Schäfter+Kirchhoff

Line Scan Cameras

from 512 to 22800 pixels, monochrome or color or TDi

Interfaces: Gigabit ETHERNET | GiGE VISION

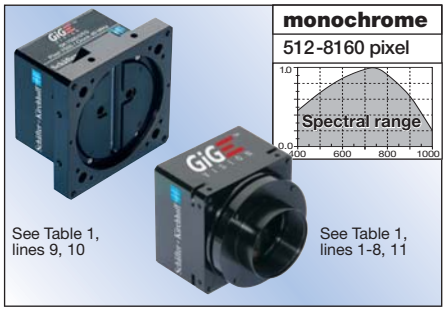
Schäfter+Kirchhoff offers two types of line scan camera with a Gigabit Ethernet interface. The hardware is technically identical and they differ only in their respective firmware.
V-series cameras are 100% GigE Vision compatible and programming is performed using the **GEN<i>CAM™** interface.
G-series cameras are not Vision compliant and their major strengths are in high performance, flexibility and additional functionality beyond the norm.

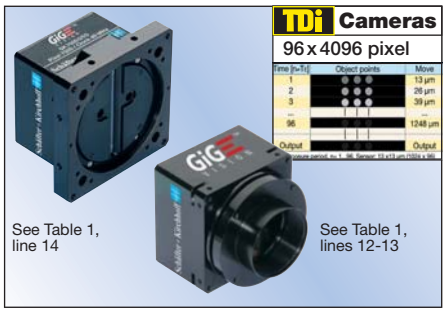
Gigabit ETHERNET

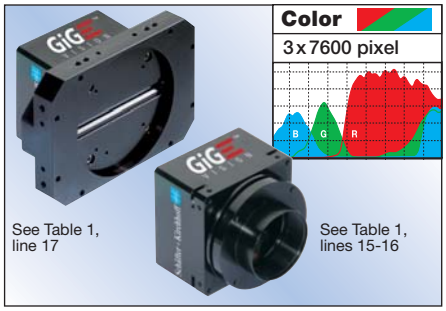
- special preprocessing algorithms can be implemented in the camera
- externally synchronizable for each line (LineSync), or for image (FrameSync)
- customer-specific IO signals in addition to the video signal
- SDK from **Schäfter+Kirchhoff** with the **SkLineScan** operating program, libraries and examples (**Sk91GigE-WIN**, see page 15)

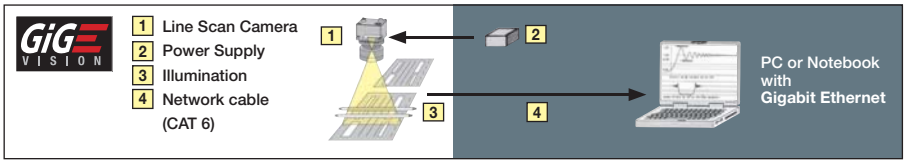
GiGE VISION

- compliant with the international standard for the industrial processing of image data based upon the Gigabit Ethernet protocol
- cameras are supported by any third party software that uses the **GEN<i>CAM™** software interface
- **Schäfter+Kirchhoff** provides the **SkGEVTool**, with its oscilloscope display of the signal, for adjustment of the camera (see page 17)









Features	Gigabit ETHERNET	GiGE VISION
Shading correction	X	X
Thresholding	X	-
Window function (ROI)	X	X
External synchronization	X	X
Extra I/O signals	X	-
User managed buffer queue	X	-
Data cable length	100 m	100 m
Windows	SK91GigE-WIN SDK	SkGEVTool-WIN Tool
LabVIEW	SK91GigE-LV VI Library	NI-IMAQdx
Linux	-	SKGEVTool-LX Tool

SK7500VTO-XL
SK7500GTO-XL (Casing CG5) with focus adapter FA26-S45, extension ring ZR-L..., adapter M39-45 and macro lens Apo-Rodagon D1x 4.0/75 mm for 1:1 depictions of the scanned object

SK2048VPD
SK2048GPD with mounting bracket SK5105 and photo lens SK1.4/50-40 (integrated focus/aperture adjustment)

