LINOS Machine Vision Lenses

Company Profile

Qioptiq designs and manufactures photonic products and solutions that serve a wide range of markets and applications in the areas of industrial manufacturing, medical and life sciences, research and development, defense and aerospace.

The company is known for its high-quality standard components, products and instruments, custom modules and assemblies, leading-edge innovation, precision manufacturing and responsive global sourcing. Due to a series of acquisitions, Qioptiq has an impressive history and pedigree, benefiting from the knowledge and experience of LINOS, Point Source, Rodenstock Präzisionsoptik, Spindler & Hoyer, Gsänger, Optem, Pilkington and others.

With a total workforce exceeding 2,300, Qioptiq has a worldwide presence with locations throughout Europe, Asia and the USA.

Milestones

1877	1898	1966	1969	1984	1991
RODENSTOCK	SPINDLER & HOYER		Gsänger	OPTEM	POINT SOURCE
Founding of Rodenstock	Founding of Spindler & Hoyer	Founding of Pilkington PE Ltd. which later becomes THALES Optics	Founding of Gsänger Optoelektronik	Founding of Optem International	Founding of Point Source

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1996

LiNOS

Merger of
Spindler & Hoyer,
Steeg & Reuter
Präzisionsoptik,
Franke Optik and
Gsänger Optoelektronik
to LINOS

2000

RODENSTOCK

LINOS acquires
Rodenstock
Präzisionsoptik

2001

AVIMO Group
is acquired
by THALES

2005

Thales sells
HTO Group
which is
rebranded
Qioptiq

2006 / 2007

QIOPTIQ
Optics with Intelligence

LINOS & Point Source
become "members
of the Qioptiq group"

2010

QIOPTIQ
Photonics for Innovation

Rebranding of all group
members to one brand -
Qioptiq

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Machine Vision

Machine vision applications are diverse and numerous. These include large-scale industrial manufacture, short-run, unique object manufacture, traffic and speed surveillance, packaging control of pharmaceuticals, inspection and process control (e.g. quality control, failure analysis), visual inventory management systems (counting, barcode reading, store interfaces for digital systems), semiconductor fabrication and many more.

From lenses to cameras...

...from illumination to controls, Qioptiq provides solutions for almost any machine vision application. We specialize in developing

technology to meet your exacting requirements. If your specifications cannot be met with our standard products, engage our technical support teams for a custom solution to your specific application.

Our customer development teams of optical, mechanical and electrical engineers, project managers and service personnel work together to offer extensive experience across a wide range of industries and applications. Our advice and practical experience are based on a 100-year cherished history of our Rodenstock, Optem and LINOS machine vision heritage.

Produced by Qioptiq:
RGB camera for particle detection
in textile manufacturing

Market	Application
Surveillance/Security	Traffic monitoring
Semiconductor production	Wafer inspection, processing & probing
Electronics	PCB and FPD inspection
Pharmaceutical	Packaging control, crystal development
Textiles	Foreign particle detection
Printing	Color consistency
Postal/Banking	Optical character recognition
Packaging	Barcode scanning, package integrity
Food processing	Color/form
Biometrics	Fingerprints, retinal scan, bio-fluid analysis
Medical	Medicine configuration
Transport/Traffic	Rail and overhead conductor inspection

From OEM to Standard

The current trend toward 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 lengths up to 60mm and more. Those new sensors need to be accompanied by high-performance optics to fully leverage the high-resolution of the sensor. Qioptiq 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 goals is a quality that complies to the highest standards. This applies also to the customized solutions that we develop and deliver to our customers when our standard products are 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 expertise in optical design and manufacturing of innovative opto-mechanical systems. The following chapters of this brochure give you a comprehensive overview of the standard LINOS Machine Vision products available from Qioptiq as well as the extensive capabilities we have for your customized solutions.

Your Demands - Our Solutions

Your Demands
- High imaging quality
- Robust reliability for harsh industrial environments
- System integration capabilities
- Compact optical modules
- Camera integration and sensor optimization
- Long-term delivery guarantee
- Comprehensive service & support

Qioptiq can help you!
Our solutions for
Machine Vision are:
- High-resolution lenses
- Large-format lenses
- Micro-inspection lenses
- Line-scan lenses
- C-Mount and F-Mount lenses
- High-performance zoom optics
- Telecentric optics
- Megapixel lenses
- Reflective objectives
- Long working distance objectives
- Electro-optic integration
- Compact optical packaging
- Specialized illumination
- UV / Visible / IR wavelength
- Precision alignment optics
- Low-distortion imaging
- Vision-based metrology

MeVis-C series

High-Resolution C-Mount Lenses for Megapixel Cameras

MeVis-C lenses are specifically developed to be used 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 for zero brightness fall off or distortion across the full field, and chromatic correction through the entire operating wavelength range (450-900nm) to eliminate irritating color fringes, these lenses resolve up to 200 lp/mm, even in the extreme image corners. The resolution is high enough for a 12 Mpixel sensor with up to 1-inch image diameter. The mechanical housing is designed with lockable screws for stability in any machine vision environment and fits all commercially available three-chip cameras with beam splitters.

Features

- Large image field up to 1-inch
- For pixel size even below 2µm
- High numerical aperture

- Transmission range: 450-1000nm
- Camera Mount: C-Mount
- Depth of thread: 3.5mm
- Focusing: manual, lockable
- Iris diaphragm: manual, lockable
- Filter thread: M35.5 x 0.5
- Diameter: 42mm

MeVis-C series - Specifications

Focal length (mm)	F-number	Max. sensor size	MOD (m)	F-number range	Length L (mm)	Weight (g)	Order No.
12	1.8	2/3"	0.03	1.8-11	63.9	240	0020-005-000-40
16	1.6	2/3"	0.22	1.6-16	51.5	170	0020-004-000-40
25	1.6	1"	0.32	1.6-16	44.1	156	0020-002-000-40
35	1.6	1"	0.45	1.6-16	59.4	210	0020-001-000-40
50	1.8	1"	0.76	1.8-16	67.5	240	0020-003-000-40

MeVis-Cm series (motorized)

Motorized Versions of MeVis-C

To meet today's growing automated imaging requirements, Qioptiq expanded the MeVis product line with a motorized version. Motorization of the MeVis-Cm lenses enables automated adjustment of the focus and diaphragm, which is a tremendous advantage for remote operation and hard-to-access installations. Encoders in the MeVis-Cm ensure precise and reproducible adjustment.

Featuring standard C-Mount connectivity, MeVis-Cm lenses are easy to integrate with a wide variety of CCD cameras typically utilized in industrial inspection applications. Because of their rugged design, the motorized lenses are ideal for use under tough industrial conditions.

- Transmission range: 450-1000nm
- Camera mount: C-mount
- Depth of thread: 3.5mm
- Focusing Iris diaphragm: single, motorized
- Filter thread: M39 x 0.5
- Length: 66mm
- Diameter: 69mm

Features

- Motorized diaphragm and focus
- User-configurable connections
- Rugged and industry-compatible version

MeVis-Cm series - Specifications

Focal length (mm)	F-number	Max. sensor size	MOD (m)	Iris range	Weight (g)	Order No.
16	1.6	2/3"	0.22	1.6-16	370	G03 8414 000
25	1.6	1"	0.32	1.6-16	356	G03 8415 000
35	1.6	1"	0.45	1.6-16	410	G03 8416 000
50	1.8	1"	0.76	1.8-16	440	G03 8417 000

MeVis-CF series

Superior Optical Performance Packaged in a Compact and Robust Housing

With the new MeVis-CF series Qioptiq introduces a new line of lenses to serve applications requiring best possible imaging quality from a compact, robust lens package. The optical performance is equal to the renowned MeVis-C series. The mechanics, however, are designed to be as simple as possible.

The major difference to the MeVis-C series is the fixed aperture which enables the durability and size needed for space-constrained applications. The lenses are available in several versions offering a variety of apertures.

Additional focal lengths are under development and will be will available for delivery in 2011.

