

## Machine Vision Essentials ■ ■ ■



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## LINOS

History	4
Vision Technology at LINOS	5
From OEM to Standard	6
<b>Standard Programm</b>	
MeVis-C / Cm series	8
MeVis-C / Cm series - Specifications	9
inspec.x UV series	10
inspec.x UV series - Specifications	11
inspec.x M series	12
inspec.x M series - Specifications	13
inspec.x L series	14
inspec.x L series - Specifications	15
Apo-Rodagon D Scan series	16
Apo-Rodagon D Scan series - Specifications	17
Rodagon/Rogonar S series	18
Rodagon/Rogonar S series - Specifications	19
Macro CCD lens series	20
Macro CCD lens series - Specifications	21
Telecentric lenses TL series	22
Telecentric lenses TL series - Specifications	23
inspec.x cam	24
inspec.x cam - Specifications	25
<b>Mechanical Accessories</b>	
Mechanical Adaptions	27
Modular & Smart Focus	28
Focus Adapter System	29
<b>Customized Solutions</b>	
Beyond the standard	31
Providing solutions	32
<b>Available lenses</b>	34



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- Standard lenses
  - Custom developments
  - Technical support services

# LINOS History

## A company with a comprehensive past and a promising future

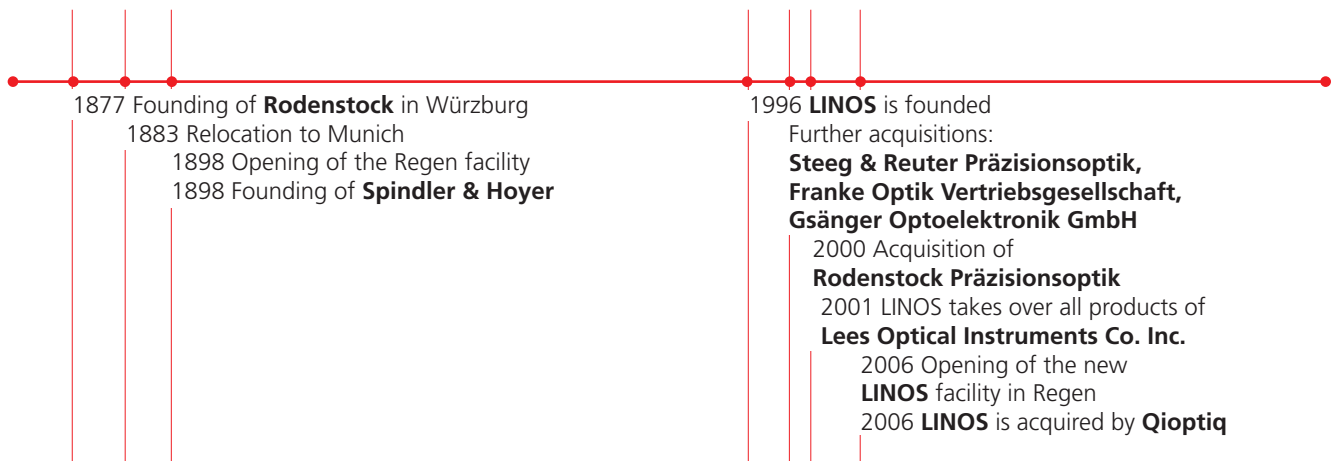
With over 800 employees (more than 130 of which are physicists and engineers) working at three German sites and many subsidiaries all over the world, we are able to meet all of our customers' requirements in the optical industry. Our aim is to provide extensive service and customer support from the very first customer contact. With many years of

experience and a huge range of projects carried out in numerous applications we can offer a solution for almost any problem. In addition there are our specialist teams who provide services to customers in the fields of optical design, system engineering, quality assurance and system manufacturing. And, last but not least, as the basis of a good supplier relationship we strive to be a reliable,

competent and longstanding partner to our customers. Our product range and services run from individual standard components to the installation of highly complex optical systems.

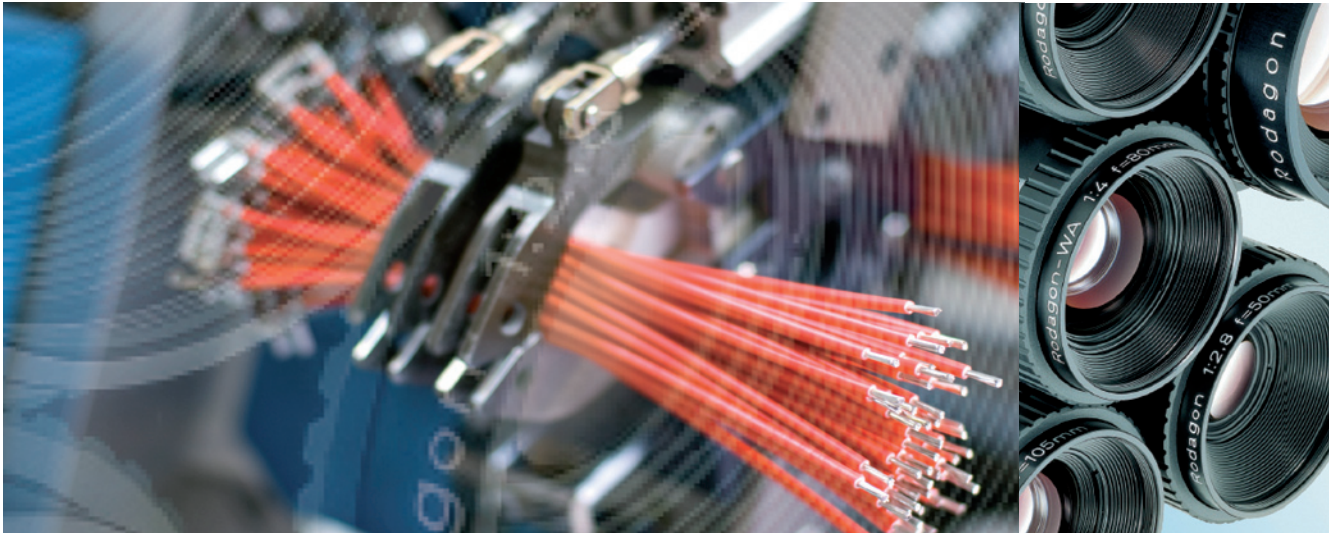


LINOS facility, Regen, Germany



A brief overview of LINOS' history

# Vision Technology at LINOS



Providing solutions in optics for any field of machine vision application we support our customers from the first optical question to a stable and reliable series delivery.

This dialog with the customer, thorough knowledge of the machine vision market and innovation and creativity act as driving forces for the steady growth of our product portfolio and of an increa-

sing demand of customized solutions.

With the new series of the Premium Class, the well established and successful A Class lenses and special camera solutions we serve the growing machine vision market for years.

Our team consisting of highly experienced and competent designers, project managers and sales managers will

give you all the advice and practical support you require either for a solution with standard components or for a special approach.

Today we see our proudly cherished over 100 years old Rodenstock heritage of development and production of high class optical components and devices as a responsibility to be also in future a reliable provider for any optical solution.

Branch	Application
Surveillance/Security	Inspection of traffic
Semiconductor production	Wafer inspection
Electronics	PCB and FPD inspection
Pharma	Packing control
Textiles	Strangepart detection
Printing	Colour consistence
Postal/Banking	ID reading
Packaging	Barcode reading
Food processing	Colour/Form
Biometrics	Fingerprints, Eye-Iris
Medical	Medicine configuration
Transport/Traffic	Inspection of overhead contact lines of railways

These examples show some spots on the large map of applications where customers already rely on LINOS know-how and LINOS products

# From OEM to Standard



The current trend towards smaller pixel sizes on the one hand and larger image sensors on the other hand makes it impossible to use standard CCTV lenses any longer without sacrificing resolution. With line scan sensors we see a combination of both trends, as pixel sizes have arrived at 5µm with a sensor length of up to 60mm and more. Those new sensors need to be accompanied by high performance optics to be able to use the high resolution of the sensor. LINOS has solutions for all current sensor and camera trends:

- High resolution lenses for c-mount that deliver the necessary resolution to fully utilize the high pixel count of sensors up to 1.2".

