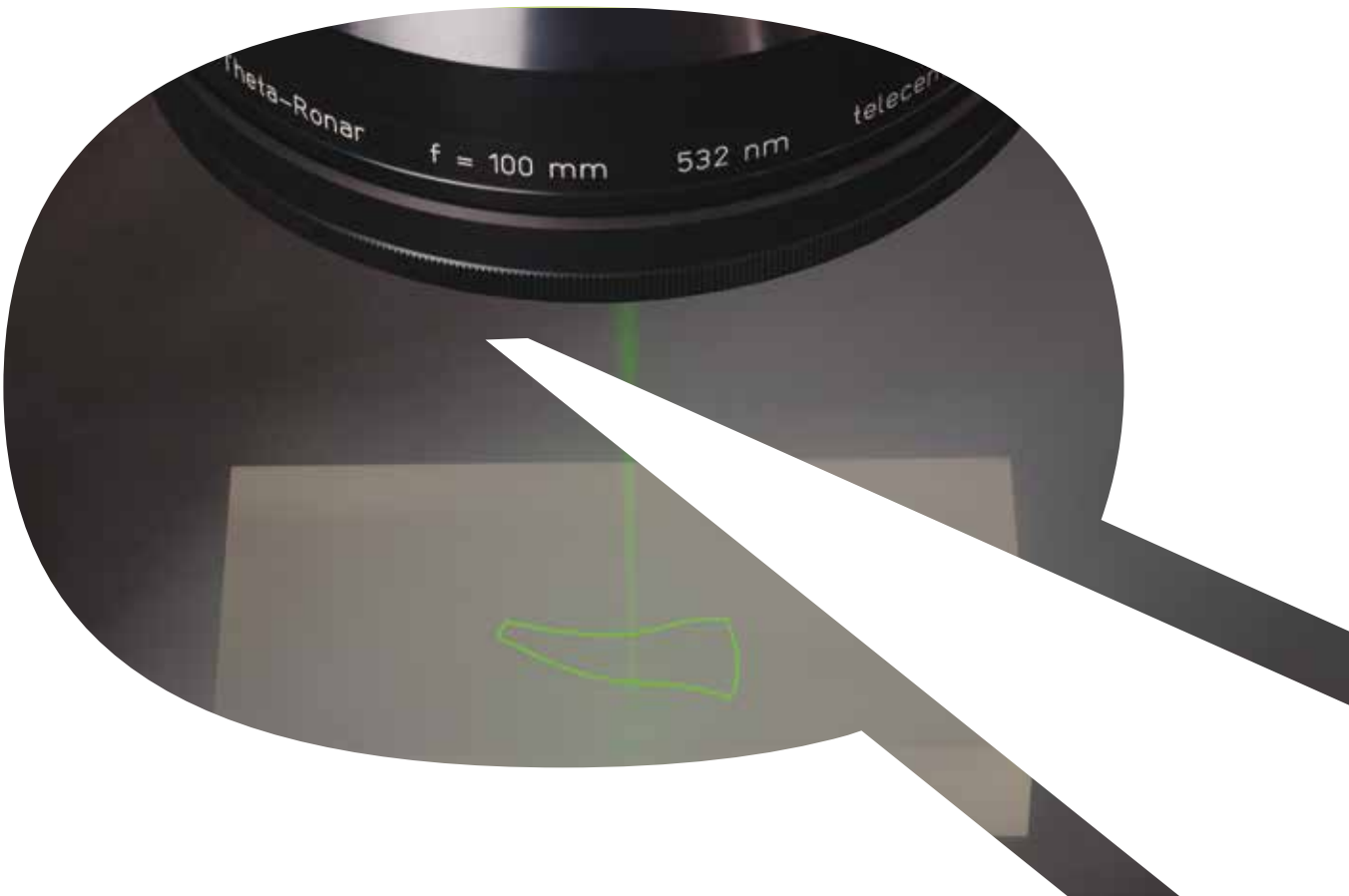
QIOPTIQ
Photonics for Innovation
An Excelitas Technologies Company

Laser Material Processing



Company Profile

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

Qioptiq benefits from having integrated the knowledge and experience of Avimo, Gsänger, LINOS, Optem, Pilkington, Point Source, Rodenstock, Spindler & Hoyer and others. In October 2013, Qioptiq was acquired by Excelitas Technologies Corp., a global technology leader focused on delivering innovative, customized solutions to meet the lighting, detection and other high-performance technology needs of OEM customers. The combined companies have approximately 5,300 employees in North America, Europe and Asia, serving customers across the world.