Features

- Highest optical performance
- Compact and robust mechanics
- C-Mount
- Up to 1" sensors

MeVis CF series Specifications

Lens name	Focal length (mm)	Aperture	Maximum image circle (mm)	Magnification range	Order No.
MeVis-CF 1.6/25	25	1.6	16	-0.1 … ∞	0020-007-000-20
MeVis-CF 2.8/25	25	2.8	16	-0.1 … ∞	0020-007-000-22
MeVis-CF 4/25	25	4.0	16	-0.1 … ∞	0020-007-000-21

NIR Lenses

Specially Designed for the Spectral Range of 800-1400nm

Because the sensitivity of CCD sensors is very low in the NIR range it is absolutely vital to bring every available photon onto the sensor. Standard lenses that are optimized for visible light are not well suited for this task as the transmission in the NIR range is often below 70%. Qioptiq now offers specialized lenses for well suited that offer outstanding transmission of up to 98% in this wavelength range.

| Features

- Highest transmission of up to 98% in NIR wavelength range
- Optimized for applications in e.g. solar cell testing, food inspection, pharmaceutical applications

NIR Lenses Specifications

Lens name	Focal length (mm)	Maximum aperture	Maximum image circle (mm)	Camera mount	Magnification range	Order No.
MeVis-C 16mm	16	1.6	11	C-Mount	-0.1 ... ∞	0020-004-000-42
MeVis-C 25mm	25	1.6	16	C-Mount	-0.1 ... ∞	0020-002-000-42
MeVis-C 35mm	35	1.6	16	C-Mount	-0.1 ... ∞	0020-001-000-42
MeVis-C 50mm	50	1.8	16	C-Mount	-0.075 ... ∞	0020-003-000-42
inspec.x M 1.4/50	50	1.4	29	F-Mount	-0.07 ... ∞	0009-243-000-42
Apo Rodagon D 2X	75	4.5	80	Universal	-0.3 ... -0.8	0701-028-000-24

Inspec.x UV-VIS series

Premium 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 investigation; or general spectroscopic imaging. More recently, other applications have begun to access the UV imaging, for example specialized machine vision, inspection and laser material processing.

With the tendency toward ever-shrinking feature sizes in micro-chip technology, critical points of interest can only be resolved under shorter and shorter UV wavelengths.

In order to meet this growing arena of imaging, Qioptiq employs unique and highly specialized UV manufacturing techniques in offering the Inspec.x UV-Vis series lenses.

Features

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

Challenges of the UV 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 demand 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. Qioptiq employs a two-phase measurement process, combining classical interferometry with the Hartmann Shack method, to ensure the utmost quality in our ultra-precise UV assemblies

Inspec.x UV-VIS series - Specifications

Item Title	Working Distance (m)	Order No.
inspec.x 2.8/50 UV-VIS APO	0.4 - 0.8	G03 3550 000
inspec.x 2.8/50 UV-VIS APO	0.7 - 1.5	G03 3551 000
inspec.x 2.8/50 UV-VIS APO	1.5 - ∞	G03 3552 000

- Excellent UV transmission
- Flare and ghosting minimized across the UV-VIS spectrum with advanced AR coating
- Precision manual focus with durable, 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
- Eight lenses integrated with high-precision mounting technique
- Highly sophisticated anti-reflection, broadband coating

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Inspec.x M series

Premium Lenses for High-Resolution Line-scan and Area-Scan Applications

Qioptiq 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.

inspec.x M 2.8/100

inspec.x M 1.4/50

Features

- Outstanding MTF performance
- Large magnification range
- Rugged mechanical design
- F-Mount standard, flexible to other mounts
- Wavelength range 450-1000nm

Inspec.x M series - Specifications

Lens name	Focal length (mm)	Magnification range	Image circle (mm)	Order No.
inspec.x M 2.8/100	100	∞ - 0.5	43.3 (35-mm format)	0703-073-000-23
inspec.x M 1.4/50	50	∞ - 0.15	28	0009-243-000-40

The high-resolution of the inspec.x M 2.8/100 combined with a high-resolution camera makes it possible to image a complete solar cell in one shot and inspect for small print defects like interrupts. The example image was taken with a 16 Mpixel camera with the lens at F/2.8.
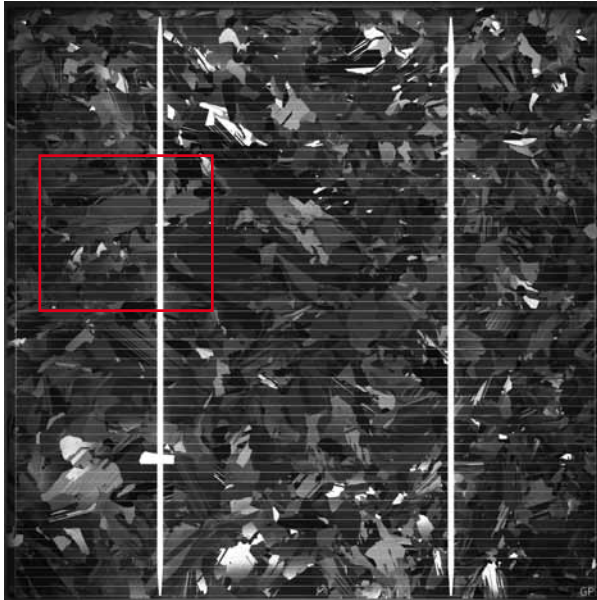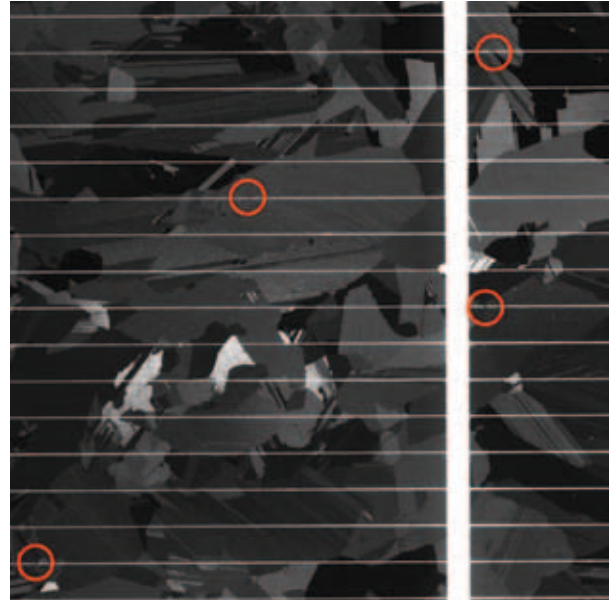
The MTF diagram shows the outstanding performance of the inspec.x M 2.8/100. Even at 80 lp/mm the contrast is above 40% over the complete image circle.
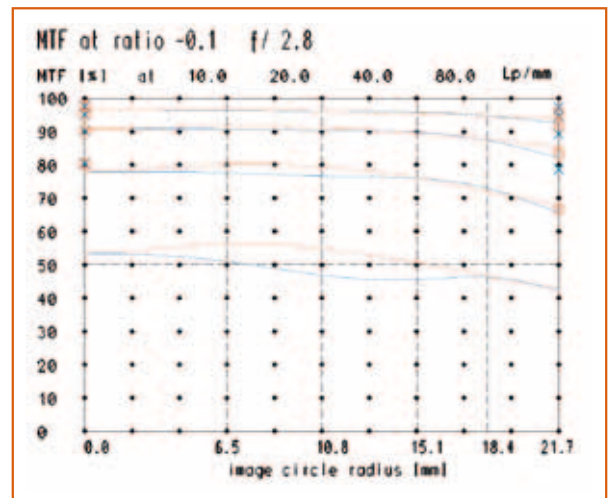
Inspec.x L series

Premium High-Resolution Lenses for Line-Scan Sensors up to 66mm

The inspec.x L-line consists of twelve 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.

The inspec.x L 4/105 3X and inspec.x L 4/105 3.5X are optimized for a magni-fication of 3:1 and 3.5 : 1. The inspec.x L 3.5/105 5X is designed to deliver diffraction limited performance at 5X magnification. For the three high mag-nification lenses with 3X, 3.5X and 5X magnification a second version is available that is corrected for a beam splitter prism on object side.

All lenses cover line sensors of up to 66mm length and the superb resolution makes it possible to use the lenses for pixel sizes down to 5µm.

The 4/60 and the 4/100 can be equipped with the Modular focus focussing unit and a broad range of different camera mounts, whereas the 105mm 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 of the 5.6/105 mm lenses, these can easily be used in the 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 inspec.x L 5.6/105 and the inspec.x L 4/105 lenses. The camera mount for this tube system is M72.