- Standard resolution lenses for large image sensors
- High resolution lenses for long line scan sensors with pixel dimensions down to 5µm

Common to all our objectives is a build quality that complies to the highest standards. This applies also to the customized solutions that we develop and deliver to our customers when the standard program is not sufficient. Be it a special revision of a standard lens without moving parts or a highly application specific optical assembly consisting of optics, mechanics and electronics, we see ourselves as your reliable partner

with a more than 100 years tradition in optical design and manufacturing of opto-mechanical systems. The following chapters of this brochure give you a comprehensive overview of the standard Machine Vision program of LINOS as well as the capabilities we have for your customized solutions. A very good overview of the standard program gives you the table on the last two pages.

## Standard Programm



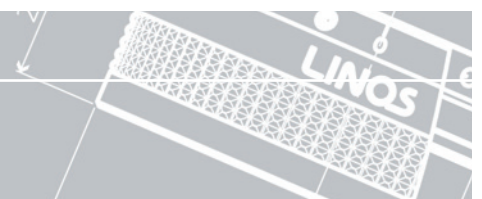
A huge variety of possible lens solutions allows to reach a high level in all system integration processes.



## Mechanical Accessories



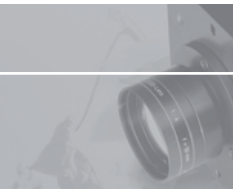
Modular Focus  
Smart Focus  
Focus Adapter System

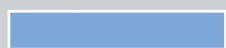
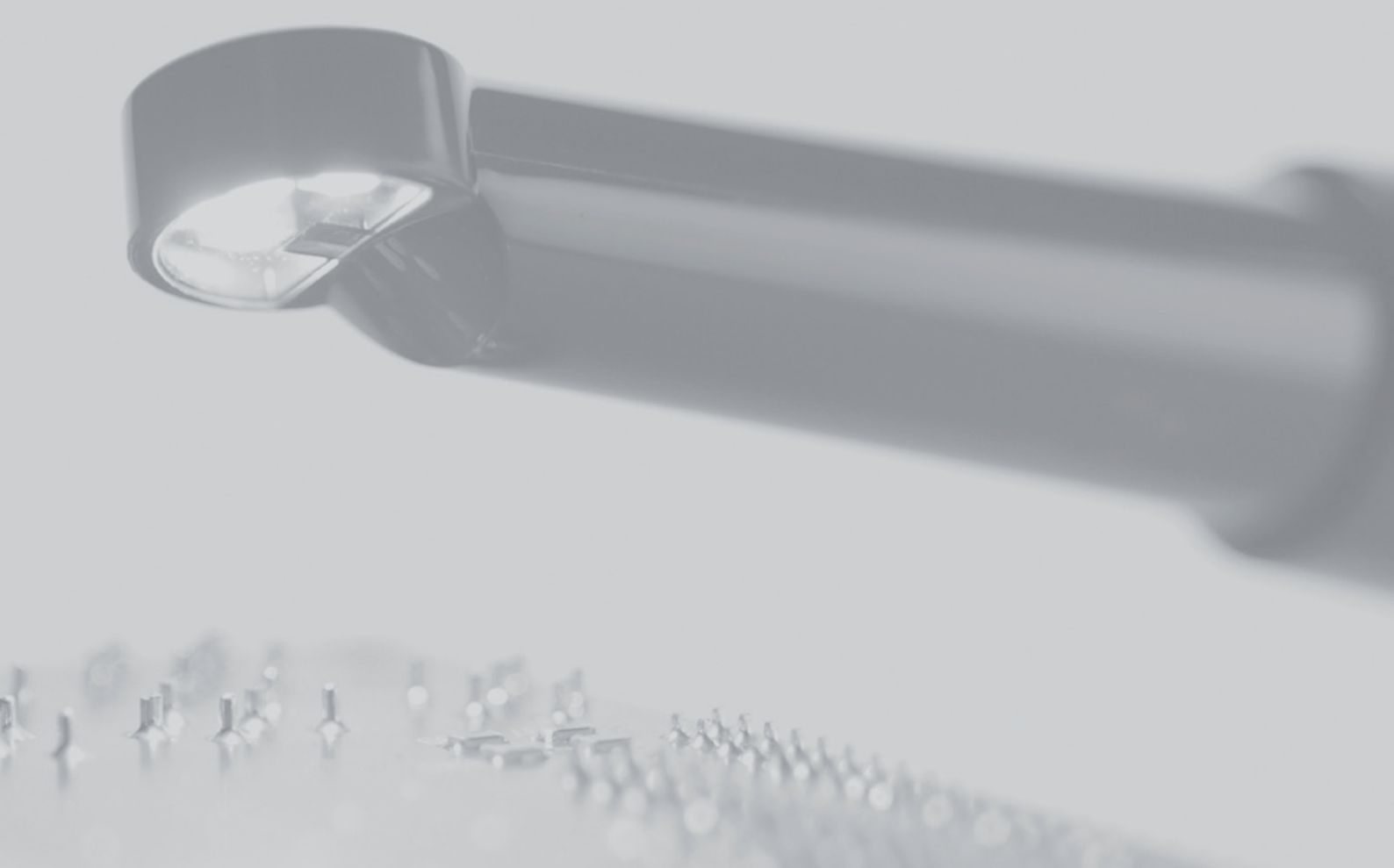


## Customized Solutions



Your application needs a modification of an existing standard product or a completely new design according to your specification? We would be glad to meet your challenges!

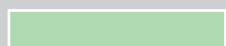




Premium Class



A-Class



inspec.x cam



Standard Programm

# MeVis-C / Cm series



Premium Class

## Machine Vision lenses for Multi-Megapixel cameras

The LINOS MeVis-C lenses are specifically developed for use with the highest resolution sensors available on the market. An exceptionally high resolution across the entire sensor ensures excellent performance for the most demanding applications.

Designed with no brightness fall off or distortion across the full field and a chromatic correction through the entire operating wavelength range (450 - 900nm) to eliminate irritating

color fringes these lenses resolve up to 120 lines per mm even in the extreme image corners. The resolution is high enough for a 12Megapixel sensor with up to 1inch image diameter.

The mechanical housing is designed with lockable screws to work in any machine vision environment and fits also to all commercially available 3 chip cameras with beam splitters.

The MeVis-C lenses are also available in a motorized version called MeVis-Cm.

This series comes with a motorized diaphragm and focus and is easily controlled by built-in potentiometers.

## Characteristics

- Large image field up to 1inch
- For pixel size even below 2 $\mu$ m
- High numerical aperture



# MeVis-C / Cm series - Specifications

Specifications	Measuring lens MeVis-C				
	12 mm	16 mm	25 mm	35 mm	50 mm
Focal length	12 mm	16 mm	25 mm	35 mm	50 mm
F-number	1.8	1.6	1.6	1.6	1.8
Max. sensor size	2/3"	2/3"	1"	1"	1"
MOD	0.03 m	0.15 m	0.26 m	0.37 m	0.67 m
Spectral range	450 - 1000 nm	450 - 1000 nm	450 - 1000 nm	450 - 1000 nm	450 - 1000 nm
Camera threaded mount	C-mount	C-mount	C-mount	C-mount	C-mount
Depth of thread	3.5 mm	3.5 mm	3.5 mm	3.5 mm	3.5 mm
Focusing	manual, lockable	manual, lockable	manual, lockable	manual, lockable	manual, lockable
Iris diaphragm	manual, lockable	manual, lockable	manual, lockable	manual, lockable	manual, lockable
F-number range	1.8 ... 16	1.6 ... 16	1.6 ... 16	1.6 ... 16	1.8 ... 16
Filter thread	M 35.5 x 0.5	M 35.5 x 0.5	M 35.5 x 0.5	M 35.5 x 0.5	M 35.5 x 0.5
Length	63.9 mm	51.2 mm	44.1 mm	59.4 mm	67.5 mm
Diameter	42 mm	42 mm	42 mm	42 mm	42 mm
Weight	275 g	170 g	156 g	210 g	240 g
Part No.	266.0012.001.040	266.0016.001.040	266.0025.001.040	266.0035.001.040	266.0050.001.040

# inspec.x UV series



Premium Class

## Machine Vision lenses for UV applications

Optical systems in the UV spectral range below 400nm are used in many different fields of application: the optical detection of electric discharges (Solar blind spectroscopy), crime-scene inspection or general spectroscopic tasks. During the last years also other applications start to capture the UV market, for example the machine vision inspection or laser material processing. A further high tech area, the micro chip production is no more conceivable without UV light. The fight for larger storage capacities by using smaller patterns is directly connected with light with shorter and shorter wavelengths.