Visit www.qioptiq.com and www.excelitas.com for more information.

1877	1898	1966	1969	1984	1991	1996
RODENSTOCK	SPINDLER & HOYER		Gsänger	OPTEM INTERNATIONAL	POINT SOURCE	LINOS
Rodenstock founded	Spindler & Hoyer founded	Pilkington PE Ltd. founded, which later becomes THALES Optics	Gsänger Optoelektronik founded	Optem International founded	Point Source founded	LINOS founded through the merger of Spindler & Hoyer, Steeg & Reuter Präzisionsoptik, Franke Optik and Gsänger Optoelektronik

Content

2000
RODENSTOCK
Rodenstock Präzisionsoptik acquired by LINOS

2001
AVIMO
AVIMO Group acquired by THALES

2005
Qioptiq founded as THALES sells High Tech Optics Group

2006 / 2007
QIOPTIQ Optics with Intelligence
Qioptiq acquires LINOS and Point Source as "members of the Qioptiq group"

2010
QIOPTIQ Photonics for Innovation
The new Qioptiq consolidates all group members under one brand

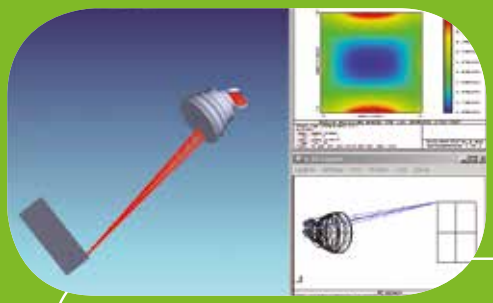
2013
QIOPTIQ Photonics for Innovation An Excelitas Technologies Company
Qioptiq is aquired by Excelitas Technologies
EXCELITAS TECHNOLOGIES

Our Core Competencies:

Products for Laser Material Processing

Benefit from over 30 years of experience in the development of optical systems for laser material processing!

Our broad selection of manual and motorized beam expanders and comprehensive range of LINOS F-Theta-Ronar and Focus-Ronar lenses are engineered to meet the most stringent requirements. We will serve you from development and prototyping to volume production. During the full lifetime of your product Qioptiq is your partner for your OEM needs.



Development

- Development of
  - Optical system design (in-house software-system, Code V®, Zemax®) including back reflection analysis
  - Mechanical design
  - Coating design
- FEM-analysis including thermal effects for high-power applications
- Advanced tolerance analysis and yield simulation adapted to Qioptiq patented mounting and gluing technologies

Consistent High-Quality Production from Rapid Prototype to High Volume

Manufacturing

- State-of-the-art machinery for optics and mechanics production
- Development of in-house processes for precise assembly of optical elements
- Mounting techniques with accuracies down to 2 µm
- Active positioning and gluing technologies
- Cleanroom facilities
- Coating process from conventional deposition up to ion-beam-sputtering in spectral range: UV; VIS; NIR

Quality Control

- Automated measurement equipment for optical parameters (e.g. focal length)
- Measurements of the image spot diameter ($1/e^2$) for Gaussian illumination for 355 nm, 532 nm and 1064 nm
- UV to NIR transmission measurements
- MTF testing at various wavelengths
- Enviromental testing (temperature, humidity, vibration, shock)
- Quality report on request
- After sales service
- Technical support

LINOS F-Theta-Ronar Lenses

The extreme versatility of lasers as a tool creates a broad market for focusing systems. F-Theta-Ronar lenses are used in combination with mirror scanning systems. High-quality LINOS F-Theta-Ronar lenses are designed to achieve consistent results over the entire scan field and are built for a wide range of applications.

- Drilling and fine cutting of metals and ceramics (e.g. micro drilling in PCBs)
- Plastic welding (e.g. fusion of plastic materials without additional materials)
- Structuring or perforating of metallic and non-metallic materials (e.g. solar cells, glass)
- Marking (e.g. of smart cards, ICs, printing plates, in-glass, dashboard designs in the automotive industry)
- Cleaning with laser pulses for careful treatment of industrial products (e.g. wafers) as well as restoration projects (e.g. monuments).

Characteristics of F-Theta lenses

F-Theta lenses have two main characteristics. When a beam is deflected by a scanning mirror in front of a lens, then the scanned distance is proportional to the scanning angle. Secondly the focus position over the entire scan field is always in the same plane.