Features

- For line sensors up to 66mm
- Designed for high contrast imaging with 12k / 5µm sensors
- Focus and aperture lockable

Inspec.x L series - Specifications

Lens name	Focal length (mm)	Magnification range	Image circle (mm)	Order No.
inspec.x L 4/60	60	∞ – 0.2	66	0019-002-000-49
inspec.x L 4/100	100	∞ – 0.2	66	0019-003-000-49
inspec.x L 5.6/105	105	-0.25 – -0.45	66	0703-085-000-20
inspec.x L 5.6/105	105	-0.4 – -0.65	66	0703-084-000-20
inspec.x L 5.6/105	105	-0.6 – -0.9	66	0703-083-000-20
inspec.x L 5.6/105	105	-0.85 – -1.2	66	0703-082-000-20
inspec.x L 4/105 3X	105	-2.8 – -3.2	66	0703-104-000-20
inspec.x L 4/105 3X prism	105	-2.8 – -3.2	66	0703-105-000-20
inspec.x L 4/105 3.5X	105	-3.3 – -3.7	66	0703-095-000-21
inspec.x L 4/105 3.5X prism	105	-3.3 – -3.7	66	0703-107-000-20
inspec.x L 3.5/105 5X	105	-4.8 – -5.2	66	0703-102-000-20
inspec.x L 3.5/105 5X prism	105	-4.8 – -5.2	66	0703-108-000-20

For high magnifications coaxial illumination is often necessary. To enable this type of illumination a beam splitter is used between lens and object. The usual beam splitter plates introduce a high degree of astigmatism that destroys the diffraction limited performance of the inspec.x L lenses. Cube beam splitters are a better solution.

Exactly for this application Qioptiq has introduced the new prism versions of the lenses with 3X, 3.5X and 5X magnification. These lenses are corrected for a 12mm beamsplitter cube with the result that the same diffraction limited performance is achieved as for an application without beam splitter. The MTF curves show the inspec.x L 4/105 3.5X in both versions.
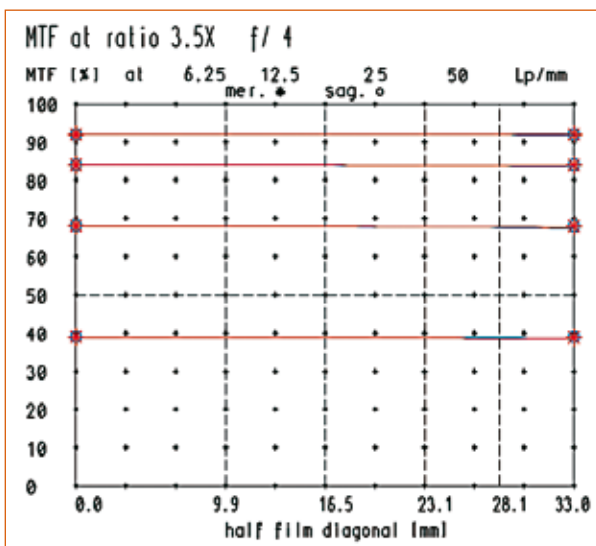
inspec.x L 4/105 3.5X
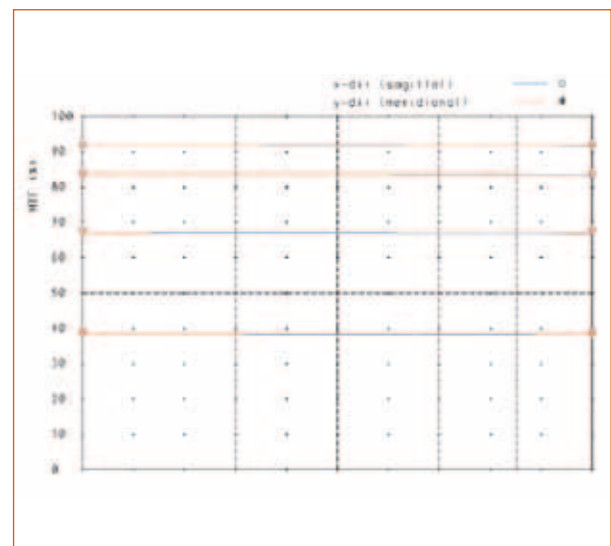
inspec.x L 4/105 3.5X prism

Rodagon F series

Precision Optics for F-Mount

You would like to use a robust objective lens with high performance optics instead of a wobbly photographic lens on your industrial camera? The Rodagon F series is the solution that also offers an excellent cost-performance ratio. The completely new and very robust mechanical design without moving parts makes it possible for the first time to use enlarging lenses of the famous Rodenstock era on F-mount. The smooth focussing is locked with a massive retaining ring that is fixed with additional screws.

The Rodagon F is available in different versions with fixed apertures from F/2.8 to F/5.6 and with focal lengths of 40, 50, and 60mm. The fixed aperture prevents accidental changes of the iris or slowly shifting aperture values through vibrations effectively. The image circle of the lens is 44mm and is therefore large enough for sensors with 35mm format and the popular 41-mm line sensors.

- Focal length: 40, 50, and 60mm
- 44mm image circle Ø at 1: ∞ and fully open diaphragm (mm)
- Max. Lens Ø without flange: 59mm
- Camera mount: F-mount (M42, M58, M72 possible
- Filter thread: M40.5 x 0.5

Features

- Proven imaging performance
- Rugged and compact design
- Excellent cost-performance ratio

Rodagon F series - Specifications

Lens	Focal length (mm)	Aperture ratio	Order No.
Rodagon-F 40	40	1:4.0	0703-090-000-25
Rodagon-F 40	40	1:5.6	0703-090-000-26
Rodagon-F 50	50	1:2.8	0703-089-000-24
Rodagon-F 50	50	1:4	0703-089-000-25
Rodagon-F 50	50	1:5.6	0703-089-000-26
Rodagon-F 60	60	1:4.0	0703-087-000-25
Rodagon-F 60	60	1:5.6	0703-087-000-26

Apo Rodagon HR series

High -Performance in a Compact and Robust Housing

The new Apo Rodagon HR series is designed to close the gap between the high-resolution lenses of the inspec.x L series and the Apo Rodagon D lenses, both in terms of imaging quality and price. The first lens of this new series is the Apo Rodagon HR 0.5X which is optimized for a magnification of 0.5X or 2X when used in retro position. The recommended magnification range is 0.35X to 0.65X.

The robust mechanics of this lens make it suitable for applications in the harshest environments. Thanks to the use of a fixed aperture there are no moving parts present that could cause problems in vibrating environments. The standard aperture of F/5.6 is the value at which the lens achieves the optimum performance. For larger aperture values diffraction already limits the achievable resolution. If a larger aperture value is necessary to achieve a certain depth of field, other versions with F/8 and F/11 are available (values in between upon request).

As you can see from the MTF curve the lens easily resolves 80 lp/mm and is therefore suitable for pixel sizes down to 5µm. Combined with the large image circle of 62mm this makes the Apo Rodagon HR 0.5X a very good match for the popular 12k/5µm line scan cameras.

The Apo Rodagon HR 0.5x features the same focal length as the Apo Rodagon D2x75mm and can therefore replace this lens if higher resolution is needed.

Apo Rodagon HR series - Specifications

Lens name	Focal length (mm)	F-number	Image circle (mm)	Order No.
Apo Rodagon HR 0.5X 5.6/75	75	5.6	62	0703-109-000-20
Apo Rodagon HR 0.5X 8/75	75	8	62	0703-109-000-21
Apo Rodagon HR 0.5X 11/75	75	11	62	0703-109-000-22

Apo-Rodagon D series

High-Resolution 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 sizes down to 5µm. The high-resolution is accompanied by ultra low distortions and negligible color fringing. The lenses are optimized for a magnification range from 1:2 to 1:1.

All lenses have the Leica-thread M39 x 1.26" lens mount in common. With the broad range of adaptor systems with helical mounts and focus 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 high magnification.

- Max. lens Ø without flange 50mm
- Leica-thread M39 x 1.26"
- Filter thread M40.5 x 0.5

Features

- Specially designed for scanning applications and large image sensors
- Optimized for 1:2 to 2:1 imaging
- Suitable for sensors with pixel sizes down to 7µm

Apo-Rodagon D series Specifications

Lens name	Focal length (mm)	Image circle (mm)	Aperture ratio	Order No.
Apo-Rodagon D1x	75	80	1:4.0	0703-005-000-40
Apo-Rodagon D2x	75	80	1:4.5	0703-028-000-21
Apo-Rodagon D 120	120	80	1:5.6	0703-043-000-20

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.

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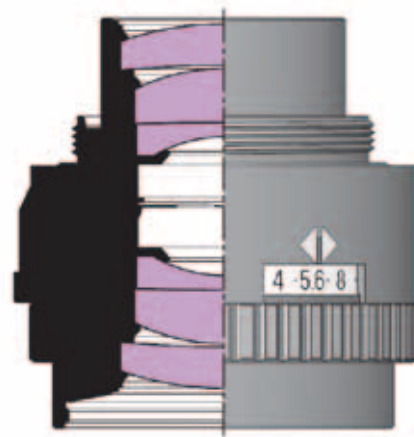
Qioptiq offers a growing range of premium machine vision lenses to meet today's growing demand for exacting machine vision. They are organized into FIXED Lens, ZOOM Optical MACRO Imaging and MICRO Imaging Lenses.