SK1024VSD
SK1024GSD
with mounting bracket SK5105 and CCTV lens

Table 1

Interface		Line scan camera: Gigabit ETHERNET Order code	Line scan camera: GiGE VISION Order code	Pixels	Line frequency, max.	Video signal	Pixel size	Active length	Anti-Bloom	Integr. Ctrl.	Shading corr.	Threshold mode	Dynamic range (RMS)	Power supply	Camera casing	Lens thread
		Order code	Order code	1	2	3	4	5	6	7	8	9	10	11	12	13
Gigabit ETHERNET / GiGE VISION	1	SK512GSD	SK512VSD	512	53.50 kHz	8/12 Bit	14 x 14 µm	7.17 mm	x	x	x	x	1:2000	+5V, +15V	BG1	C-Mount
	2	SK1024GPD	SK1024VPD	1024	45.00 kHz	8/12 Bit	10 x 10 µm	10.24 mm	x	x	x	x	1:1500	+5V, +15V	BG1	C-Mount
	3	SK1024GSD	SK1024VSD	1024	28.00 kHz	8/12 Bit	14 x 14 µm	14.30 mm	x	x	x	x	1:2000	+5V, +15V	BG1	C-Mount
	4	SK2048GJR-L	SK2048VJR-L	2048	4.73 kHz	8/12 Bit	14 x 14 µm	28.70 mm	-	x	x	x	1: 625	+5V, +15V	BG3	M45x0.75
	5	SK2048GPD-L	SK2048VPD-L	2048	23.00 kHz	8/12 Bit	10 x 10 µm	20.50 mm	x	x	x	x	1:1500	+5V, +15V	BG3	M45x0.75
	6	SK2048GSD-L	SK2048VSD-L	2048	14.30 kHz	8/12 Bit	14 x 14 µm	28.70 mm	x	x	x	x	1:2000	+5V, +15V	BG3	M45x0.75
	7	SK4096GFD-L	SK4096VFD-L	4096	27.78 kHz	8/12 Bit	10 x 10 µm	41.00 mm	x	x	x	-	1:2000	+5V, +15V	BG3	M45x0.75
	8	SK5150GJR-L	SK5150VJR-L	5148	7.56 kHz	8/12 Bit	7 x 7 µm	36.00 mm	-	-	x	x	1: 500	+5V, +15V	BG3	M45x0.75
	9	SK7500GTF-XB	SK7500VTF-XB	7500	8.26 kHz	8/12 Bit	7 x 7 µm	52.50 mm	-	-	x	x	1:1000	+5V, +15V	EG5	M72x0.75
	10	SK7500GTO-XL	SK7500VTO-XL	7500	5.20 kHz	8/12 Bit	7 x 7 µm	52.50 mm	-	-	x	x	1: 750	+5V, +15V	CG5	M72x0.75
	11	SK8160GKO-LB	SK8160VKO-LB	8160	11.90 kHz	8/12 Bit	5 x 5 µm	40.80 mm	x	x	x	x	1:2500	+5V, +15V	BG3	M45x0.75
	12	SK1024GTDI-L	SK1024VTDI-L	96 x 1024	43.40 kHz	8/12 Bit	13 x 13 µm	13.30 mm	x	-	x	x	1:2500	+5V, +15V	BG3	M45x0.75
	13	SK2048GTDI-L	SK2048VTDI-L	96 x 2048	43.50 kHz	8/12 Bit	13 x 13 µm	26.60 mm	x	-	x	x	1:2500	+5V, +15V	BG3	M45x0.75
	14	SK4096GTDI-XL	SK4096VTDI-XL	96 x 4096	22.70 kHz	8/12 Bit	13 x 13 µm	53.20 mm	x	-	x	x	1:2500	+5V, +15V	CG5	M72x0.75
	15	SK6288GKOC-L	SK6288VKOC-L	3 x 2096	9.28 kHz	8/12 Bit	14 x 14 µm	29.30 mm	-	x	x	-	1:2500	+5V, +15V	BG3	M45x0.75
	16	SK12240GKOC-LB	SK12240VKOC-LB	3 x 4080	4.80 kHz	8/12 Bit	10 x 10 µm	40.80 mm	x	x	x	-	1:2500	+5V, +15V	BG3	M45x0.75
	17	SK22368GTOC-LA	SK22368VTOC-LA	3 x 7456	5.13 kHz	3*8 Bit	4.7 x 4.7 µm	35.04 mm	-	-	x	-	1:1000	+5V, +15V	BG3	M45x0.75
	18	SK22800GJRC-XC	SK22800VJRC-XC	3 x 7600	4.95 kHz	3*8 Bit	9.3 x 9.3 µm	70.87 mm	-	-	x	-	1:1000	+5V, +15V	FG7	M72x0.75

The camera casing, power supply and connections are identical for line scan cameras with either of the interfaces: GigE Vision™ or Gigabit Ethernet.

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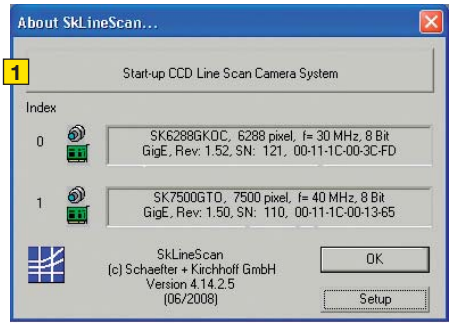
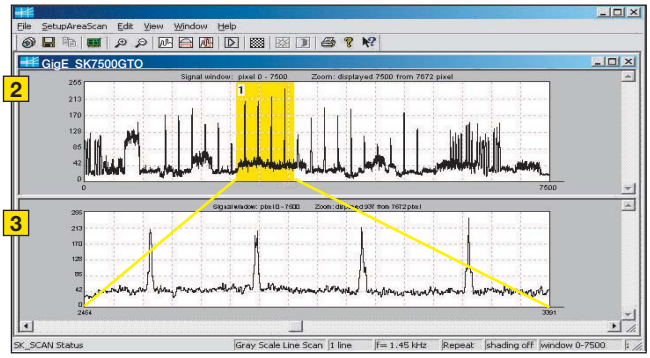
Gigabit ETHERNET Software SK91GigE-WIN, SkLineScan Program



The **SK91GigE-WIN** software package includes everything needed for a rapid setup of the GigE camera, the configuration tool **SKGigEconfig**, as well as the software development kit (SDK) with DLLs and class libraries for development of application software. The Windows 7 (x64, x86) / Vista (x64, x86) and XP operating systems are supported.

The **SkLineScan®** program recognizes the connected line scan cameras automatically and organizes the camera IDs according to the increasing values of their individual MAC addresses 1 .

The oscilloscope display 2 of the line scan signal, with zoom function 3, is an important tool for aligning the optical system. Controls for integration time, gain and offset allow the online configuration of the camera.

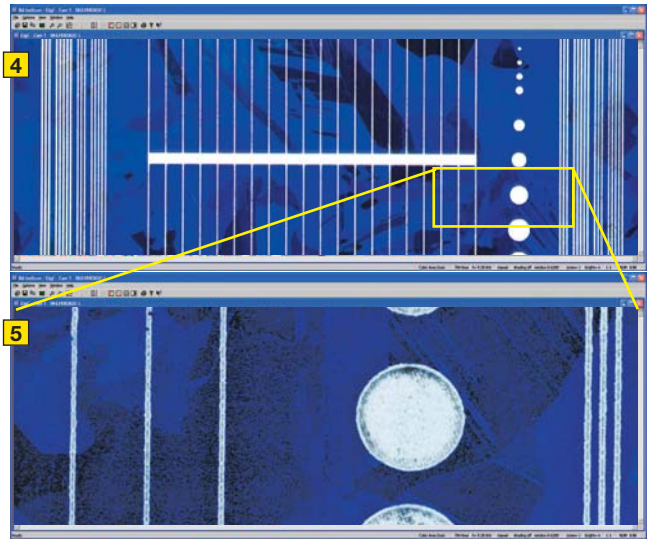


2-dimensional area scans can easily be performed using the **SkLineScan®** program 4. Simply specify the number of line scans to be integrated into the scan to produce a desired area scan.