Basic calculations of F-Theta-Ronar lenses

All LINOS F-Theta-Ronar lenses achieve diffraction limited performance. The truncated entrance-beam diameter and the image spot diameter refer to the intensity $1/e^2$ at Gaussian illumination and for ideal $M^2=1$. The spot size of LINOS F-Theta-Ronar lenses can be calculated with the following formula:

Spot-Ø = 1.83 * λ * FL / beam-Ø

Spot-Ø: image spot diameter [mm]
1.83: factor of apodisation
λ: wavelength [nm]
FL: focal length [mm]
Beam-Ø: entrance-beam diameter [mm]

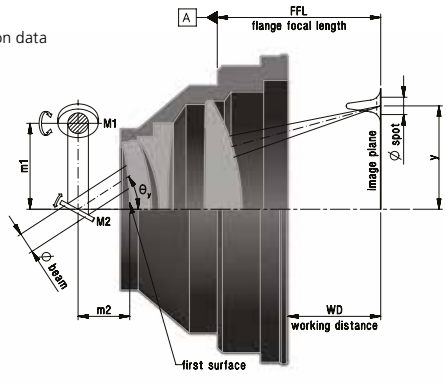
The scan length in each direction x or y can be calculated by the formula:

$2y = FL * 2\Theta_y * \pi/180$ and $2x = FL * 2\Theta_x * \pi/180$

2x, 2y: scan length in direction x,y [mm]
FL: focal length [mm]
$2\Theta_{x,y}$: max. scan angle Theta for each mirror [°]
π/180: conversion factor (into radians)

The mirror distances m1 and m2 are recommended values and may vary. A smaller entrance-beam diameter allows larger scan angles and therefore larger scan fields are achievable.

Application data



Product range of LINOS F-Theta-Ronar lenses

Optical glass lenses

For all major applications a wide variety of lenses exist with various focal lengths ranging from 70 mm to 420 mm and for different wavelengths from 532 nm to 2050 nm.

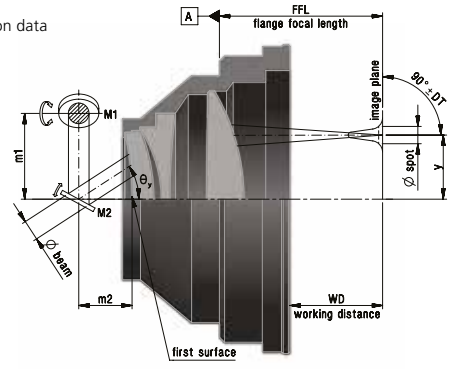
Fused-silica lenses

Qioptiq has developed a range of sophisticated F-Theta-Ronar scan lenses made of fused silica for high-power and short-pulse laser material processing. Fused-silica lenses provide minimized thermal focus shift and higher resistance when working at high power density. These lenses are usable for wavelength ranges of 340-360 nm, 515-540 nm, 1030-1080 nm, and 1940-2050 nm. A specially developed coating achieves very low reflection and absorption values. The optical designs minimize damage due to back reflections onto the scanning mirrors and internal reflections. The LINOS fused-silica F-Theta-Ronar lenses are suitable for fiber- and disk lasers as well as short-pulse and ultra-short-pulse lasers.

Telecentric lenses

With telecentric lenses the beam impact angle on the work piece is nearly perpendicular over the entire scan field.

Application data



The maximum scan field of telecentric lenses cannot exceed the lens diameter. On the other hand the spot roundness and the impact angle is constant over the scan field. Qioptiq offers telecentric F-Theta-Ronar lenses made of fused silica and of optical-glass/fused-silica combination.

Further information for all standard F-Theta-Ronar lenses is available at: www.qioptiq-shop.com including 3D CAD data and lens data sheets.

Customized solutions

In addition to our existing LINOS F-Theta-Ronar lenses Qioptiq offers customized solutions from adapted wavelength shift of standard lenses up to complete new designs. Please contact Qioptiq to discuss your requests with our specialists.

Coating

Coatings are applied on each lens surface to maximize the transmission of the complete optical system like F-Theta-Ronar lenses or beam expanders. The additional challenge for coatings in laser material applications lies in a high damage resistance. All our coatings are analyzed for laser-damage threshold values. The tests are conducted according to the standardized test method DIN EN ISO 11254-2, a multi-pulse procedure (S on 1) with given pulse lengths:

	Laser-damage threshold (J/cm²)	Pulse length (ns)
Optical-glass lenses		
532 nm	6 - 20	6
1064 nm	10 - 40	9
Fused-silica lenses		
355 nm	2	9
532 nm	15	12
1064 nm	20	12

There is no guarantee that the same values will result under the customer's conditions of use.