This product guide focuses on Fixed Macro Lenses.

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Rodagon / Rogonar
Versatile large-format lenses

Inspec.x UV-VIS / L / M
High-resolution area & linescan

Telecentric Lenses TL
Objectives for 2D & 3D

MeVis-C / Cm / CF
High-resolution
C-Mount
megapixel lenses

NIR Lenses
Optimized for
NIR applications

Macro

Fixed

Fixed

Macro CCD Lenses
Compact c-mount

Fixed

Micro

Optem FMOS Inspection Lenses
High-magnification modular lenses
for close working distances

Mi

Macro

Micro

Zoom

Zoom

Zoom

Optem MVZL
Macro Video Zoom Lens

**Fetura Advanced Zoom
with Macro Lens Accessory**
Extreme precision, speed,
reliability and durability

Fetura Advanced Zoom Imaging
Extreme programmable zoom optical
precision, speed, and stamina

Optem Zoom Micro Inspection Lenses
Zoom, function and illumination options

Rodagon / Rogonar S series

Versatile Imaging Value for Large Sensors and Line-Scan Applications

Designed to the highest standards, Qioptiq 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.

| Features

- Wide variety of different focal lengths
- Precise and established optical design
- Different series for special applications

You may choose out of various lens types for different requirements:

- **Rogonar-S:**
  Inexpensive lens with good imaging perfomance. Optimum price/performance ratio

- **Rodagon:**
  High performance lens featuring a highly consistent imaging quality and broad magnification range

- **Rodagon-WA:**
  High perfomance lens with extended viewing angle-shorter focal length for the same image field possible

- **Apo-Rodagon-N:**
  Apochromatically corrected lens designed to meet the highest requirements in an especially broad magnification range

Rodagon / Rogonar S series Specifications

Lens name	Focal length (mm)	Image circle (mm)	Aperture ratio	Order No.
Rogonar-S 25	25	18	1:4	0801-272-000-20
Rogonar-S 35	35	25	1:4	0801-273-000-20
Rogonar-S 50	50	43.3	1:2.8	0801-364-000-40
Rogonar-S 60	60	56	1:4.5	0801-324-000-40
Rogonar-S 75	75	84.8	1:4.5	0801-325-000-40
Rogonar-S 90	90	84.8	1:4.5	0801-326-000-40
Rogonar-S 105	105	75	1:4.5	0801-327-000-40
Rodagon 28	28	30	1:4	0701-358-000-20
Rodagon 35	35	30	1:4	0701-357-000-20
Rodagon 50	50	43.4	1:2.8	0701-345-000-40
Rodagon 60	60	56	1:4	0701-393-000-40
Rodagon 80	80	65	1:4	0701-391-000-40
Rodagon 105	105	80	1:5.6	0701-394-000-40
Rodagon 135	135	174	1:5.6	0701-398-000-40
Rodagon WA 40	40	43.3	1:4	0701-399-000-40
Rodagon WA 60	60	84.4	1:4	0701-276-000-40
Rodagon WA 80	80	75	1:4	0701-277-000-40
Apo-Rodagon N 50	50	43.3	1:2.8	0701-349-000-40
Apo-Rodagon N 80	80	70	1:4	0703-092-000-40
Apo-Rodagon N 105	105	100	1:4	0703-019-000-40

Macro CCD Lens series

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 0.14X (ratio 1:7) to 8X (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 2X to 8X which are available in a choice of versions with coaxial illumination for shadow-free illumination (for example in narrow recesses). Ideal for applications with space restrictions requiring compact lenses.

Features

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

Macro CCD Lenses 0.14X to 1X

Macro CCD Lenses 2X to 8X

	A (w/o frontal illumination)	B (frontal illumin.)
Macro CCD Lens 2 x	72.8	76.2
Macro CCD Lens 4 x, 6 x, 8 x	103.6	107.1
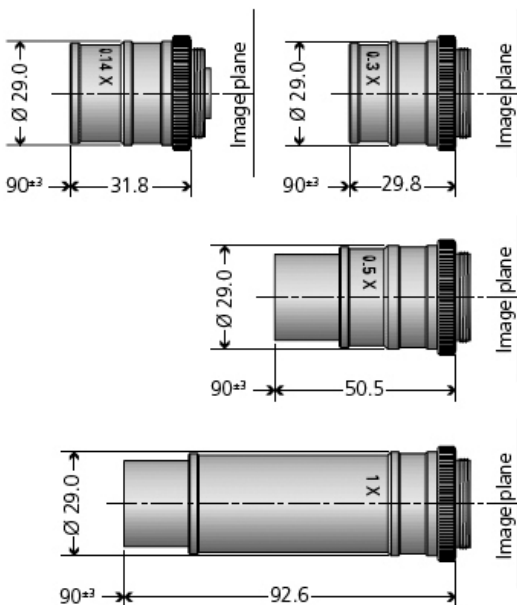
Macro CCD Lens series Specifications

Magnification 0.14X -1X

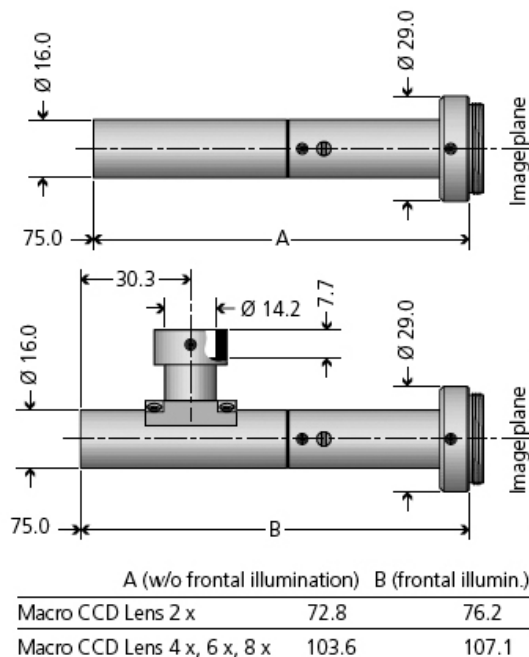| Lens name	Focal length (mm)	Magnification	Aperture ratio	Order No.
Macro CCD Lens 0.14X	15	0.14X (1:7.1)	4	0009-189-000-40
Macro CCD Lens 0.14X	15	0.14X (1:7.1)	5.6	0009-189-000-41
Macro CCD Lens 0.14X	15	0.14X (1:7.1)	8	0009-189-000-42
Macro CCD Lens 0.3X	24	0.3X (1:3.3)	3.5	0009-190-000-40
Macro CCD Lens 0.3X	24	0.3X (1:3.3)	5.6	0009-190-000-41
Macro CCD Lens 0.3X	24	0.3X (1:3.3)	8	0009-190-000-42
Macro CCD Lens 0.5X	35	0.5X (1:2)	5.6	0009-191-000-40
Macro CCD Lens 0.5X	35	0.5X (1:2)	8	0009-191-000-41
Macro CCD Lens 1X	50	1X (1:1)	4	0009-192-000-41
Macro CCD Lens 1X	50	1X (1:1)	5.6	0009-192-000-42
Macro CCD Lens 1X	50	1X (1:1)	8	0009-192-000-43

Magnification 2X - 8X / w/o illumination

Lens name	Focal length (mm)	Magnification	With epi-illuminator	Order No.
Macro CCD Lens 2X	26	2X (2:1)		0009-193-000-40
Macro CCD Lens 2X	26	2X (2:1)	x	0009-205-000-40
Macro CCD Lens 4X	20	4X (4:1)		0009-194-000-40
Macro CCD Lens 4X	20	4X (4:1)	x	0009-206-000-40
Macro CCD Lens 6X	13	6X (6:1)		0009-195-000-40
Macro CCD Lens 6X	13	6X (6:1)	x	0009-199-000-40
Macro CCD Lens 8X	9	8X (8:1)		0009-196-000-40
Macro CCD Lens 8X	9	8X (8:1)	x	0009-200-000-40

Telecentric Lenses TL series

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.

Qioptiq 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.