Optical components and systems for applications in the ultraviolet spectral range underly particular demands and requires special knowledge. Optics companies like LINOS rise to these challenges in this growing market and develop the optical systems as well as the necessary special techniques for production and measuring.

### Challenges of the design and production process:

Optical systems acquire their high imaging performance mainly by a sophisticated combination of optical glasses with different diffraction and dispersion.

In contrast to the visible region there are only a few crystal glasses available for the optical designer to develop a UV system. Furthermore the outstanding resolution requirements for such systems enforce precise mounting technologies as typically accepted tolerances for the single lens elements are below 1µm! This is only possible by using precision turning techniques for the lens production. To measure these high class systems LINOS uses a combination of classical interferometry and the Hartmann-Shack-method.

### Characteristics

- For applications down to 240nm
- Designed for high resolution megapixel cameras
- Minimized focal shift over the complete wavelength range
- Precision manual focus with long life full metal construction

# inspec.x UV series - Specifications

Lens name	Order number	Working distance
inspec.x UV/VIS APO 2,8/50	G033550000	0.4 - 0.8 m
inspec.x UV/VIS APO 2,8/50	G033551000	0.7 - 1.5 m
inspec.x UV/VIS APO 2,8/50	G033552000	1.5 m - inf

- Excellent UV transmission
- Flare and ghosting minimized across the UV-VIS spectrum with advanced AR coating
- Precision manual focus with long life full metal construction
- Designed for High Resolution Megapixel Cameras like Toshiba Teli CS3930UV or Sony XCD-SX910UV
- Compact Size
- Minimized focal shift over complete wavelength range
- Applications: Surface inspection, Forensics and Law Enforcement, Solar blind imaging, Corona and arcing detection
- Focal length: 50mm
- Aperture Range: f/2.8 – f/22
- Spectral range: 240-700nm (UV-VIS)
- Max. CCD Format: 2/3" (optimized for 1/2")
- Angular FOV at working distance 10.5° (at 400mm object distance in diagonal) calculated for 2/3"
- FOV at Min. Working distance 80mm (at 400mm object distance in diagonal) calculated for 2/3"
- Temperature: -20°C to +50°C
- 8 lenses with high precision mounting technique
- High sophisticated anti-reflection broadband coating

# inspec.x M series



Premium Class

## **Lenses for high resolution linescan and areascan applications**

LINOS systems enable 100% quality control in manufacturing. Our long-standing experience with optomechatronic systems and our extensive technology transfer across a wide variety of industries and research institutions enable us to continuously optimise our systems. When it comes to innovation, even the smallest element is ultimately indispensable. The new inspec.x M series closes the gap between the outstanding

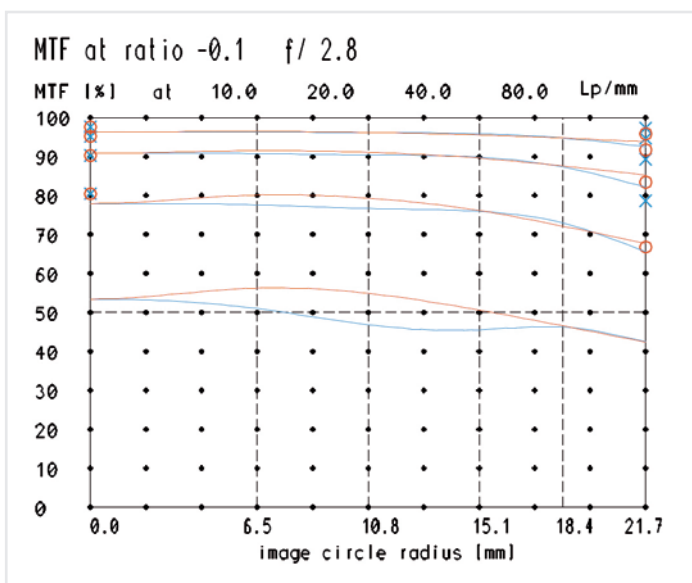
c-mount MeVis-C lenses and the large format inspec.x L scan lenses. Equipped with lockable manual focus and manual iris these F-mount lenses are the ideal choice for high resolution 35mm format sensors. To cover the magnification range from infinity to 1:2 without a drop of quality the lenses are designed with a floating element.

### **Characteristics**

- Outstanding MTF performance
- Large magnification range
- Rugged mechanical design
- F-mount, flexible for other camera mounts

# inspec.x M series - Specifications

Lens name	Order number	Focal length	Magnification range	Image circle
inspec.x M 2,8/100	269.0100.001.000	100 mm	Inf - 0.5	43,3 (35 mm format)
inspec.x M 1,4/50	269.0050.001.040	50 mm	Inf - 0.15	28



The MTF diagram shows the outstanding performance of the inspec.x M 2.8/100. Even at 80lp/mm the contrast is above 40% over the complete image circle.

# inspec.x L series



## Premium Class

### Lenses for high resolution line scan applications

The inspec.x L line consists of six lenses. While the 4/60 and 4/100 lenses are optimized for a magnification of 1:30 and 1:20 the four variants of the 5.6/105 are optimized for 1:3, 1:2, 1:1.5 and 1:1 respectively.

All lenses cover line sensors of up to 70mm length, and the superb resolution makes it possible to use the lenses for pixel sizes down to 5 $\mu$ m.

The 4/60 and the 4/100 can be equip-

ped with the Modular Focus focussing unit and a broad range of different camera mounts, whereas the 5.6/105 lenses are mountable via a v-groove.

By using this v-groove the best azimuth (factory marked) can be used. As the v-groove is present at both ends the lenses can easily be used in retro position to achieve a magnification of 3:1, 2:1 and 1.5:1 respectively.

An optimized tube system with fine

adjustment of magnification is available for the 5.6/105. The camera mount for this tube system is M72.

## Characteristics

- For line sensors up to 70mm
- Focus and aperture lockable
- Designed for high contrast imaging with 12k/5 $\mu$ m sensors

# inspec.x L series - Specifications

Lens name	Order number	Focal length	Magnification range	Image circle
inspec.x L 4/60	268.0060.001.049	60 mm	Inf – 0.2	70 mm
inspec.x L 4/100	268.0100.001.049	100 mm	Inf – 0.2	70 mm
inspec.x L 5,6/105	268.0105.001.085	105 mm	-0.25 – -0.45	70 mm
inspec.x L 5,6/105	268.0105.001.084	105 mm	-0.4 – -0.65	70 mm
inspec.x L 5,6/105	268.0105.001.083	105 mm	-0.6 – -0.9	70 mm
inspec.x L 5,6/105	268.0105.001.082	105 mm	-0.85 – -1.2	70 mm

# Apo-Rodagon D Scan series



A Class

## High performance lenses for large imaging sensors and Line-Scan applications

The high resolution of the Apo-Rodagon-D lenses make them an optimum solution for cameras with a pixel size down to  $5\mu\text{m}$ . The high resolution is accompanied by ultra low distortions and neglectable color fringing. The lenses are optimized for a magnification range from 1:2 to 1:1.

All lenses have the „Leica-thread“ M39x1.26“ lens mount in common. Via the broad range of adaptor systems with helical mounts and focussing units the Apo-Rodagon-D lenses can be used with a broad variety of cameras. All lenses can also be used in retro position to achieve the inverse magnification.