The zoom function allows the magnification of interesting areas 5 and full or partial images can be stored as bitmaps.

For color line scan cameras, a white balance correction is necessary and the shading correction procedure described on this page provides this capability.

The various synchronization procedures allow images to be acquired either stepwise per line (**LineSync**) or per area (**FrameSync**) using an external trigger, according to the particular requirements of the customer or the image aquisition application.

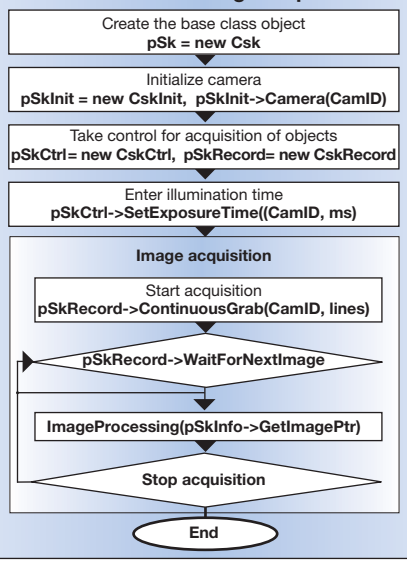


SDK for GigE line scan cameras

Csk	**– Base class**
struct sk_interface	Communication structure for the driver
CskInit: Csk	**– Initializing class**
::Camera	Initializing the camera
::AllocBuffer	Allocate memory in the user area
::FreeBuffer	Release memory
::SetUserBufferPtr	Set pointer to user buffer
CskCtrl: Csk	**– Control class**
::SetIntegrationTime	Set integration time (ms)
::SetLineFrequency	Set line frequency (kHz)
::SetSyncMode	Set synchronization mode
::SetGain	Set camera gain
::SetOffset	Set camera offset
CskRecord: Csk	**– Acquisition class**
::SingleLineScan	Get a single line scan
::AreaScan	Acquire a 2D scan
::ContinuousGrab	Start continuous grab
::GetImage	Get single image from a continuous grab
::StopContinuousGrab	Stop continuous grab
CskView: Csk	**– View class**
::LineScanView	Display a line scan signal
::AreaScanView	Display an area scan
CskInfo: Csk	**– class**
::GetCamType	Name of current camera
::GetPixWidth	Number of current camera pixels
::GetLineFrequency	Current line frequency in kHz
::GetUserBufferPtr	Pointer to data set in user memory

* Examples from the class library containing more than 60 ways to control a GigE line scan camera

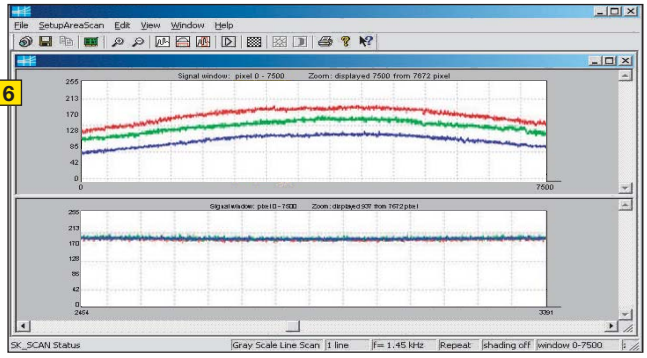
Flow of camera image acquisition



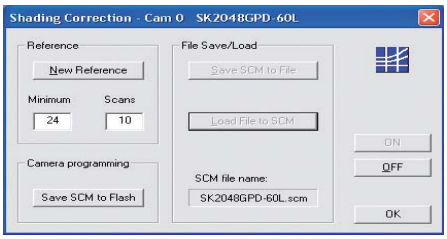
SK91GigE-WIN Order Code

Shading Correction with the SkLineScan program

Shading correction is a procedure used for compensating for the potential sources of variation in the signal, whether caused by lens vignetting or variations in pixel sensitivity or illumination. A reference signal for the shading correction is obtained by taking an image of a plain white surface, so that each individual pixel can be compensated for algorithmically to provide a maximum overall intensity, depending on the scale (e.g. 4095 for a 12-bit resolution), and producing an idealized flat signal.



The shading correction reference values are stored in the designated shading correction memory (SCM) in the camera for future use. The persistent writing of the SCM into the camera memory uses the **GEN<i>CAM** command **SkSaveScmToFlash** from the custom feature table. Shading correction for color line scan cameras uses the white balance method (see 6).



The dialog window for **Shading Correction** in the **SkLineScan** program.

New Reference: Acquisition of a new shading correction reference set and its storage in the SCM

Scans: Number of lines for the reference values to be determined

Minimum: Only the minimum pixel value is used for scaling

SaveSCM to Flash: Pesistent storage of the shading correction reference values in the flash memory of the camera

Save/Load: The shading correction reference values are written to or read from a file

1 Start-up and status window of the **SkLineScan** program
2 Oscilloscope display of a line scan signal
3 Zooming to a region of interest (yellow) in the line scan signal
4 Area Scan using the line scan camera SK6288GKOC-L
5 Zooming to a particular area of interest
6 Shading Correction function in the **SkLineScan** program

