all our cameras we offer a free-of-charge high-performance software development kit (SDK3). The SDK3 supports the embedding of Kappa digital cameras into your application programs based on Microsoft Windows® and allows developers the straightforward integration of our cameras into software projects and applications.

With its modular and hardware-independent structure, all basic configurations like camera control, live image and image capture are the same, no matter what combination of camera and frame grabber you use.

The SDK3 uses modern Windows® technologies like .NET Framework 2.0 and DirectX). The programming interface is a C functions library (API), which takes care of all camera-specific tasks like live image display, control and image capture, and provides room for the user to develop their own specific applications.

Extensive sample programs (C++/C#) clarify the structure and handling of SDK3 and can be used as a basis for the user's own programs.

The SDK3 comprises documentation, C functions library and sample programs.

## Drivers

For all cameras that can be operated via PC and software, drivers for the following operating systems are available:

- ☒ Windows 2000
- ☒ Windows XP 32-bit
- ☒ Windows Vista 32-bit

The FireWire cameras are IIDC compatible and can be run with Linux.





## General Terms and Conditions

### § 1 Scope of Application

- (1) The following Terms and Conditions as in effect at the respective time shall be applicable exclusively to any and all supply contracts, agreements and offers within the scope of ordinary business transactions even if in future instances we should not expressly make reference to the applicability thereof. By placing an order for or accepting delivery of any goods or services the Customer shall accept the applicability and effectiveness of these Terms and Conditions.
- (2) These Terms and Conditions shall also, and most particularly, be applicable in the event that the Customer communicates, or submits in written form, his own terms and conditions which may vary from ours. Such Customer's terms shall not become part of the Contract unless expressly agreed by us or any agent acting on our behalf.
- (3) Any modifications of or amendments to these Terms and Conditions shall be agreed in writing. This shall also apply to the written form requirement itself.

### § 2 Conclusion of Contract

- (1) Should our Contract confirmation vary from any oral order placement or understanding, the written Contract confirmation shall be deemed contractually agreed unless written objection is lodged within five working days.
- (2) We reserve the right of ownership and the copyright of any data, illustrations, drawings, calculations or other documents that we have put at the Customer's disposal. These data and/or documents shall not be disclosed to or duplicated for any third parties unless expressly approved by us.
- (3) The Customer shall observe any third-party proprietary rights or copyrights. Should such third party raise any claims [arising from such rights] against us, the Customer shall at our request indemnify us against any and all claims or pay compensation for any costs already incurred.

### § 3 Prices /Payment

- (1) Agreed prices are net prices, with applicable VAT payable in addition. Unless otherwise agreed, the prices are ex works. Billing and payment is in euro currency. Any additional costs incurred due to payment in foreign currency shall be borne by the Customer.
- (2) Any circumstances arising four months after Contract conclusion which impact the bases of our calculations in a material and unforeseeable way and which are beyond the Seller's control shall justify us to adjust the agreed prices by an amount exclusively accounted for by these circumstances. This provision applies most particularly to legislative changes, dispositions by governmental agencies, etcetera. The price so adjusted shall be calculated on the same basis as the price originally agreed and shall not serve to increase the profit.
- (3) Any amounts invoiced are immediately due. Payment within 30 days after invoice date shall authorize the Customer to deduct a 2% discount. The value date indicated on our business account shall be relevant for due date compliance.

- (4) The Customer shall pay interest on arrears in the amount of 8 percentage points above the base lending rate. We expressly reserve the right to claim additional damages for default.
- (5) Cheques shall only be accepted on account of performance; likewise, bills of exchange shall only be accepted on account of performance and provided that such type of payment is based on a specific agreement.
- (6) The Customer shall not be authorised to exercise any right of retention or set-off unless his claims are undisputed or have been recognised by declaratory judgement.