## Characteristics

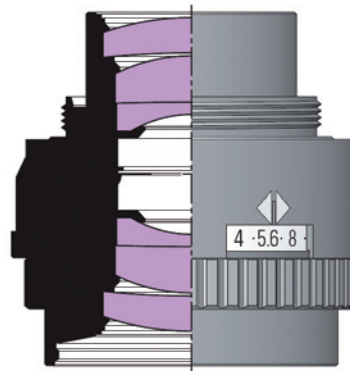
- Specially designed for scanning applications and large imaging sensors
- Optimized for 1:2 to 2:1 imaging
- Suitable for sensors down to  $5\mu\text{m}$  pixel size



# Apo-Rodagon D Scan series - Specifications

Lens name	Order number	Focal length	Image circle	Aperture ratio
Apo-Rodagon D2 50	273.0050.001.020	50 mm	43,3 mm	1:4.5
Apo-Rodagon D1x	273.0075.001.040	75 mm	80 mm	1:4.0
Apo-Rodagon D2x	273.0075.002.040	75 mm	80 mm	1:4.5
Apo-Rodagon D 120	273.0120.001.040	120 mm	80 mm	1:5.6

The 6 element, apochromatically corrected lenses feature high contrast and sharpness right up to the picture corners with practically no color fringes. Distortion is corrected almost to zero and cannot be seen even in critical subjects with straight-lined structures. The optimum working aperture is between f/5.6 and f/8. This is worth mentioning because the effective aperture of a lens focused for a scale of about 1:1 is approximately two f-stops smaller than the nominal aperture and therefore stopping down to smaller apertures than nominal f/8 would result in visible blur because of diffraction. All four models are fitted with clickstop aperture rings.



# Rodagon / Rogonar S series



A Class

## For large imaging sensors and line scan applications

Designed to the highest standards, LINOS Enlarging Lenses offer unprecedented optical performance for the most demanding applications. The large image field allows use with large format line scan and area scan

cameras. The lenses are compatible with nearly any common mount through the use of our broad range of mechanical accessories. You may choose out of various lens types for different requirements:

### Rogonar-S

Inexpensive lens with good imaging performance. Optimum price/performance ratio.

### Rodagon

High performance lens featuring a highly consistent imaging quality and broad magnification range.

### Rodagon-WA

High performance lens with extended viewing angle - shorter focal length for the same image field possible.

### Apo-Rodagon-N

Achromatically corrected lens designed to meet the highest requirements in an especially broad magnification range

## Characteristics

- Large amount of different focal lengths
- Precise and established optical design
- Different series for special applications

# Rodagon / Rogonar S series - Specifications

Lens name	Order number	Focal length	Image circle	Aperture ratio
Rogonar-S 25	208 0025 001 000	25 mm	18 mm	1:4
Rogonar-S 35	208 0035 001 000	35 mm	25 mm	1:4
Rogonar-S 50	208 0050 001 040	50 mm	43,3 m	1:2.8
Rogonar-S 60	208 0060 001 040	60 mm	56 m	1:4.5
Rogonar-S 75	208 0075 001 040	75 mm	84,8 mm	1:4.5
Rogonar-S 90	208 0090 001 040	90 mm	84,8 mm	1:4.5
Rogonar-S 105	208 0105 001 040	105 mm	75 mm	1:4.5
Rodagon 28	270 0028 001 000	28 mm	30 mm	1:4
Rodagon 35	270 0035 001 000	35 mm	30 mm	1:4
Rodagon 50	270 0051 001 040	50 mm	43,4mm	1:2.8
Rodagon 60	270 0060 001 040	60 mm	56 m	1:4
Rodagon 80	270 0081 001 040	80 mm	65 mm	1:4
Rodagon 105	270 0105 001 040	105 mm	80 mm	1:5.6
Rodagon 135	270 0135 001 040	135 mm	174 mm	1:5.6
Apo-Rodagon N 50	275 0050 001 040	50 mm	43,3 mm	1:2.8
Apo-Rodagon N 80	275 0080 001 040	80 mm	70 mm	1:4
Apo-Rodagon N 105	275 0105 001 040	105 mm	100 mm	1:4
Rodagon WA 40	277 0040 001 040	40 mm	43,3 mm	1:4
Rodagon WA 60	277 0060 001 040	60 mm	84,4 mm	1:4
Rodagon WA 80	277 0080 001 040	80 mm	75 mm	1:4

# Macro CCD lens series



A Class

**Developed for c-mount CCD cameras**

Macro Lenses for CCD cameras feature the highest resolution, excellent contrast, color neutrality and are virtually free of distortion. The Macro CCD lenses are designed for 1/2" and 2/3" sensors.

A large selection of Macro Lenses is available: With fixed focal lengths for magnifications of 0.14 x (ratio 1:7) to 8 x (ratio 8:1), which can be supplied with various fixed diaphragm aperture settings and a number of Macro Lenses with fixed focal

lengths for magnifications of 2 x to 8 x which are available in a choice of versions with parallel axis illumination for shadow-free illumination (for example in narrow recesses).

## Characteristics

- Huge range of magnifications available
- Designed for 1/2" and 2/3" sensors
- Outstanding performance

# Macro CCD lens series - Specifications

Lens name	Order number	Focal length	Magnification	Aperture ratio
Macro CCD Lens 0.14 x	260.0014.001.020	15	0.14 x (1:7.1)	4
Macro CCD Lens 0.14 x	260.0014.001.021	15	0.14 x (1:7.1)	5.6
Macro CCD Lens 0.14 x	260.0014.001.022	15	0.14 x (1:7.1)	8
Macro CCD Lens 0.3 x	260.0030.001.020	24	0.3 x (1:3.3)	3.5
Macro CCD Lens 0.3 x	260.0030.001.021	24	0.3 x (1:3.3)	5.6
Macro CCD Lens 0.3 x	260.0030.001.022	24	0.3 x (1:3.3)	8
Macro CCD Lens 0.5 x	260.0050.001.020	35	0.5 x (1:2)	5.6
Macro CCD Lens 0.5 x	260.0050.001.021	35	0.5 x (1:2)	8
Macro CCD Lens 1 x	260.0100.001.020	50	1 x (1:1)	4
Macro CCD Lens 1 x	260.0100.001.021	50	1 x (1:1)	5.6
Macro CCD Lens 1 x	260.0100.001.022	50	1 x (1:1)	8

Lens name	Order number	Focal length	Magnification	With epi-illuminator
Macro CCD Lens 2 x	261.0200.001.020	26	2 x (2:1)	
Macro CCD Lens 2 x	261.0200.002.020	26	2 x (2:1)	x
Macro CCD Lens 4 x	261.0400.001.020	20	4 x (4:1)	
Macro CCD Lens 4 x	261.0400.002.020	20	4 x (4:1)	x
Macro CCD Lens 6 x	261.0600.001.020	13	6 x (6:1)	
Macro CCD Lens 6 x	261.0600.002.020	13	6 x (6:1)	x
Macro CCD Lens 8 x	261.0800.001.020	9	8 x (8:1)	
Macro CCD Lens 8 x	261.0800.002.020	9	8 x (8:1)	x

# Telecentric lenses TL series



A Class

## Objectives for 2D and 3D measurement applications

Metrology, quality inspection and image analysis are the most important applications for telecentric measuring lenses. The advantage of using a telecentric lens is that it produces an image over a spatial depth. Within its telecentric range, the imaging scale remains constant so that correct image dimensions can be measured from three dimensional objects for software controlled processing. LINOS has developed telecentric lenses

each for 1/2" and 2/3" CCD cameras with different object area diameters. They are characterized by extreme sharpness, freedom from distortion and a high aperture (NA = 0.1). All models are designed for the visible spectral range and come fitted with an iris which allows adjustment of the depth of field. The large working distance makes illumination and operation easier.