Features

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

Telecentric Lenses TL series Specifications

Lens name	Working distance (mm)	ß'	NA	Distortion (%)	Order No.
TL 1-12-215	106	1	0.06	0.9	0018-007-000-40
TL 2-28-280	117	0.5	0.015	0.45	0018-006-000-40
TL 3-55-395	174	0.337	0.02	0.6	0018-005-000-40
TL 5-6-270	92	0.2	0.02	0.12	0018-004-000-40
TL 6-60-260	144	0.13	0.01	0.1	0018-003-000-40
TL 10-120-745	284	0.098	0.01	0.1	0018-002-000-40
TL 15-120-705	284	0.067	0.008	0.15	0018-001-000-40
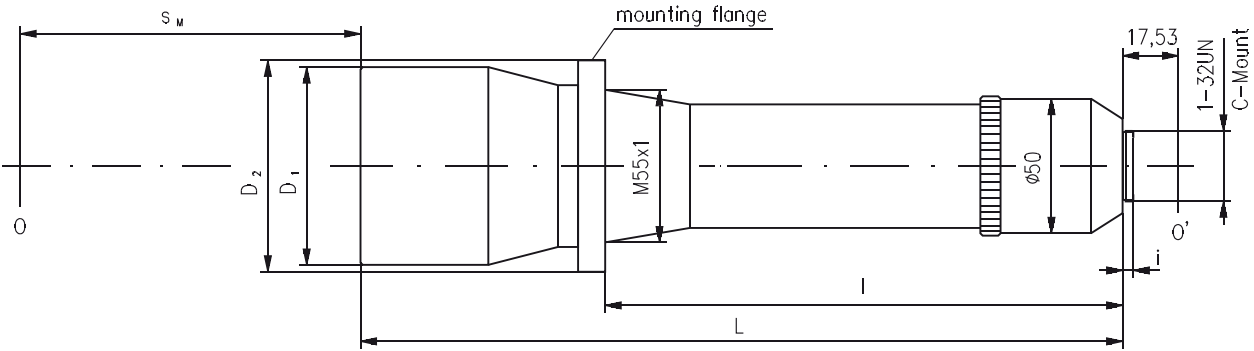
Mechanical Accessories

Adaptions fom Qioptiq Large Format Lenses to all Existing Camera Systems

The Qioptiq measuring lenses for large-format sensors have a M39 x 1/26" thread and come without an internal focusing mechanism, so we have created a complete range of adapters to mount those lenses onto all existing camera systems: You will find the needed Adapter within our adapter systems:

- **Modular Focus System:**
  Numerous high quality adapters, designed to keep the lens from rotating during focusing.

- **Smart Focus System**
  Economical version of the Modular Focus with a shorter shift and the lens rotates while it is focused

- **Fokus Adapter System:**
  Alternative to helical mount for quick and safe adaption, mainly used in OEM applications

- **Focus Tubes M72:**
  Designed for our inspec.x L 105 series

- **Focus Units M72 x 0.75:**
  Various versions with focal lengths from 80-135mm

Modular Focus System

A helical mount with many options for adapting Qioptiq CCD lenses onto different camera mounts. Using "Lens adapters" for M32.5 and M39 lens threads and "Camera adapters" for all existing camera mounts such as C-mount, F-mount, M42 x 1 plus individual camera mounts for DALSA, ATMEL, BASLER etc. The Modular Focus is designed to keep the lens from rotating during focusing, a critical factor in line scan and distortion sensitive area scan applications.

Modular Focus Helical Mount
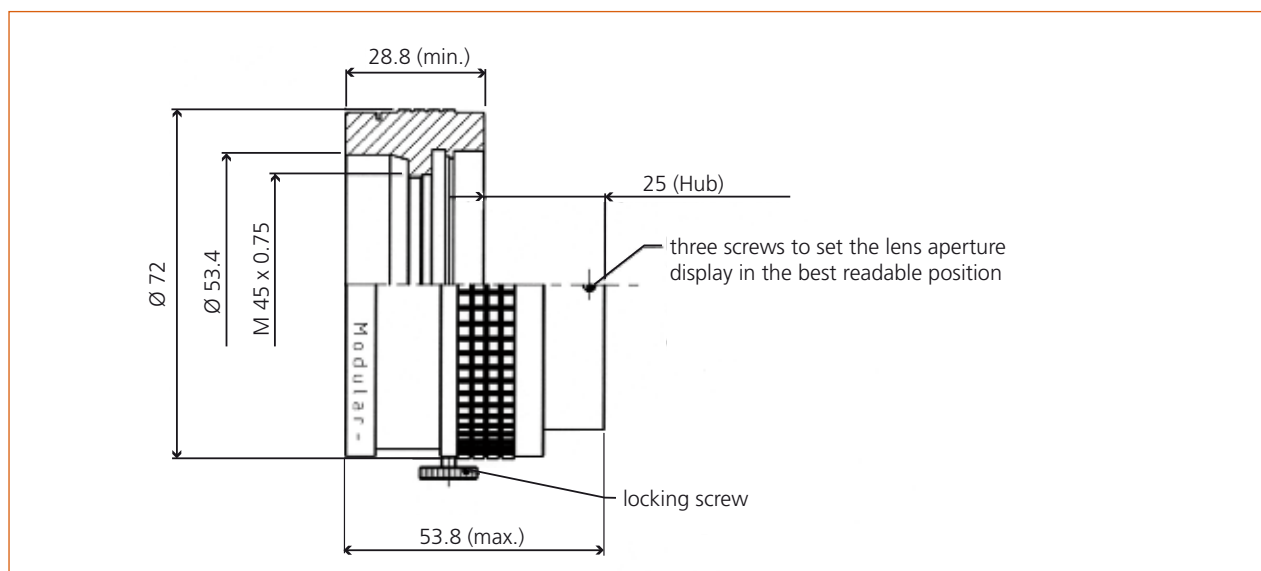
Components	Order No.
Modular Focus Helical Mount	2408-009-000-40
Camera Adapter:	
Camera adapter C-mount	2408-009-106-00
Camera adapter SLR M42 x 1	2408-009-119-00
Camera adapter Nikon adapter/F-mount	2503-651-200-00
Camera adapter M58 x 0.75	2408-009-132-00
Camera adapter M72 x 0.75	2408-009-134-00
Lens Adapter:	
Lens adapter M39 x 1/26"	2408-009-118-00
Lens adapter M39 x 1/26" [1]	2408-009-112-00
Lens adapter M32.5 x 0.5	2408-009-111-00
Lens adapter V-groove [2]	2408-009-147-00
Extension Tubes	
Extension tube 25mm	2408-009-113-00
Extension tube 25mm for M72 camera adapter	2408-009-135-00
Extension tube 87.5mm	2408-009-122-00
Extension tube 60mm	2408-009-123-00
Retro ring M40.5-M39	2404-113-104-00

[1] To be used with Rodagon 135mm, Apo Rodagon N 105mm, Apo Rodagon D 2 x 75mm, Apo Rodagon D 120mm, Rodagon WA80
[2] To be used with inspec.x L and Apo-Rodagon HR lenses

Modular Focus Assembly Example

lens adaptor

Modular-Focus

enlarging lens

extention tube
(can be omitted)
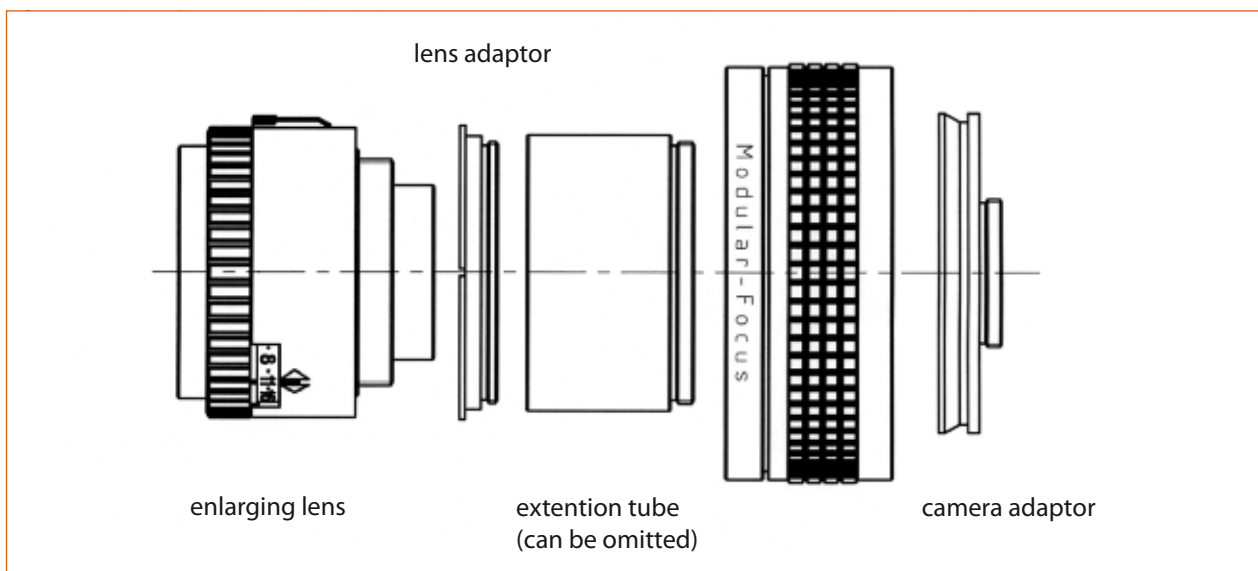
camera adaptor

Smart Focus Sytem

An economical version of the Modular Focus with M39 thread for lenses and using the camera adapters from the Modular Focus system. The focus range is shorter than that of the Modular Focus and the lens rotates while it is focused. Also, the Smart Focus uses set screws to lock the focus rather than thumb screws.