### § 4 Term for Delivery

- (1) An agreed Term for Delivery is deemed to be met if upon expiration of such term the Ordered Products have left our warehouse, or the manufacturer's works if the Products are shipped ex works, or readiness for shipment has been notified.
- (2) Failing any acts to be performed or preconditions to be met by the Customer in order for us to be able to supply our Products or render our Services, the Term for Delivery shall be extended by the respective period of time. Should this happen, new Terms for Delivery have to be agreed.
- (3) Should we be unable to meet our contractual obligations due to any circumstances attributable to force majeure that were not foreseeable at the time of Contract conclusion - such as labour disputes, strikes, lock-outs, unpredictable stoppage or inevitable raw material shortages and other circumstances for which we cannot be held responsible – we shall be released from our contractual obligations as long as these circumstances persist. Any agreed Terms for Delivery shall be extended by the duration of such stoppage. The Customer shall have no right to claim damages for any circumstances of the type specified above. Likewise, the Customer's contractual obligations shall remain suspended as long as the stoppage continues. We shall promptly inform the Customer about the onset and end of any circumstances of force majeure in terms of this provision, and we shall furnish evidence that we cannot be held liable for the situation and shall do so no later than six months after the end of the stoppage. This is without prejudice to the Parties' right to withdraw from the Contract pursuant to existing statutory provisions.
- (4) Paragraph (3) shall not apply if we are found at fault as regards any takeover or precautionary measures or damage control.
- (5) If our performance is delayed due to any circumstances attributable to the Customer, the latter shall be liable to pay compensation for any additional costs that we may have to incur.
- (6) If the Customer negligently refuses acceptance of the Products, he shall be liable to pay damages to us in the amount of 0.1% per working day of the net order volume total. His total liability to pay damages shall be limited to 10% of the net order volume total. We expressly reserve the right to claim damages in excess thereof. The Customer shall be expressly authorized to furnish evidence that the actual damage caused is lower than what has been claimed.

- (7) If after Contract conclusion the Customer specifies any place for delivery other than the place originally agreed, he shall bear the additional costs attributable to such change, including additional transport and warehousing costs.

### § 5 Passing of Risk / Shipment

- (1) The price risk shall pass to the Customer as soon as the Products have been handed over to the person entrusted with shipping.
- (2) Upon request by the Customer we shall insure the Products against theft, breakage, damage in transit, fire and water damage and any other insurable risks. The respective costs shall be borne by the Customer.
- (3) Partial deliveries shall be allowed unless the Customer cannot be reasonably expected to tolerate them.

### § 6 Reservation of Ownership

- (1) We reserve the ownership of the Delivered Product up to the date of payment of any and all receivables due to us by the Customer on account of the entire business relation with the latter. The reservation of ownership also includes the recognised account balance to the extent we book receivables due to us by the Customer in our current account.
- (2) In the event of breach of Contract by the Customer, including default of payment, we shall be authorised to take the Delivered Product back; the Customer shall be under an obligation to surrender the Delivered Product. Unless expressly stated by us in writing, our taking-back shall not constitute any revocation of the Contract provided that the German Civil Code [BGB] does not provide otherwise. Any pledging of the Product shall consistently constitute the revocation of the Contract. The Customer shall be under an obligation to promptly inform us in writing about any pledging or other encumbrance of the Delivered Product by any third party in order to enable us to file suit pursuant to Article 771 ZPO. If we cannot recover our judicial and extra-judicial costs of the law suit from such third party pursuant to Art. 771 ZPO, then such third party shall be liable for the loss sustained by us.
- (3) The Customer shall be authorised to sell the Delivered Product in the ordinary course of his business; at this point the Customer already cedes to us any and all receivables in the amount of the invoice total (including VAT) which are due to him by his customer or any third party on account of the sale of the Product of which the ownership has been retained, and to do so irrespective of whether or not the Delivered Product was sold before or after the agreement. The Customer is authorised to collect such receivables despite their having been ceded. We are authorised to collect such receivables ourselves; however, we undertake and promise not to collect any receivables as long as the Customer meets his payment obligations and is not in default. Should the Customer be defaulting, we shall be authorised to request the Customer to disclose the receivables that have been ceded to us as well as the respective debtors, to furnish the details and the respective documents required for collecting the money, and to inform the creditors (third parties) about the cession.

- (4) If the Delivered Product is firmly connected with or integrated into other products that are not owned by us we shall be deemed co-proprietors of the new item, with the ratio of such joint property reflecting the value of the Delivered Product as percentage of the new item at the time the connection or integration was made. If the connection or integration is such that the Customer's product constitutes the principal component, it is atng understood that the Customer transfers property to us on a pro rata basis.
- (5) The Customer shall hold our exclusive or joint property in safe custody on behalf of us. To collateralise the receivables due to us by the Customer, the latter shall also cede to us such part of the receivables due to him by a third party that reflects the Customer's input into the new item which is a connection or composition of the Delivered Product with the Customer-manufactured product.
- (6) The Customer can request the retained ownership title to be unfreezed once the collateral securities are in excess of 110% of the realisable value. Likewise, the Customer can request unfreezing of the retained title if the estimated value of the goods ceded as a guarantee is 150% of the receivables secured.