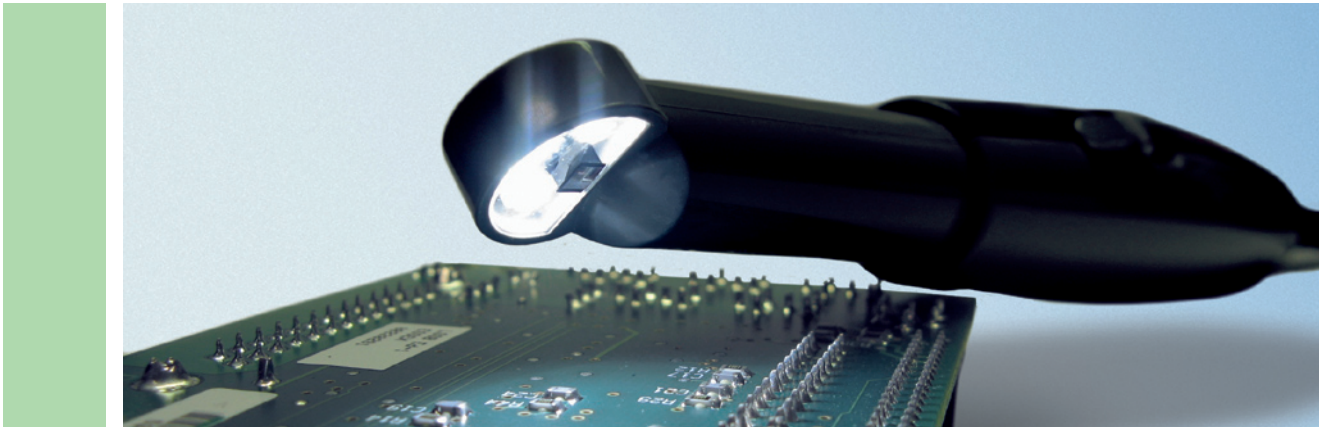
## Characteristics

- Ultra low distortion
- Designed for 1/2" and 2/3" sensors
- High numerical aperture

## Telecentric lenses TL series - Specifications

Lens name	Order number	Working distance	$\beta'$	NA	Distortion [%]
TL 1-12-215	265.0001.012.215	106	1	0.06	0.9
TL 2-28-280	265.0002.028.280	117	0.5	0.015	0.45
TL 3-55-395	265.0003.055.395	174	0.337	0.02	0.6
TL 5-6-270	265.0005.060.270	92	0.2	0.02	0.12
TL 6-60-260	265.0006.060.260	144	0.13	0.01	0.1
TL 10-120-745	265.0010.120.745	284	0.098	0.01	0.1
TL 15-120-705	265.0015.120.705	284	0.067	0.008	0.15

# inspec.x cam



## Camera Systems

### USB 2.0 handheld inspection camera

LINOS Photonics is pleased to introduce a new 90° video inspection camera with a range of focus from 3mm to infinity. The inspec.x cam is a rigid unit containing a 1/3" CCD camera, four imbedded white LEDs for illumination, one simple control lever for controlling aperture, illumination and focus and a button to store single images.

The patented coupling of focus, iris adjustment and LED lighting provides bright images and high depth of field for viewing at both macro and infinity. Housed in durable plastic and weighing only 200 grams, the camera can be used in numerous industrial applications for

inspection inside small spaces and crevices where normal cameras cannot go. The maximum magnification is approximately 60x when the image is displayed on a 17" TFT monitor. Typical applications include the inspection of:

- The inside of tubing and exhaust pipes
- Engine crevices and various automotive parts
- Circuit boards
- Small storage tanks

The inspec.x cam is a portable, rugged device allowing easy use out in the field. The distal tip of the camera head is submersible as the first 50mm are waterproof. Because LINOS employs a high resolution sensor and distortion-free vario focal length optics the image quality produced by the inspec.x cam is exceptional including true color reproduction.

## Characteristics

- Easy-to-use USB 2.0 inspection camera
- Patented coupling of focus and lighting adjustment
- „Direct Image Storage“ button
- Ideal for service and field applications



# inspec.x cam - Specifications

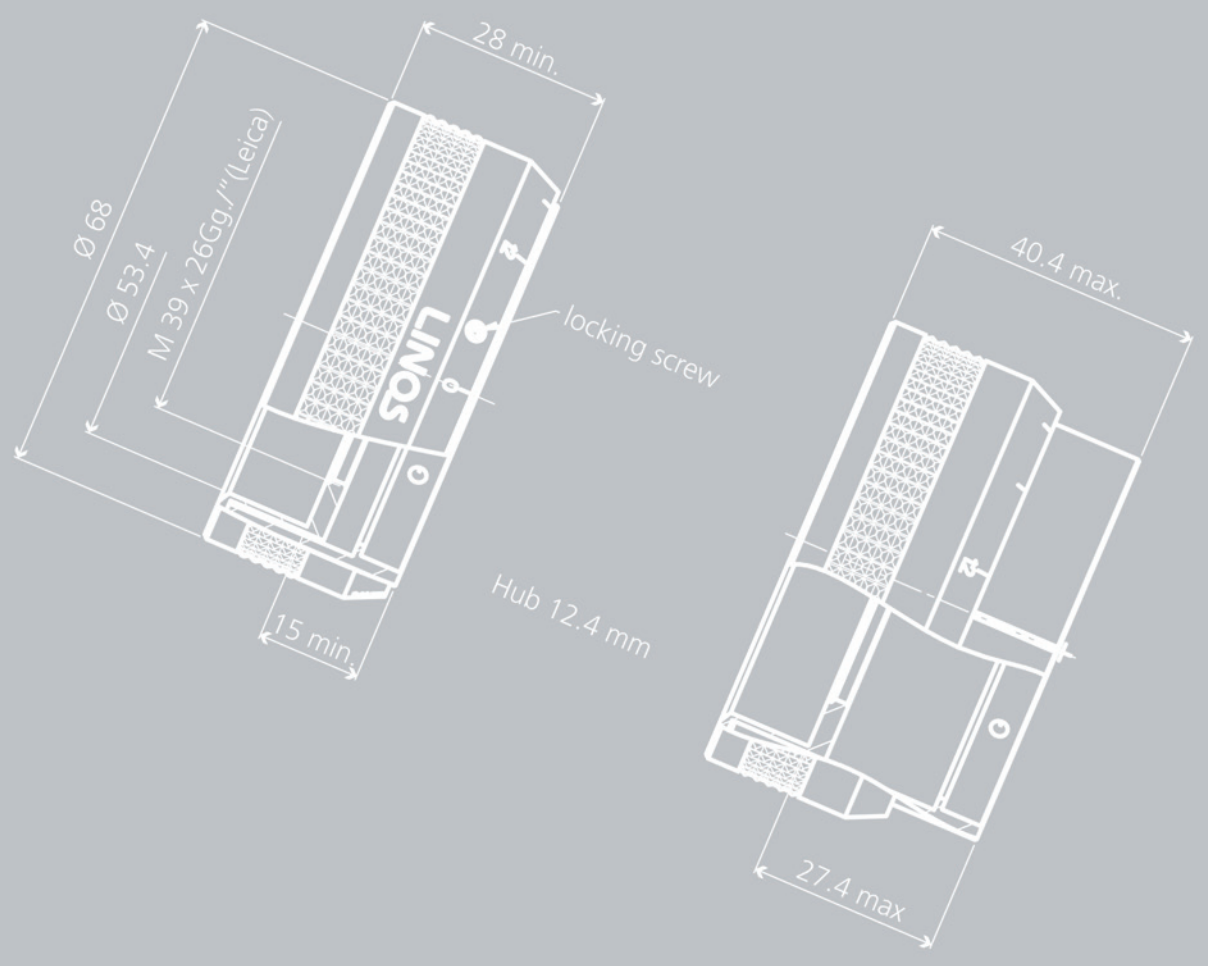
Image Sensor	
Sensor	1/3" CCD Color
Pixels	795 Horizontal x 596 Vertical

ICamera Hand Piece & Tubing	
Weight	200 grams
Length	225 mm (without cable)
Cover Glass	Sapphire (highly scratch resistant)

ICamera Module	
Signal Standard	PAL Color System
Image Scanning	2:1 Interlace
Electronic Shutter	1/60 to 1/2000 seconds
Video Output	USB 2.0 interface
Video driver interface	DirectShow compatible
Power supply	USB 2.0

Optical System	
Illumination	4 LEDs (white)
Angle of View	53 degrees (diagonal)
Diaphragm	Adapts to focus setting
Focus Range	3 mm to Infinity
Distortion	< 5% at 3 mm focus distance
Optical design	7 lenses with AR-coating; color and aberration corrected

# Mechanical Accessories



# Mechanical Accessories

## Mechanical Adaptors

Since the LINOS "Measuring Lenses for Large Format Sensors" have a quite

unusual thread (M 39 x 1/26") and no focusing device we have created a

complete range of ways to adapt those lenses to all existing camera systems:

### Modular Focus

A helical mount with modular possibilities of adapting numerous LINOS CCD lenses onto different camera threads.