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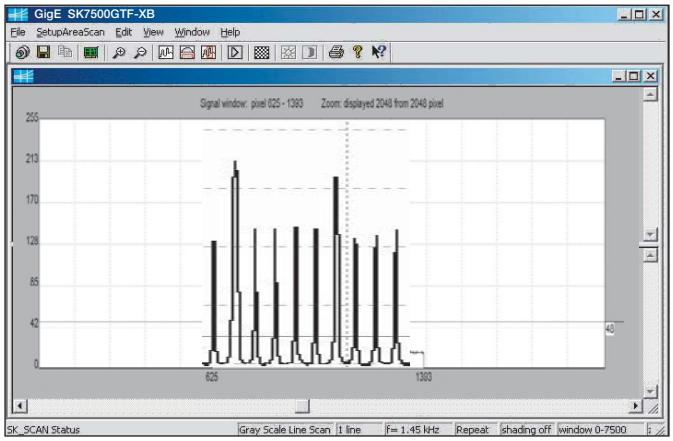
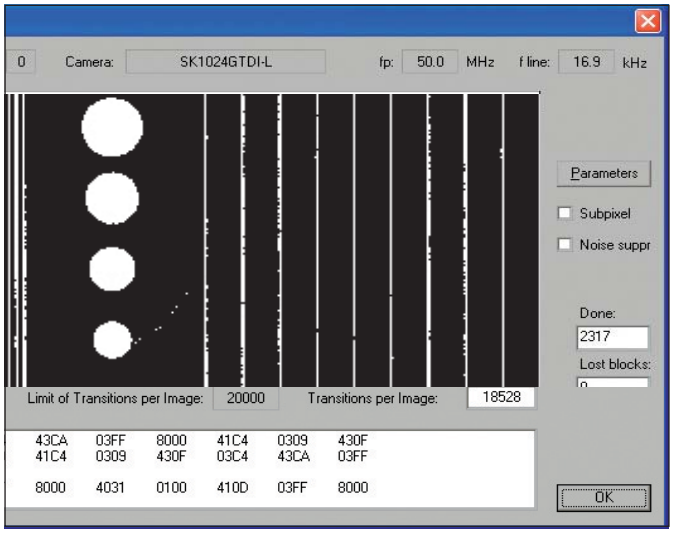
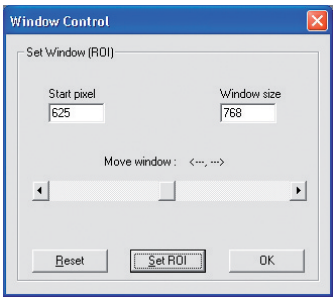
Gigabit ETHERNET Software SK91GigE-WIN





Example program for continuous Thresholding

Window Function (ROI)



Control dialog for setting a region of interest

The window function defines a freely programmable window (region of interest, ROI) on the line sensor. Only the pixel information within this window reaches the FIFO and, therefore, only these ranges are then illuminated. This window control function reduces the data volume and the data processing effort for both line and picture acquisitions.
The video data of the ROI is written left-bounded into the image buffer and the oscilloscope display in the **SkLineScan** program adjusts the ROI to the actual pixel address of the signal window. One restriction of the memory allocation is that the ROI length must be divisible by 8.

Thresholding

Thresholding is a special capability of cameras with a Gigabit Ethernet interface that offers an effective alternative to gray shade evalution and enumeration, assuming there is sufficient contrast available in the image. The development of thresholding is the successful outcome of an initiative to perform data reduction without information loss when monitoring changes in signal intensity. The thresholding process generates a binary signal, with data values below the threshold yielding 0 and those above yielding 1. Only the pixel addresses of the location and value (from high → low or low → high) of the threshold transition are transmitted with a line-end character (Runlength Encoding).

Thresholding is particularly suitable for measuring widths or edge positions, as the substantial complexities inherent in edge position determination have been reduced to simply masking the required pixel addresses.

Other thresholding features and possibilities include:

- **Noise suppression filtering**
- **Subpixel resolutions**

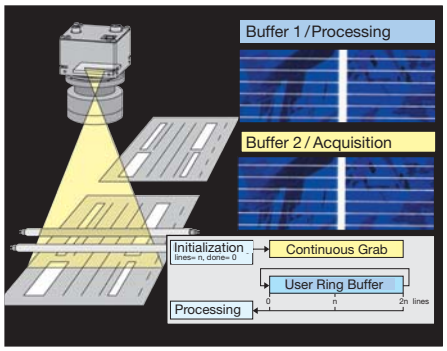
Data format:	16-bit integer without a starting character
Bit 0...13:	pixel address of the signal transition
Bit 14:	0 = transition from high → low 1 = transition from low → high
Bit 15:	1 = line end character

Gigabit ETHERNET Management of the GigE line scan camera memory by the user

The SDK in the **SK91GigE-WIN** software package provides library functions that allow the user to allocate memory areas for the image acquisition. The GigE line scan camera then writes directly into these predefined memory areas, obviating any copying of the data from one area to another. The writing of camera data into memory can be performed either in a cyclical manner or after all of the buffers have been filled. This latter method is particularly useful for a sequence of images, up to a maximum of 256 individual images.

The image sequence method allows the acquisition of extremely large images, circumventing the internal restriction of 64 MB and 16383 lines per image. The user defines the appropriate memory size in virtual memory for the desired size of image, which is then divided in up to 256 component parts. A sequence series is programmed by simply pointing to this buffer and the acquisition of the sequence images then results in the image data being collected up to the desired size.

Controlling continuous measurement processes using a GigE line scan camera



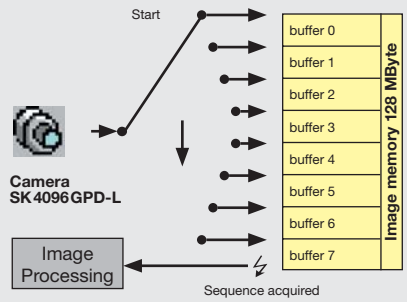
Special functions have been added to the SDK of the **SK91GigE-WIN** software from **Schäfter+Kirchhoff** that enable the efficient control and manipulation of continuous measurement applications

The ability to customize the memory allocation for the Gigabit Ethernet line scan cameras can be used for the continuous collection of the camera data into a User Buffer Queue. This speeds up operations as data must not be copied back and forth, freeing up the CPU for other activities, such as data evaluation or for controlling external devices. The writing of data into the User Buffer Queue is cyclical. Up to 256 buffer suballocations can be set according to the demands of the application. The minimum permitted size is exactly one line scan.

The data in a previously filled buffer can be manipulated or evaluated while the camera is writing data into the next buffer. The user receives an event signal and the address of the buffer in the queue that was written to last. For the successful continuous evaluation of camera data in the two buffers, without loss of data, the evaluation of the first buffer must be completed after the illumination of *n* lines, at the latest.