Components	Order No.
Smart Focus Helical Mount	2408-021-000-43
Extension tubes:	
Extension tube 12mm	2408-021-108-00
Extension tube 24mm	2408-021-109-00
Extension tube 48mm	2408-021-110-00
Extension tube 120mm	2408-021-111-00

Smart Focus Helical Mount
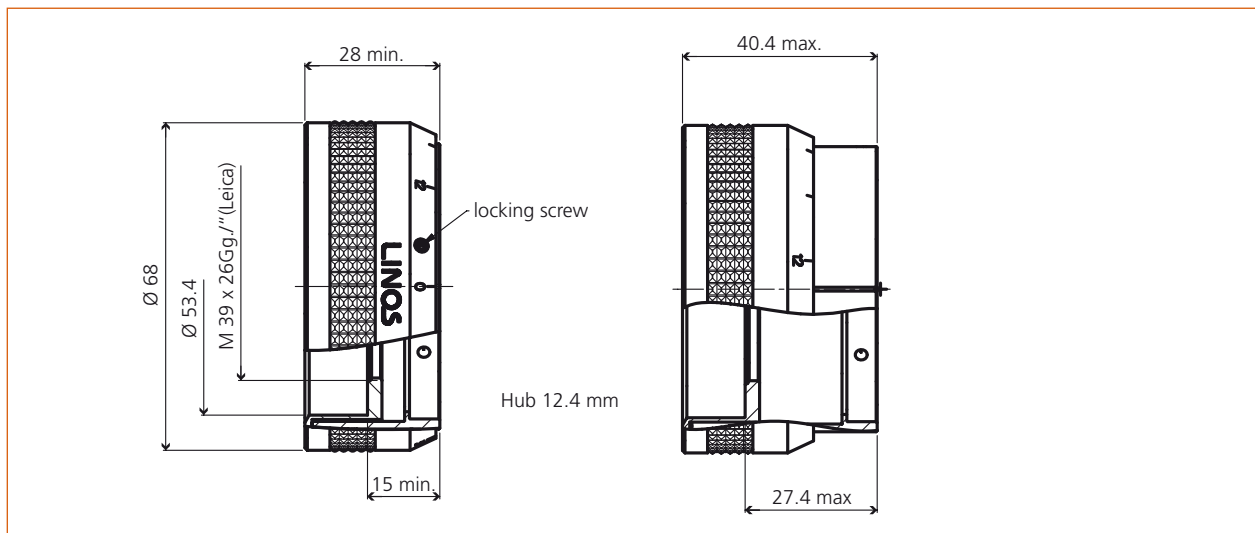
Smart Focus Assembly Example
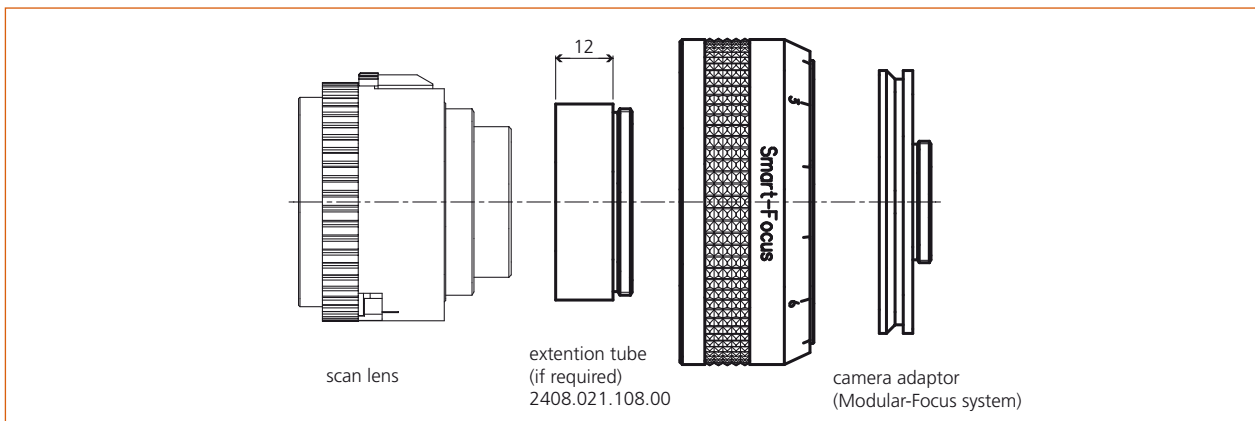
Focus Adapter System

The adjacent diagram illustrates how a lens is connected to the focus mechanism via a lens adapter.

The focus mechanism is then connected to the camera via a camera mount adapter

Components	Order No.
Lens adapter from M39 (Leica) to M42 x 1	2408-005-101-00
Counter ring 50mm	2408-005-102-00
Counter ring 63mm	2408-005-103-00
Adapter for connection to existing camera adapter Modular Focus	2408-005-104-00
Camera adapter C-mount	2408-005-105-00
Extension tube 11mm	2408-005-106-00

Examples of application

counter ring 50 mm
2408-005-102-00

counter ring 50 mm
2408-005-102-00

extention tube 11 mm
2408-005-106-00

counter ring 50 mm
2408-005-102-00

C-Mount
2408-005-105-00

counter ring 50 mm
2408-005-102-00

extention tube 11 mm
2408-005-106-00

camera adapter C-Mount
2408-005-105-00

counter ring 63 mm
2408-005-103-00

adapter for modular
focus camera adapter
2408-005-104-00

counter ring 50 mm
2408-005-102-00

extention tube 11 mm
2408-005-106-00

adapter for modular
focus camera adapter
2408-005-104-00

scan lens

lens adapter
M42x1
2408-005-101-00

Focus Tubes inspec.x L 105

Components	Order No.
Focus tube for lenses 0703-082-000-20 and 0703-083-000-20	2408-012-000-30
Focus tube for lenses 0703-084-000-20 and 0703-085-000-20	2408-012-000-31
Focus tube for lens 0703-095-000-21	2408-012-000-32
Focus tube for lens 0703-102-000-20	2408-012-000-33
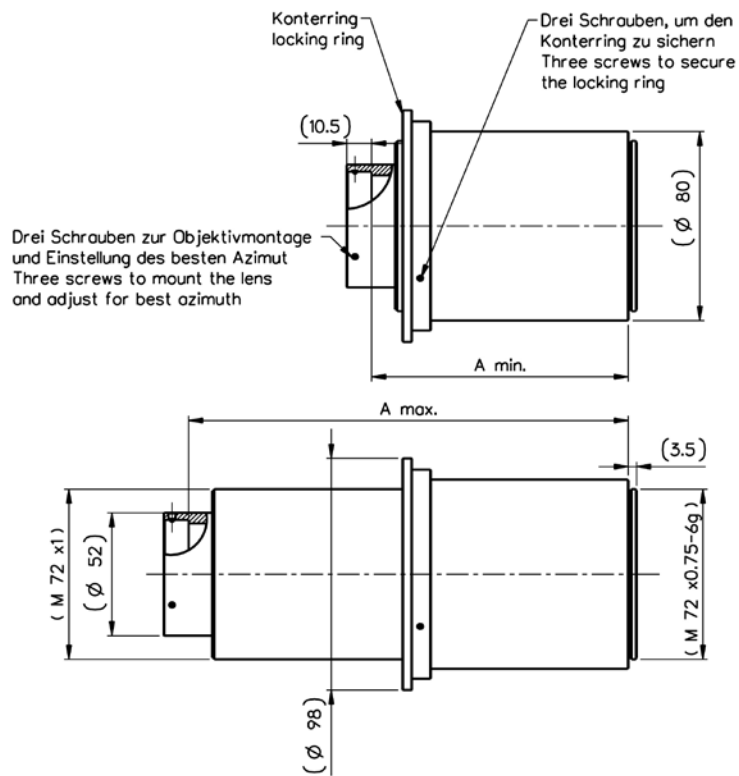
Focus Units M72x0.75