Using "Lens adapters" for M 32,5 and M 39 lens threads and "Camera adapters" for all existing camera threads like C-mount, F-mount, M 42 x 1 and individual camera threads for DALSA, ATMEL, BASLER etc. The Modular Focus is designed to keep the lens from rotating during focusing.

### Accessories

1094.2408.009.020 Helical mount

### Camera Adapter

1094.2408.009.106 C-mount  
1094.2408.009.115 T2 M 42 x 0,75  
1094.2408.009.119 SLR M 42 x 1  
1094.2408.009.116 Leica M 39 x 1/26"  
1094.6512.000.120 Nikon Adapter/  
F-mount  
1094.2408.009.124 DALSA 1,965"  
1094.2408.009.125 DALSA Spyder/  
Spark  
1094.2408.009.129 ATMEL SM2/M2  
1094.2408.009.130 ATMEL M4/6k  
1094.2408.009.131 ATMEL M4/8k  
1094.2408.009.134 M72x0,75

### Lens Adapter

1094.2408.009.118 M 39 x 1/26"  
1094.2408.009.112 M 39 x 1/26" \*  
1094.2408.009.111 M 32,5 x 0,5

### Extension Tubes

1094.2408.009.113 25mm  
1094.2408.009.122 87,5mm  
1094.2408.009.123 60mm  
1094.2408.009.135 24mm f. M72

### Smart Focus

Low cost version of Modular Focus with M 39 thread for lenses and using the camera adapters from the Modular Focus system.

Difference to Modular Focus? The lift is shorter than the one from Modular Focus and the lens rotates while it is focused.

### Accessories

1094-2408-021-043 Helical mount

### Extension Tubes

1094.2408.021.108 12mm  
1094.2408.021.109 24mm  
1094.2408.021.110 48mm  
1094.2408.021.111 120mm

### Focus Adapter System

The lens adapter 1094.2408.005.101 is used to enlarge the serial M 39 thread up to M 42 x 1.

Together with retaining ring 1094.2408.005.102, which fixes the reached focus position, it is already possible to mount the lenses onto M 42 camera threads. Referring to focal length and magnification it will be necessary to use extension tubes like 1094.2408.005.103.

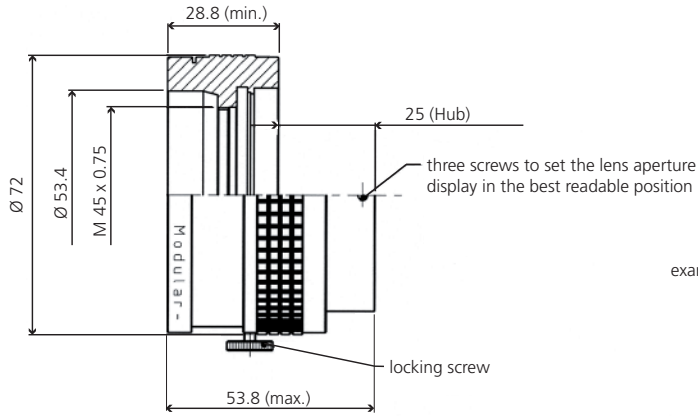
The Focus Adapter System was created as a reasonable alternative to the existing helical mounts. It is mainly used in OEM applications where a quick and safe adaption of the well known LINOS lenses is needed.

### Accessories

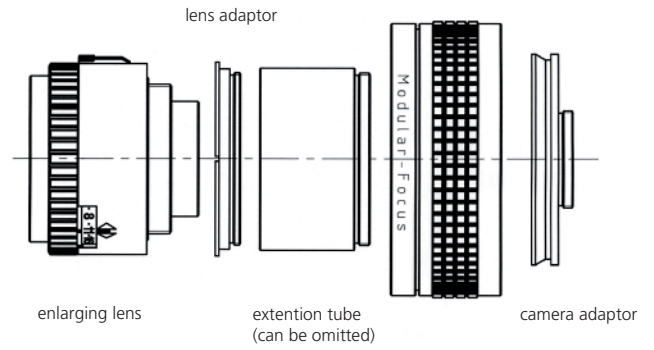
1094.2408.005.101 Lens adapter  
1094.2408.005.102 Counter ring  
50mm  
1094.2408.005.103 Counter ring  
63mm  
1094.2408.005.104 Adapter for  
mounting onto  
existing camera  
adapter Modular  
Focus  
1094.2408.005.105 C-mount  
1094.2408.005.106 Extension tube  
11mm

\* to use with Rodagon 135mm, Apo Rodagon N 105mm, Apo Rodagon D 2x 75mm, Apo Rodagon D 120mm

# Modular Focus

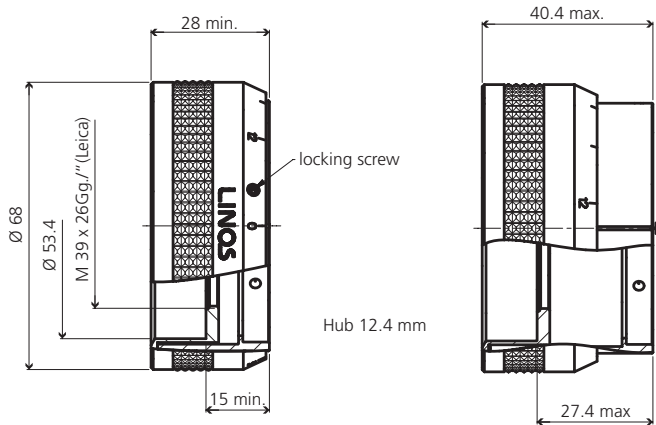
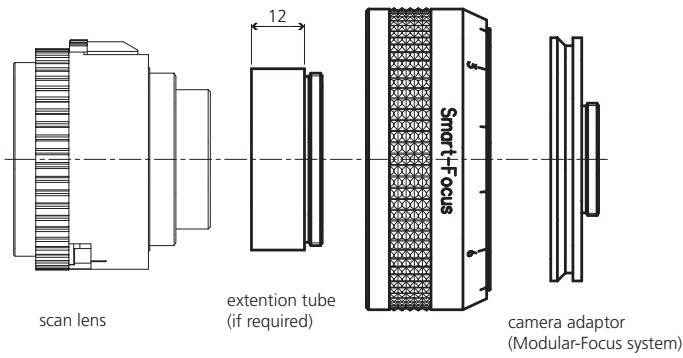