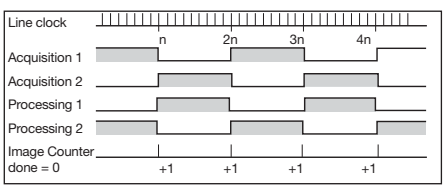
The sequential method of acquisition of large images with a GigE line scan camera

image dimension:	4096 x 32768 Pixel
image size:	128 MByte
number of buffers:	8
buffer size :	16 MByte



When more than two buffers are allocated and there is a time delay caused by the manipulation of data from one buffer then the time delay can be recovered by the rapid utilization of the data in the next or subsequent buffers.

Thus, there are effectively no time limits or restrictions when performing continuous acquisition and data manipulation tasks.



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Software

The V series of line scan cameras are 100% compatible with the **GigE Vision™** and **GEN<i>CAM™** standards and can be controlled using any program of choice that supports the **GEN<i>CAM** standard.*
The **SkGEVTool**, for either Windows** or Linux, is provided by **Schäfter+Kirchhoff** for the commissioning and initial parameterization of the camera and is available for downloading.

SkGEVTool for Windows and Linux

The **SkGEVTool** was specially developed for controlling the line scan cameras. The oscilloscope display of the signal provides an intuitive depiction for adjusting the illumination time, amplification, lens shutter, focus and orientation of the line scan camera.

The **SkGEVTool** can use either of the Pleora drivers eBus Optimal or eBus Universal, which can be downloaded from *www.pleora.com* after registering online.

1 Oscilloscope display of the line signal using the zoom function. Any alterations to the illumination time or amplification of the line scan camera are immediately displayed.

2 Select **Area Scan** to perform a 2-dimensional scan of an area. The number of lines per image to be scanned is selected from the Device Feature List under **Height** in the category **Image-SizeControl**.

* e.g. Common Vision Blox from STEMMER, MIL from Matrox, NIMAX National INstruments, HALCON from IDS, etc.
** Operating systems: Windows 7 / Vista (32/64 bit) and XP

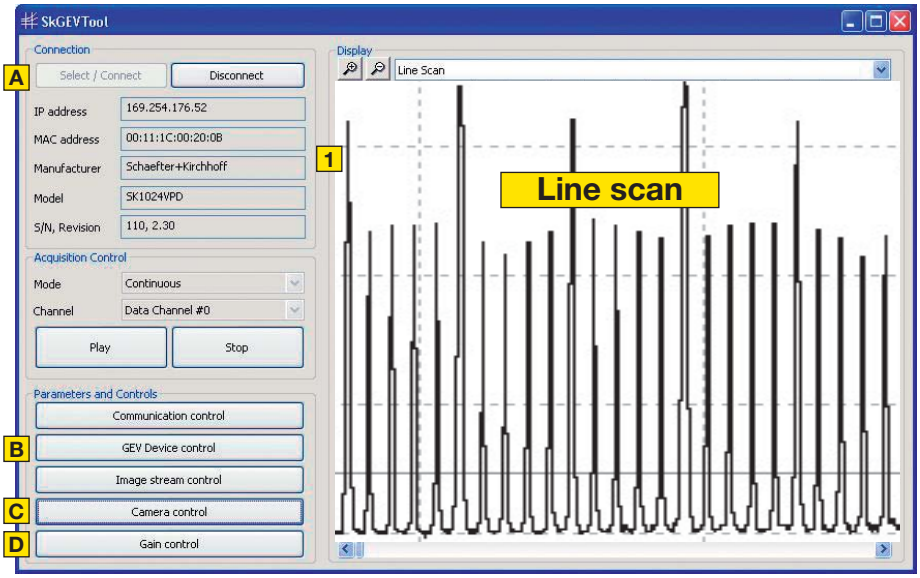
Device Feature Table (selection)

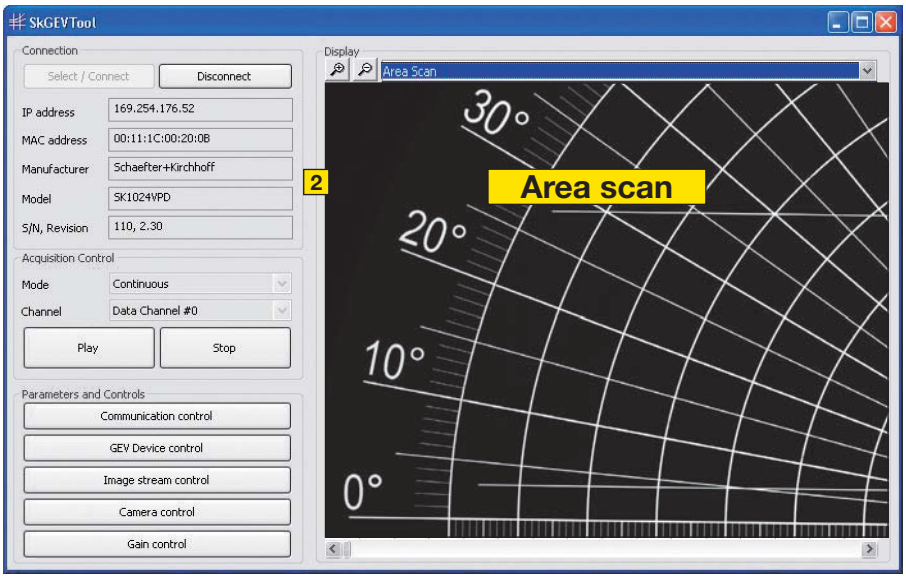
GEV Device Control — Visibility: Beginner

DeviceInformation	
DeviceVendorName	Schaefter+Kirchhoff
DeviceModelName	SK1024VPD
DeviceManufacturerInfo	Hamburg (00080602)
DeviceVersion	Version 1.0 (02.01.12)
DeviceID	S/N 110
DeviceUserID	
DeviceScanType	Linescan
ImageSizeControl	
SensorWidth	1024
SensorHeight	1
AnalogControls	
GainSelector	Tap1
BlackLevelSelector	All
GainRaw	128
GainAbs	6.0206 dB
BlackLevelRaw	4
AcquisitionAndTriggerControls	
AcquisitionLineRateAbs	12500 Hz
TriggerSelector	FreeRun
ExposureTimeRaw	80
AcquisitionFrameCount	1
ExposureTimeAbs	0.08 ms