Components	Order No.
Focus Unit f'=80mm	2408-012-000-23
Focus Unit f'=105mm	2408-012-000-28
Focus Unit f'=135mm	2408-012-000-29
Focus Unit II f'=80mm [1]	2408-012-000-35
Focus Unit II f'=105mm [1]	2408-012-000-36
Focus Unit II f'=135mm [1]	2408-012-000-37

[1] To be used with: Rodagon 135mm, Apo Rodagon N 105mm, Apo Rodagon D 2 x 75mm, Apo Rodagon D 120mm and Rodagon WA 80

Focus Unit f'=80mm, Order No. 2408-012-000-23
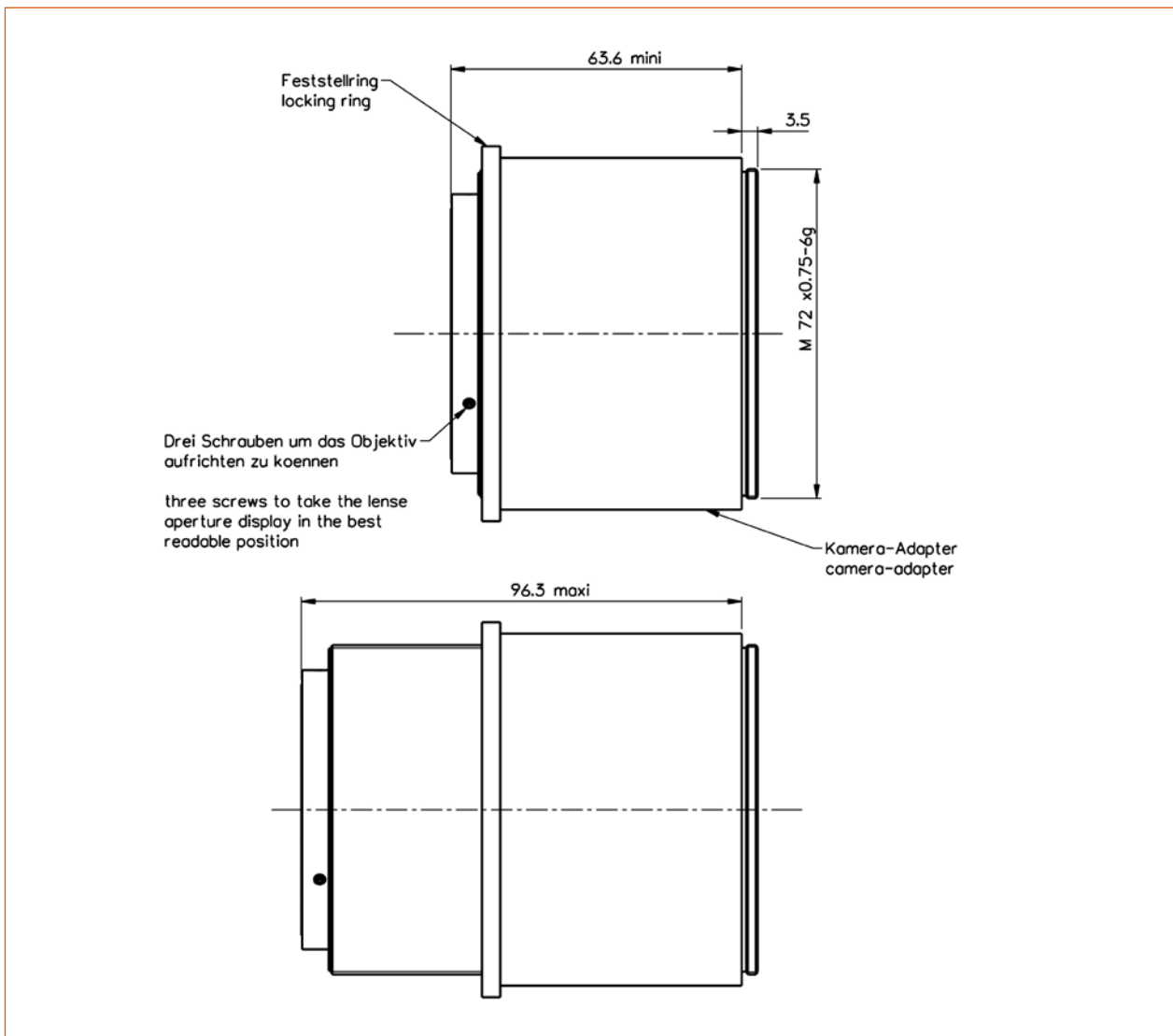
Selection Chart Lenses

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	Lens	Sensor Size					Camera Mount					
		1/2″	2/3″	1″	35mm	62mm line scan	C-Mount	F-Mount	M72	M58	M42	Other
A-Class	Rogonar-S 25	✓	✓	✓			✓		✓	✓	✓	✓
A-Class	Rogonar-S 35	✓	✓	✓			✓		✓	✓	✓	✓
A-Class	Rogonar-S 50	✓	✓	✓	✓		✓		✓	✓	✓	✓
A-Class	Rogonar-S 60	✓	✓	✓	✓		✓		✓	✓	✓	✓
A-Class	Rogonar-S 75	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
A-Class	Rogonar-S 90	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
A-Class	Rogonar-S 105	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
A-Class	Rodagon 28	✓	✓	✓			✓		✓	✓	✓	✓
A-Class	Rodagon 35	✓	✓	✓			✓		✓	✓	✓	✓
A-Class	Rodagon 50	✓	✓	✓	✓		✓		✓	✓	✓	✓
A-Class	Rodagon 60	✓	✓	✓	✓		✓		✓	✓	✓	✓
A-Class	Rodagon 80	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
A-Class	Rodagon 105	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
A-Class	Rodagon 135	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
A-Class	Apo-Rodagon N 50	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
A-Class	Apo-Rodagon N 80	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
A-Class	Apo-Rodagon N 105	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
A-Class	Rodagon WA 40	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
A-Class	Rodagon WA 60	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
A-Class	Rodagon WA 80	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
A-Class	Apo Rodagon D 1X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
A-Class	Apo Rodagon D 2X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
A-Class	Apo Rodagon D 120	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
A-Class	Apo Rodagon HR 0.5X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
A-Class	Rodagon F 40	✓	✓	✓	✓			✓				
A-Class	Rodagon F 50	✓	✓	✓	✓			✓				
A-Class	Rodagon F 60	✓	✓	✓	✓			✓				
A-Class	Macro CCD	✓	✓				✓					
A-Class	Telecentric	✓	✓				✓					
Premium Class	MeVis-C 12mm	✓	✓				✓					
Premium Class	MeVis-C 16mm	✓	✓				✓					
Premium Class	MeVis-C 25mm	✓	✓	✓			✓					
Premium Class	MeVis-C 35mm	✓	✓	✓			✓					
Premium Class	MeVis-C 50mm	✓	✓	✓			✓					
Premium Class	inspec.x M 2.8/100	✓	✓	✓	✓			✓				
Premium Class	inspec.x M 1.4/50	✓	✓	✓				✓				
Premium Class	inspec.x L 4/100	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Premium Class	inspec.x L 4/60	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Premium Class	inspec.x L 5.6/105	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Premium Class	inspec.x L 5.6/105	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Premium Class	inspec.x L 5.6/105	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Premium Class	inspec.x L 5.6/105	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Premium Class	inspec.x L 4.0/105 3X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Premium Class	inspec.x L 4.0/105 3.5X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Premium Class	inspec.x L 3.5/105 5X	✓	✓	✓	✓	✓			✓			
Premium Class	inspec.x UV 2.8/50	✓	✓				✓					

Lens	Magnification range								Minimum Pixel Size					
	inf.	0.05	0.1	0.5	0.75	1	2	3.5	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 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				✓	✓		✓ [2]		✓	✓				
Apo Rodagon D 120				✓	✓		✓ [2]		✓	✓				
Apo Rodagon HR 0.5X				✓			✓ [2]		✓	✓	✓			
Rodagon F 40		✓	✓	✓					✓	✓				
Rodagon F 50		✓	✓	✓					✓	✓				
Rodagon F 60		✓	✓	✓					✓	✓				
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				✓ [1]			✓ [2]		✓	✓	✓	✓		
inspec.x L 5.6/105				✓			✓ [2]		✓	✓	✓	✓		
inspec.x L 5.6/105					✓				✓	✓	✓	✓		
inspec.x L 5.6/105						✓			✓	✓	✓	✓		
inspec.x L 4.0/105 3X								✓	✓	✓	✓	✓		
inspec.x L 4.0/105 3.5X								✓	✓	✓	✓	✓		
inspec.x L 3.5/105 5X								✓	✓	✓	✓	✓		
inspec.x UV 2.8/50	✓	✓	✓						✓	✓	✓	✓		

[1] Optimized for 0.33
[2] In retro position

MachVis Software

Lens Selection Software

MachVis software is designed to help you find the right lens for your machine vision application. Starting with 4 simple parameters:

• Object size
• Working distance
• Sensor size
• Camera mount

MachVis calculates the necessary optical parameters and then, from the extensive Qioptiq lens catalogue, selects all suitable lenses that meet the specifications.