example of application



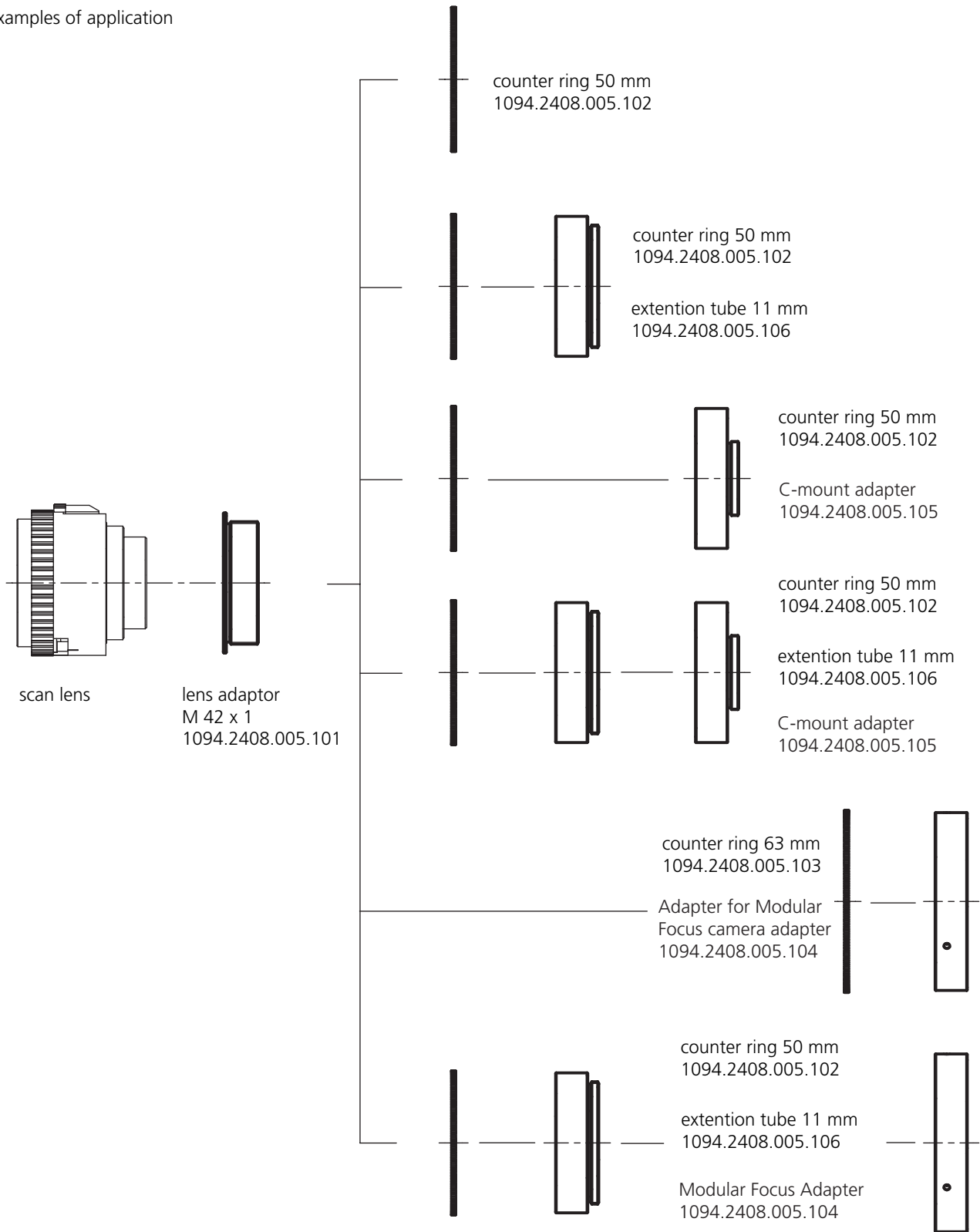
# Smart Focus

example of application



# Focus Adapter System

examples of application



# Customized Solutions



# Beyond the standard



Customer specific developments

## **Diffraction limited lenses, cameras, modules for any machine vision application**

Many customers involve us in the development of their products at a very early stage. Our widely experienced development teams can analyze the task and indicate how optical systems can contribute to the solution.

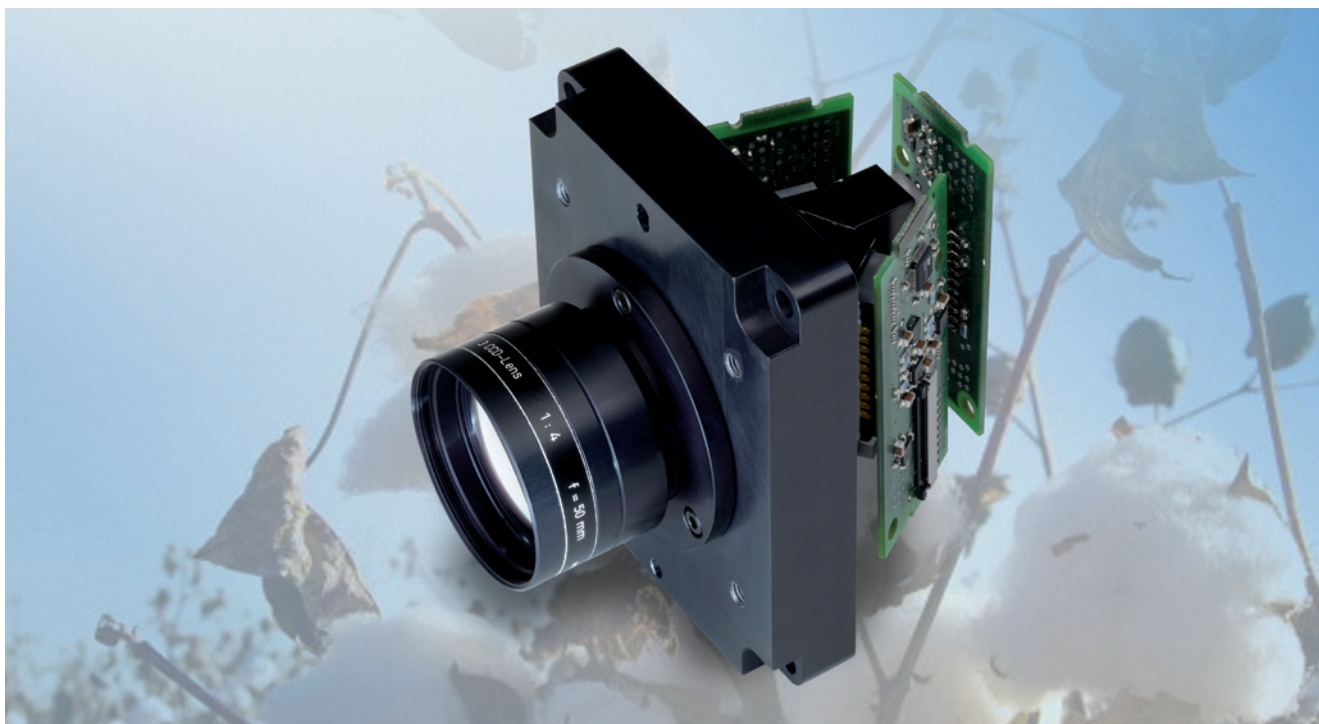
Optical design has been our core competency for over 100 years. Our optical designers use both commercial software and in-house programs that we have developed to meet special requirements. Additionally, our engineering staff includes mechanical & electrical engineers who help us integrate each technology into a custom solution.

The biggest step in the development of a new product is the conversion from design to the actual working model. Our engineering staff works closely with our production department to enable this to happen quickly and accurately. Rapid prototyping is available if needed by our customers.

LINOS has mastered the transfer of the manufacturing from prototype quantities to mass production. The entire development and production process at LINOS is integrated in a comprehensive quality management system that is ISO 9001 certified. Additionally, our production

organization is based upon the flexibility of our workers and our group processes. We use interdisciplinary, semi-autonomous work groups, responsible for all aspects of production, from purchasing raw materials to planning and production of the finished product.

## Providing solutions



### Development of a RGB camera module for detecting foreign particles in cotton fibres

*„In the course of processing a customer-request for a 3-CCD camera, we came across several duties and responsibilities, each of them with the necessity of a proprietary technological solution. Since we had access to a huge base of know-how grown over the past at LINOS, we successfully presented the results of our labour within the given time schedule.“*

**Markus Middlecamp,**  
Product Manager LINOS

#### Situation

When cotton fibres are processed, it is important to detect foreign particles and cut them out safely without a large-scale loss of fibres in order to ensure they are ideally prepared for spinning mills. Foreign particles and fibres can be subdivided into two completely different categories: the first category comprises particles that clearly distinguish themselves from cotton in terms of colour, contrast and structure. The second category comprises light and transparent objects. The colour of these foreign substances, which are mostly made of poly-

propylene or PE films hardly ever differs from the colour of cotton, which is why conventional foreign particle separators are unable to detect them.