AcquisitionLineRateAbs	12500 Hz
TriggerSelector	FreeRun
ExposureTimeRaw	LineStart
AcquisitionFrameCount	ExposureStart ExposureActive
ExposureTimeAbs	FreeRun

A description of the trigger mode is provided on page 18





A Start with **Select/Connect**

B **GEV Device Control** reveals all camera features in the **GEN<i>CAM** table

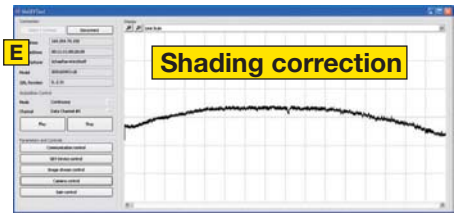
C **Camera control** enables the selection of illumination time and trigger mode

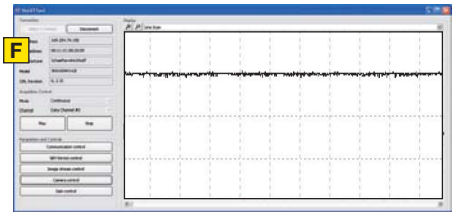
D **Gain control** adjusts the gain and offset

Shading Correction with the SkGEVTool

Shading correction is a procedure used for compensating for the potential sources of variation in the signal, whether caused by lens vignetting or variations in pixel sensitivity or illumination. A reference signal for the shading correction is obtained by taking an image of a plain white surface, so that each individual pixel can be compensated for algorithmically to provide a maximum overall intensity, depending on the scale (e.g. 4095 for a 12-bit resolution), and producing an idealized flat signal.
The shading correction reference values are stored in the designated shading correction memory (SCM) in the camera for future use. The permanent writing of the SCM in the camera uses the command **SkSaveScmToFlash** from the **GEN<i>CAM** custom features.
When shading correction is active then all images recorded by the camera are corrected by the content of the SCM and a fully compensated signal is produced.

SkShadCorrReference	SkShadCorrReference
SkSaveScmToFlash	{Command}





E A line signal from a homogeneous white surface reveals the typical signal loss at the extremities through lens vignetting

F A line signal after shading correction and reduction of illumination time

The camera always starts with the last-used shading correction status as default. If shading correction was deselected when the camera was switched off then the camera starts without shading correction using an unscaled line signal.

Gigabit ETHERNET GiGE VISION — Synchronization modes

LINE SYNC Modes

FreeRun (mode 0): The next scan is started automatically on completion of the previous line scan. The camera works in free run mode with the programmed exposure time.

LineStart (mode 1): The line scan exposed at the time of the external trigger is read out. The start and duration of exposure are controlled internally by the camera. The trigger frequency does not affect the exposure time.

ExposureStart (mode 4): A new line exposure is started exactly at the time of triggering (falling of a TTL signal trailing edge). Programmed exposure times are unaffected by, although must be longer than, the trigger frequency.

ExposureActive (mode 5): The external trigger determines the start and duration of illumination, which also equals the total exposure time.

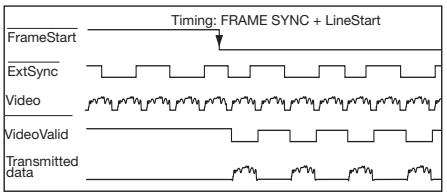
Sync divider: The external trigger frequency is divided by a programmed integer. Only every *n*-th line is recorded.

FRAME SYNC Mode

As well as a line synchronization mode, the GigE line scan cameras also have external frame synchronization (**FrameSync**) for the synchronized acquisition of 2D scans.

The individual lines of the image can be synchronized internally or externally. The camera suppresses the data transfer until the falling edge of a TTL signal occurs at **FrameStart** input (e.g. triggered by breaking a light beam). Only then is **VideoValid** set to active and the subsequent camera data can then be transferred via GigE to the PC.

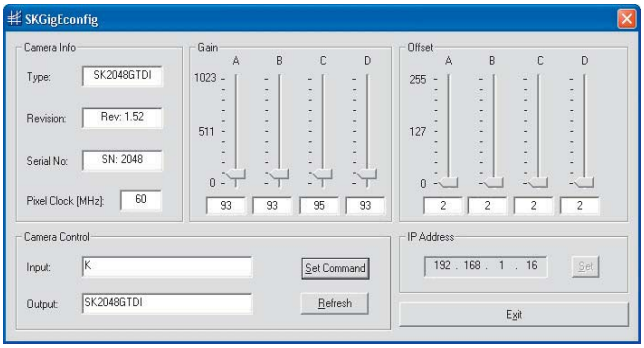
In the **FrameActive** mode, data acquisition is terminated by the rising edge of a TTL signal, before the image has been completely acquired, allowing the precise measurement of objects of varying length.



Selection of camera commands

Operation	Description
Gnnnn<CR>	Set Gain Chan1 (Red) 0-24 dB
Bnnnn<CR>	Set Gain Chan2 (Green) 0-24 dB
Hnnnn<CR>	Set Gain Chan3 (Blue) 0-24 dB
Ommm<CR>	Set Offset Chan1 (Red)
Pmmm<CR>	Set Offset Chan2 (Green)
Qmmm<CR>	Set Offset Chan3 (Blue)
F1<CR>	Output Format: Thresholding
F8<CR>	Output Format: 8 bit data
F12<CR>	Output Format: 12 bit data
C30<CR>	Camera Clock: 30 MHz
C60<CR>	Camera Clock: 60 MHz
T0<CR>	Test pattern off / SCM off
T1<CR>	Test pattern on
T2<CR>	Shading Correction on
T3<CR>	Auto Shading Correction, SCM on
T4<CR>	Copy Flash Memory to SCM
T5<CR>	Copy SCM to Flash Memory
M0<CR>	Free Run
M1<CR>	Trigger **LineStart** (Mode 1)
M2<CR>	Free Run with maximum line rate
M4<CR>	Trigger **ExposureStart** (Mode 4)
M5<CR>	Trigger **ExposureActive** (Mode 5)
Lmmm<CR>	Set threshold level
K<CR>	returns SK type number
R<CR>	returns Revision number
S<CR>	returns Serial number
I4<CR>	returns Camera Clock Low Freq.
I5<CR>	returns Camera Clock High Freq.
range of values:	
nnnn=	0...1023, mmm= 0...255

Configuration program SkGigEconfig

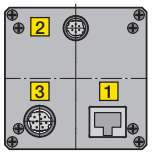


The config program **SkGigEconfig** uses the camera commands to adjust the GigE line scan camera parameters, such as gain, offset or pixel frequency.