If mechanical accessories (e.g. focussing unit, extension tubes etc.) are needed, MachVis will create a printable, itemised list of the required parts. MachVis also generates a schematic drawing of the lens and accessories in the order of assembly.

Specifications, along with your own project notes, may be saved to disk for later recall. Datasheets (PDF) for each lens and mechanical part are integrated with MachVis and may be viewed for a more detailed analysis.

To facilitate the mechanical design of your system as much as possible MachVis offers you the direct download of 3D data in step or parasolid format of all lenses and accessories.

> **Download your free copy today:**
>
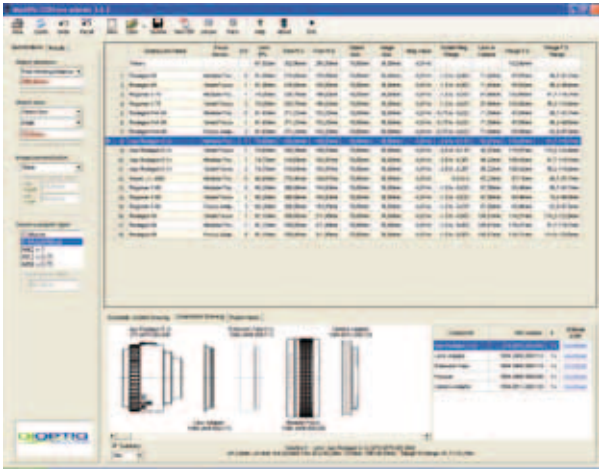> http://www.qioptiq.com/machvis
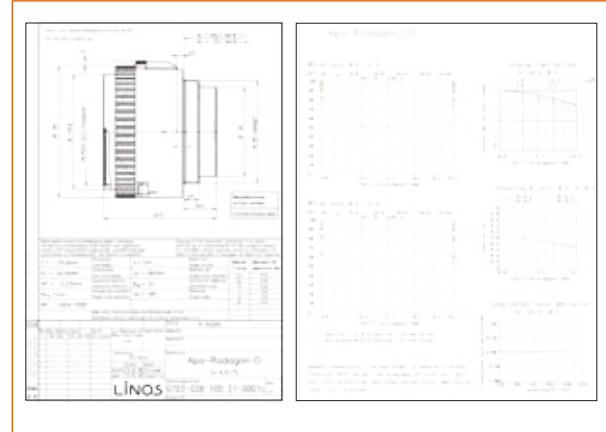
Example datasheets with drawing and MTF curves
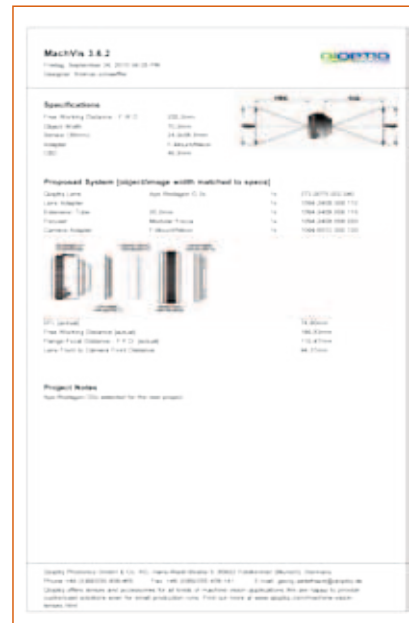
Printout of the selected system

Lens overview dialog

Streamlined Workflow:

From lens selection ...

... to 3D modelling

... to the final system:

Customized Solutions

Providing optical solutions for any machine vision application is not just sending quotations and waiting for the order. There is so much more to discuss and negotiate to find the optimum solution for a given task. We emphasize on finding the optimum solution together with the customer instead of just selling what could be good enough.

These discussions are even more important when an application specific solution needs to be developed. Our team of highly experienced and competent optical and mechanical designers, project managers and sales managers will dive into your application and discuss every aspect of your request. Only after a full specification is set up that both sides understand and approve the development is started

This dialog with the customer along with thorough knowledge of the machine vision market and the latest optical technologies act as driving forces for the steady growth of our portfolio of standard products on the one hand and enable us to find the best possible solution for application specific solutions on the other hand.

Qioptiq serves the whole range of Machine Vision applications with either standard components or customer specific products.

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. All the experience with tolerances of optical systems and manufacturing of optical components that was gained over many decades finds its way into our in-house software and allows us to precisely simulate manufacturing tolerances of the complete product. With these results we can predict system performance already before we start to manufacture prototypes.

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.

Qioptiq has mastered the transfer of the manufacturing from prototype quantities to mass production. The entire development and production process at Qioptiq is embedded 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.

Customized Solutions

A customized solution is not necessarily a completely new lens or optical system. In many cases a slight modification of a standard product is enough to enable new solutions. These modifications can be:

- A different camera mount
- Fixed aperture instead of an iris aperture
- A different coating – even filter functions can be integrated into the lens
- Special mounting flanges
- Motorization of focus and or iris aperture
- Many more

We have done hundreds of these modifications over the past decades and we are happy to talk with you about your needs.
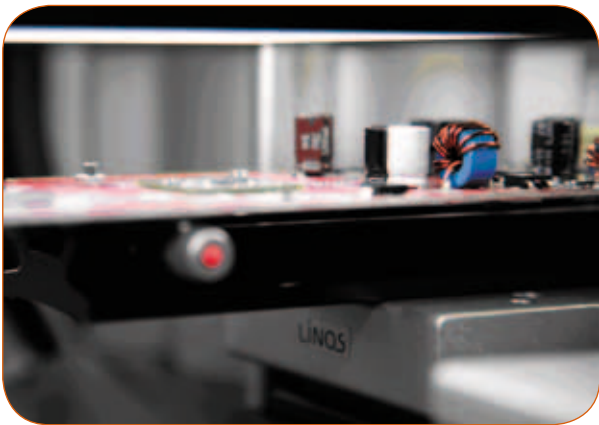
The following list mentions a few example projects we have done in the past. This list is not at all comprehensive and gives only a little overview about what is possible and can be done.
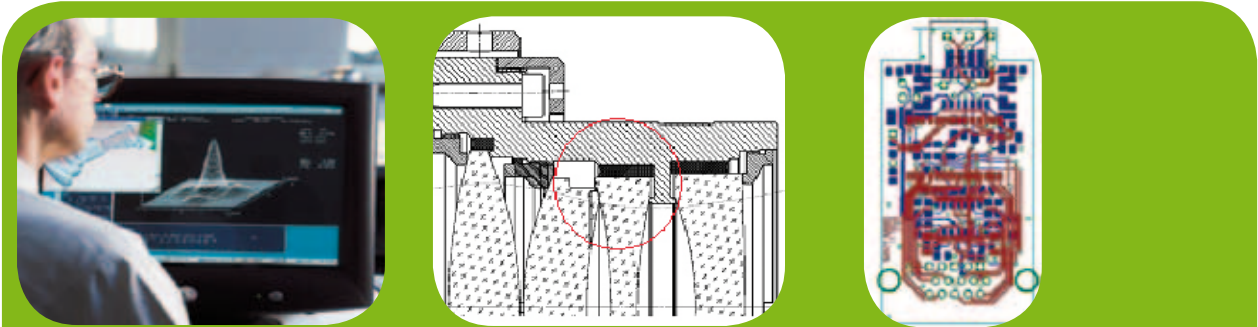
- Diffraction-limited lens with floating element for a large magnification range. Application: FPD Inspection
- Apochromatically corrected lens for the complete visible range with minimum lateral and longitudinal chromatic aberrations. Application: solar cell inspection
- Special SWIR coating for a Rodagon lens. Application: Artwork inspection
- Complete 3CCD camera including prism alignment. Application: cotton inspection
- Customized version of an inspec.x L lens for a certain magnification range. Application: FPD inspection
- Matched lens for a prism based 3CCD camera. Application: diverse

Qioptiq – All Technologies for Optical Systems Available In-House

Qioptiq is an integrated optical company that has all technologies and knowledge available that are needed to supply state-of-the-art optical systems from very cost-effective solutions up to high-end systems that push the boundaries of limits of optical physics.

Design

Optical design

Mechanical design

Electronics design

Manufacturing

Optical elements

Coating

Mechanics

Assembly and Test

Assembly

Test

System integration

Q

Photonics for Innovation