### § 7 Customer's Rights in the Presence of Defects

- (1) The Customer shall be under an obligation to inspect the Products promptly upon delivery and to notify in writing any defects detected. Defects shall not be recognised unless notified prior to the expiration of five days after Product delivery. Hidden defects shall be notified in writing to us promptly upon detection but no later than five days after detection. Such term shall be deemed met if communication is by fax, with the original letter following immediately afterwards. Notification of the defect is to be addressed directly and exclusively to us. The Customer undertakes to keep the defective Products, or the respective parts thereof, unmodified available for inspection by us.
- (2) If a defect in the supplied Product has been notified within due time, we shall at our discretion remedy the defect or substitute the Product. If remedy is either not reasonable or if it fails, the Customer shall be at option to either have the purchase price reduced or to rescind the Contract.
- (3) The Customer's claim to remedial performance shall become statute-barred 12 months after delivery of the Product. During that term, the Customer shall comply with the instructions given by us for storing the Product in order to keep the Product in the best condition possible.
- (4) Any parts replaced by us within the scope of remedial performance shall become our property.
- (5) The Customer shall give us reasonable opportunity to perform any remedial measures that may be required. Upon default by the Customer in that respect we shall not adopt any further liability for any additional damage occasioned after the default date.

- (6) We shall not be held liable for any damage caused by the defectiveness of the Product unless such damage was caused by grossly negligent breach of obligations on our part or by our legal representatives or vicarious agents. We shall not be liable for the workability of the Product if such workability is attributable to any specification commissioned by the Customer.
- (7) The above restriction shall expressly not apply if we are liable to pay damages for any person's death or impairment of his physical integrity or health caused by culpable breach of obligations on our part or by our legal representatives or vicarious agents.
- (8) To the extent that we have warranted particular characteristics of the Product sold by us for the duration of a specified period of time, the above paragraphs (1), (2), (3) and (6) shall not apply.
- (9) The above provisions shall not prejudice any claims under the German Product Liability Act [Produkthaftungsgesetz].

### § 8 Non-Liability Clause / Restriction of Liability

- (1) The Customer shall not be entitled to any other claims for damages of whatever kind, including but not limited to claims on account of culpa in contrahendo or breach of collateral contractual or statutory obligations, unless such damages are attributable to at least grossly negligent breach of obligations by us or our legal representatives or vicarious agents.
- (2) The restriction stated in the above paragraph shall not apply to foreseeable damages due to breach of contractual obligations. However, we shall be liable only to the extent that such damages were foreseeable at the time of Contract conclusion. We shall not be held liable for any non-foreseeable excess damages.
- (3) Moreover, the above restriction shall expressly not apply if we are liable to pay damages for any person's death or impairment of his physical integrity or health caused by culpable breach of obligations on our part or by our legal representatives or vicarious agents.

### § 9 Revocation of Contract

- (1) We shall have the right to withdraw from the Contract if, after Contract conclusion, material conditions relating to the performance of the Contract have developed in a way that is beyond our control and that makes it impossible or unreasonably difficult for us to perform the Contract (e.g. sub-contractors' non-performance, or performance materially hampered, due to reasons not attributable to us).
- (2) We shall also have the right to withdraw from the Contract if the Customer materially fails to comply with his contractual obligations, including his duty to exercise due care in handling the Product supplied to him under reservation of title.
- (3) We shall also have the right to withdraw from the Contract if the Customer makes incorrect representations as regards his credit standing. This provision shall apply most particularly in the event that the Customer is objectively not creditworthy and, accordingly, our claims for payment appear jeopardized. The same shall apply if the Customer has sworn an affidavit.
- (4) Subject to the aforesaid, our right and the Customer's right to revoke the Contract shall be governed by the statutory provisions.

### § 10 Applicable Law / Venue

- (1) The contractual relationship between the Parties shall be governed exclusively by German law. The UN Convention on Contracts for the International Sales of Goods shall not be applicable.
- (2) The venue for any and all disputes arising from or in connection with this Contract shall be Göttingen.
- (3) The venue shall be as specified in paragraph (2) if, once a dispute has arisen, the Parties have reached agreement accordingly. Moreover, it is hereby understood by and between the Parties that if the Customer relocates his permanent or habitual residence to a place that is not within the jurisdiction of the German Code of Civil Procedure, or if his permanent or habitual residence is unknown at the time an action is brought, the venue shall also be Göttingen.

### § 11 Place of Performance

- (1) The Place of Performance for any and all claims arising from this Contract shall be the city of Göttingen.



Member of  
**Measurement  
Valley**



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