Current parameters, as well as specific product information, can also be read from the camera.

The parameter settings are stored in the non-volatile flash memory of the camera and so are available for subsequent use and a rapid start-up, even after a complete shut down or loss of power.

Camera back view



1 Data:
RJ45 connector for Gigabit Ethernet cable specification CAT6

2 Power
Hirose Series 10A, male 6-pin, +5V, 700mA +15V, 350mA

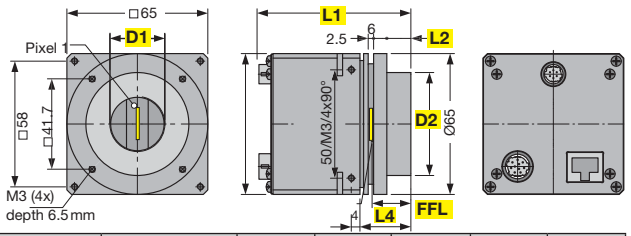
Pin	Signal	Pin	Signal
1	+15V	4	+5V
2	+15V	5	GND
3	+5V	6	GND

3 I/O-Connector
Hirose Series 10A, male 12-pin

Pin	Signal
1	GND
8	FrameSync
10	LineSync

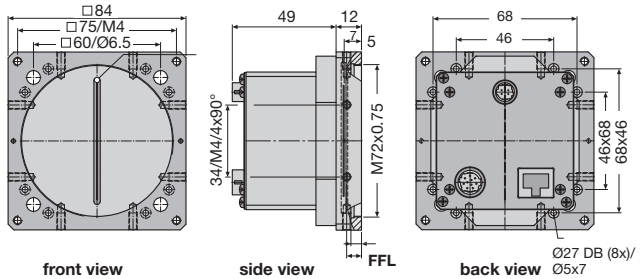
Dimensions

BG...
Lens mount: D1
Seat for bracket: D2
Flange focal length: FFL



Casing	D1 (Lens mount)	L1 (mm)	L2 (mm)	D2 (mm)	FFL (mm)	L4 (mm)
BG1	C-Mount	71.10	11.10	42.00	17.54	23.50
BG3	M45x0.75	72.40	12.70	47.50	19.50	25.10

CG5 Lens mount: M75x0.75
Flange focal length: FFL = 8mm



CG5 EG5 FG7 see Line Scan Camera Family XL/XB/XC, p. 36

Data/Control cable

CAT6 cable for line scan cameras with GigE interface

Shielded CAT6 patch cable, halogen-free, both ends with RJ45 connectors for Gigabit Ethernet

CAT6.3 Order Code
3 = 3m cable length (standard)
5 = 5m
x = length of choice (max.=100m)

Cable for external synchronization

External synchronization cable for line scan cameras with GigE interface

BNC coaxial cable with Hirose connector HR10A (female 12-pin)

SK9024.3 Order Code
3 = 3m cable length
5 = 5m (standard)
x = length of choice

External power — Power cable

Power supply cable SK9015... for line scan cameras with GigE interface

Shielded cable with Lumberg SV60 (male 6-pin) and Hirose HR10A (female 6-pin) connectors

SK9015.1.5-MF Order Code
MF = connector (male/female)
1.5 = 1.5m length
0.2 = 0.2m length

CAB0515.10 Extension cable for SK9015.0.2-MF, 10m

External power — Power supply

Power Supply PS051515 Order Code

Input:
- 100–240V AC
- 0.8A
- 50/60 Hz

Connector IEC 320 (3-pin)

Output:
- 5V DC/2.5A
- 15V DC/0.5A
- -15V DC/0.3A

Connector Lumberg KV60 (female 6-pin)

Software

Software SK91GigE-WIN Order Code

SkLineScan
Control program

SDK
with DLLs and C++ class library

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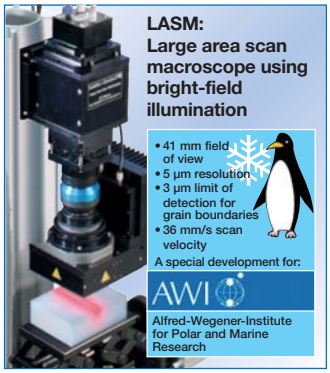
Line Scan Cameras

Some Examples from Research, Analytical and Quality Control

Interfaces: Gigabit ETHERNET · GiGE VISION™

Particle size and stratigraphy scanners in polar research

For details: see catalog pages 52–53



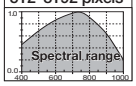
LASM: Large area scan macroscope using bright-field illumination

- 41 mm field of view
- 5 µm resolution
- 3 µm limit of detection for grain boundaries
- 36 mm/s scan velocity

A special development for:

AWI Alfred-Wegener-Institute for Polar and Marine Research

B/W cameras
512–8192 pixels



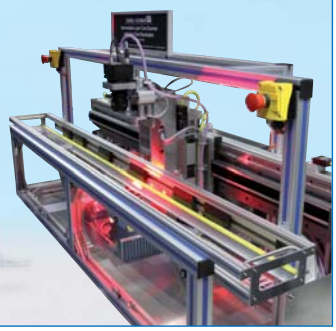
The collection of ice cores from the Greenland ice sheet, under the auspices of the (NEEM) North Greenland Eemian Ice Drilling project, was successfully completed in July 2010, after 3 years, when the drill-head hit bedrock. The ice cores from depths of up to 2.5 km provide a record of the past climate covering more than 120 000 years.