#### Problem

Standard cameras with trilinear sensors for red, green and blue are used in numerous machine-vision applications. A colour line camera with a triple-line sensor cannot be used for the application described above because the cotton fibres are not transported over the whole width of the viewing field at the same speed. The reason for this is



that the individual colour channels of the triple-line sensor are located at a distance of approx. 30-40µm from each other and the three channels are not pointing to the same place. This means that it is absolutely necessary to use a camera system with a prism beam splitter as only this would ensure that the individual colour channels point to the same place at exactly the same time. When one takes a closer look at the cameras generally available on the market, it soon becomes clear that standard cameras with prism beam splitters do not satisfy the special requirements for this application. Trützschler has found a competent partner for the development of a customer-specific camera system in LINOS. A study proved the feasibility of the requirements so Trützschler then consequently decided to assign the task of development of the camera system to LINOS.

#### **Solution**

The central element of system development was an optimised special lens

design, which corrects the occurring aberrations (optical imaging errors) of the triple-channel prism used. In order to ensure that all three colour channels point to the same place, a special emphasis was placed on the lateral chromatic aberration in the various design approaches. Another central aspect is appropriate colour splitting in the triple prism by dielectric colour-splitter layers. The quality of the colour-splitter layers has a major impact on the precision of reconstruction of the colour of an object from the three colour channels. LINOS has extensive experience with designing such layer systems. A suitable layer design could be developed with multiple simulation iterations. As manufacturing customer-specific prism systems (in this case also with an air gap) is an everyday task for LINOS, this essential element of the camera system could also be completed target-specifically. Once the lens and prism system had been defined and developed for the present application, this component only had to be integrated, together with three

linear sensors, into a camera system. A solution had to be found to position and fix the three sensors accurately down to the micrometre. The requirement of <2µm positioning accuracy of the three sensors towards each other resulting from the tolerance assessment could be put into practice on the basis of LINOS' know-how in the field of bonding technology. The cameras are set up, adjusted and fixed completely by LINOS using a particular special-to-type tooling and adjustment software. The customer is offered a product that can be used directly in his plants.

*"We could fully rely on the LINOS capabilities in R&D and production for doing customized solutions. With the RGB camera module we got a high quality product which very well fits to our own claim of being a technological and market leader for textile machinery manufacturing."*

**Guido Engels**

Trützschler, Germany

# Available lenses

	Lens	sensor size					camera mount					
		1/2"	2/3"	1"	35mm	70mm line scan	C-mount	F-mount	M72	M58	M42	Other
A-Class	Rogonar-S 25	✓	✓	✓			✓	✓	✓	✓	✓	✓
	Rogonar-S 35	✓	✓	✓			✓	✓	✓	✓	✓	✓
	Rogonar-S 50	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
	Rogonar-S 60	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
	Rogonar-S 75	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
	Rogonar-S 90	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Rogonar-S 105	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Rodagon 28	✓	✓	✓			✓	✓	✓	✓	✓	✓
	Rodagon 35	✓	✓	✓			✓	✓	✓	✓	✓	✓
	Rodagon 50	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
	Rodagon 60	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
	Rodagon 80	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Rodagon 105	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Rodagon 135	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Apo-Rodagon N 45	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
	Apo-Rodagon N 50	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
	Apo-Rodagon N 80	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Apo-Rodagon N 105	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Rodagon WA 40	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
	Rodagon WA 60	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
	Rodagon WA 80	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Apo Rodagon D 1x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Apo Rodagon D 2x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Apo Rodagon D 120	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Apo Rodagon D2 50	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
Macro CCD	✓	✓				✓						
Telecentric	✓	✓				✓						
Premium Class	MeVis-C 12mm	✓	✓				✓					
	MeVis-C 16mm	✓	✓				✓					
	MeVis-C 25mm	✓	✓	✓			✓					
	MeVis-C 35mm	✓	✓	✓			✓					
	MeVis-C 50mm	✓	✓	✓			✓					
	inspec.x M 2.8/100	✓	✓	✓				✓				
	inspec.x M 1.4/50	✓	✓	✓				✓				
	inspec.x L 4/100	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	inspec.x L 4/60	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	inspec.x L 5.6/105	✓	✓	✓	✓	✓			✓			
	inspec.x L 5.6/105	✓	✓	✓	✓	✓			✓			
	inspec.x L 5.6/105	✓	✓	✓	✓	✓			✓			
	inspec.x L 5.6/105	✓	✓	✓	✓	✓			✓			
	inspec.x UV 2.8/50	✓	✓				✓					

	magnification range							minimum pixel size					
	inf	0,05	0,1	0,5	0,75	1	2	10	7	5	<5	2	<2
Rogonar-S 25		✓	✓					✓	✓				
Rogonar-S 35		✓	✓					✓	✓				
Rogonar-S 50		✓	✓					✓	✓				
Rogonar-S 60		✓	✓					✓	✓				
Rogonar-S 75		✓	✓					✓	✓				
Rogonar-S 90		✓	✓					✓	✓				
Rogonar-S 105		✓	✓					✓	✓				
Rodagon 28		✓	✓					✓	✓				
Rodagon 35		✓	✓					✓	✓				
Rodagon 50		✓	✓					✓	✓				
Rodagon 60		✓	✓					✓	✓				
Rodagon 80		✓	✓					✓	✓				
Rodagon 105		✓	✓					✓	✓				
Rodagon 135		✓	✓					✓	✓				
Apo-Rodagon N 45		✓	✓					✓	✓				
Apo-Rodagon N 50		✓	✓					✓	✓				
Apo-Rodagon N 80		✓	✓					✓	✓				
Apo-Rodagon N 105		✓	✓					✓	✓				
Rodagon WA 40		✓	✓					✓	✓				
Rodagon WA 60		✓	✓					✓	✓				
Rodagon WA 80		✓	✓					✓	✓				
Apo Rodagon D 1x						✓		✓	✓	✓			
Apo Rodagon D 2x				✓	✓		✓ <sup>2)</sup>	✓	✓	✓			
Apo Rodagon D 120				✓	✓		✓ <sup>2)</sup>	✓	✓	✓			
Apo Rodagon D2 50				✓	✓		✓ <sup>2)</sup>	✓	✓	✓			
Macro CCD			✓	✓		✓	✓	✓	✓	✓			
Telecentric		✓	✓	✓		✓		✓	✓				
MeVis-C 12mm	✓	✓	✓					✓	✓	✓	✓	✓	✓
MeVis-C 16mm	✓	✓	✓					✓	✓	✓	✓	✓	✓
MeVis-C 25mm	✓	✓	✓					✓	✓	✓	✓	✓	✓
MeVis-C 35mm	✓	✓	✓					✓	✓	✓	✓	✓	✓
MeVis-C 50mm	✓	✓	✓					✓	✓	✓	✓	✓	✓
inspec.x M 2.8/100	✓	✓	✓	✓				✓	✓	✓			
inspec.x M 1.4/50	✓	✓	✓					✓	✓	✓			
inspec.x L 4/100	✓	✓	✓					✓	✓	✓	✓		
inspec.x L 4/60	✓	✓	✓					✓	✓	✓	✓		
inspec.x L 5.6/105				✓ <sup>1)</sup>				✓	✓	✓	✓		
inspec.x L 5.6/105				✓			✓ <sup>2)</sup>	✓	✓	✓	✓		
inspec.x L 5.6/105					✓			✓	✓	✓	✓		
inspec.x L 5.6/105						✓		✓	✓	✓	✓		
inspec.x UV 2.8/50	✓	✓	✓					✓	✓	✓	✓		

<sup>1)</sup> optimized for 0.33, 3x magnification in retro position

<sup>2)</sup> in retro position

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