Scan of an ice core obtained from Antarctica at a depth of 60 m. The light granular structure and dark gas bubbles are clearly discernable.

The LASM scanner (left) was specially developed for documenting the fine structure of the ice cores and to determine the sizes of the ice granules and enclosed bubbles. The ILCS scanner (right) was developed for documenting the stratigraphy and dating of the ice cores. All of the mechanical, electronic and optical components were specially developed for use in the NEEM camp at temperatures down to -40°C.

Transportation to the Neem Camp

ILCS: Stratigraphy scanner using dark-field illumination



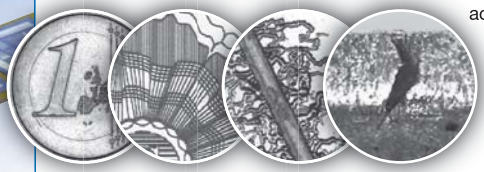
Line scan camera with integrated bright-field illumination

For details: see catalog pages 50, 56

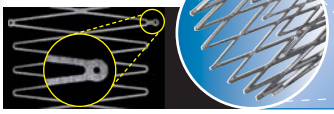
Automated surface and texture inspection of flat and rotating objects

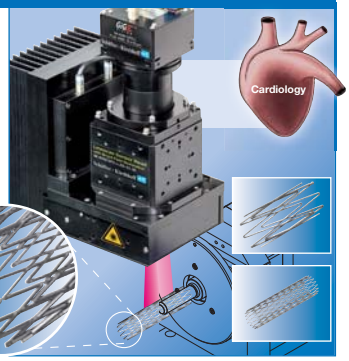
A novel development in automated surface inspection and analysis:
The application of increasingly sophisticated illumination techniques for the enhancement of specific object features is routine in microscopy.

High-contrast image acquisition of structured objects: making the invisible visible. Illumination and image acquisition techniques that exploit the object properties emphasize the features of real interest.



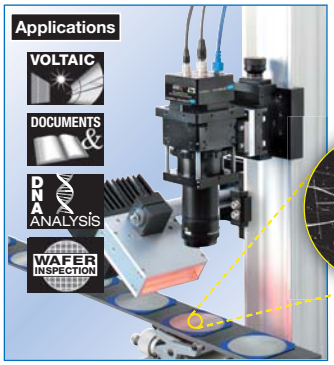
Imprint testing · Microembossing · Paint damage · Crack detection



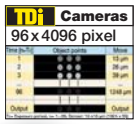


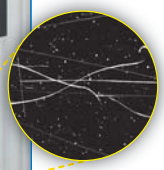
Dark-field illumination with a TDI line scan camera Wafer inspection

For details: see catalog pages 30–31



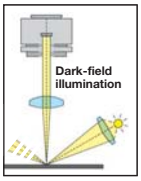
TDI Cameras
96 x 4096 pixel





For the detection of reflecting scratches and particles down to the submicron level.

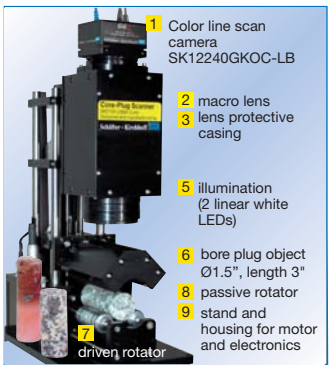
In industrial image processing, dark-field illumination is particularly useful for the examination of highly reflecting surfaces. The light beam is directed at the surface of the test object at a low angle of incidence, so that the light is undetected by the camera when reflected from a perfect surface. With an immaculate surface, a scanned object appears totally dark. When there are surface irregularities caused by some damage, such as a scratch or a crack, or contamination, such as dust, lint or grease, then a small part of the incident light is scattered diffusely, captured by the lens and directed onto the sensor. The tiniest of irregularities are observed as light areas on a dark background. The dark-field illumination of a reflective surface produces quite faint images. With conventional line scan cameras, longer integration times have to be used in comparison with directed bright-field illumination or for image acquisition from a diffusely reflecting object. Such low signal amplitudes mean only low line frequencies and scan velocities are possible. The highly amplified sensitivity of TDI line scan cameras make them particularly suitable for dark-field illumination, allowing much higher scan and measurement velocities to be achieved than are obtainable with conventional technology.



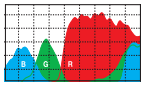
Application fields:
Surface examination of highly reflective materials, such as chips, wafers or mirrored surfaces.
Highlighting of contours, scratches, cracks, dust particles and dirt.

Plug Scanner SK-4080-GigE Color… Gold, Diamond and Oil Sniffer

For details: see catalog page 35



Color

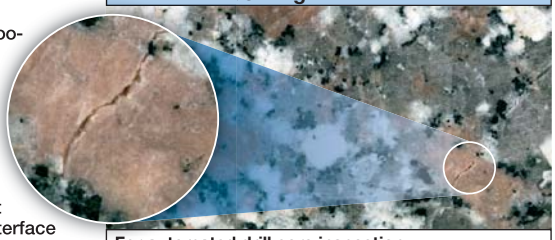


The bore plug scanner SK-4080-GigE Color was specially developed as a fully mobile surface-scanning macroscope by Schäfter+Kirchhoff for the investigation of smooth and cylindrical objects, such as ice bore plugs.

Features:

- Rapid and precise exchange of test objects by using two rotating supports
- Simple adjustment of focus for objects with different diameters
- A surface scan by simply pressing a switch or a mouse button
- Automatic white balance
- One-click zooming for 1:1 depictions
- Printing and saving of total or zoomed sections
- The Gigabit Ethernet interface makes the placement of the scanner highly flexible, so that it can be used almost anywhere

One-click zooming



For automated drill core inspection:
the color line scan camera SK12240GKOC-LB, 3 x 4080 pixel (RGB)
- Optical resolution of 1360 dpi
- For object diameters of 1"– 2" up to a length of 75 mm

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