LINOS F-Theta-Ronar Lenses 340-360 nm

LINOS F-Theta-Ronar telecentric lens for 355 nm, focal length 167 mm

- Fused-silica designs
- Telecentric versions available
- Focal lengths ranging from 100 mm to 255 mm, tolerance ±1%
- Screw thread M85x1

- Transmission ≥ 96 % with good performance in VIS-range
- Laser-damage threshold up to 2 J/cm² at 355 nm, 9 ns, 10 Hz
- Includes interchangeable fused-silica protective glasses

- All lenses can be used with enlarged beam diameters and different mirror distances. Accordingly the scan fields and spot size diameters will be changed. Please feel free to send us your request.

LINOS F-Theta-Ronar 340-360 nm, Fused Silica

Focal length (mm)	Scan field (mm²)	Max. scan angle $\pm\Theta_{x,y}$ (°)	Beam diameter truncated at 1/e² (mm)	Spot diameter at 1/e² (µm)	Mirror distances m1/m2 (mm)	Working distance (mm)	Protective glass	Part No.
100 telecentric	46 x 46	±12.7	10	7	13/29	136.7	PG11	4401-509-000-21
161	99 x 99	±17.6	7	15	12/16	197.4	PG4	4401-399-000-21
167 telecentric	68 x 68	±11. 3	10	13	13/48	255.0	PG15	4401-511-000-21
255	170 x 170	±19.3	10	17	13/30	318.1	PG11	4401-481-000-21

Subject to technical changes

LINOS F-Theta-Ronar Lenses 515-540/532 nm

LINOS F-Theta-Ronar telecentric lens for 515-540 nm, focal length 100 mm

- Fused-silica and optical-glass designs
- Telecentric versions available
- Focal lengths ranging from 100 mm to 420 mm, tolerance ±1%
- Screw thread M85x1

- Transmission ≥ 96 % with good performance in VIS-range
- Laser-damage threshold up to 20 J/cm² at 532 nm, 6 ns, 100 Hz
- Includes interchangeable protective glasses

- All lenses can be used with enlarged beam diameters and different mirror distances. Accordingly the scan fields and spot size diameters will be changed. Please feel free to send us your request.

LINOS F-Theta-Ronar 515-540 nm, Fused Silica

Focal length (mm)	Scan field (mm²)	Max. scan angle $\pm\Theta_{x,y}$ (°)	Beam diameter truncated at 1/e² (mm)	Spot diameter at 1/e² (µm)	Mirror distances m1/m2 (mm)	Working distance (mm)	Protective glass	Part No.
100 telecentric	43 x 43	±12.2	14	9	17/28	138.5	PG13	4401-547-000-21
167 telecentric	86 x 86	±15.4	14	12	17/33	215.5	PG21	4401-517-000-21
255	170 x 170	±19.3	10	25	13/30	318.1	PG13	4401-496-000-21

Subject to technical changes

LINOS F-Theta-Ronar 532 nm, Optical Glass

Focal length (mm)	Scan field (mm²)	Max. scan angle $\pm\Theta_{x,y}$ (°)	Beam diameter truncated at 1/e² (mm)	Spot diameter at 1/e² (µm)	Mirror distances m1/m2 (mm)	Working distance (mm)	Protective glass	Part No.
100	58 x 58	±17.7	6	15	16/12	90.8	PG8	4401-304-000-21
100 telecentric *	54 x 54	±15.6	15	7	20/32	126.6	PG7	4401-461-000-21
160	98 x 98	±17.7	10	16	16/12	176.1	PG8	4401-305-000-21
250	154 x 154	±17.7	20	12	22/24	288.5	PG7	4401-289-000-20
330	204 x 204	±17.7	14	23	18/24	389.0	PG7	4401-485-000-21
420	275 x 275	±18.7	15	27	17/28	494.6	PG7	4401-489-000-21

* Entrance lens made of fused silica

Subject to technical changes

LINOS F-Theta-Ronar Lenses 940-980 nm

LINOS F-Theta-Ronar lens for 940-980 nm, focal length 330 mm

- Focal lengths ranging from 100 mm to 420 mm, tolerance ±1%
- Screw thread M85x1, except 4401-527-000-21: M76x1

- Transmission ≥ 97 %
- Transmission ≥ 75 % at VIS-range
- Laser-damage threshold up to 6 J/cm² at 1064 nm, 10 ns, 100 Hz
- Includes interchangeable protective glasses

- All lenses can be used with enlarged beam diameters and different mirror distances. Accordingly the scan fields and spot size diameters will be changed. Please feel free to send us your request.

LINOS F-Theta-Ronar 940-980 nm, Optical Glass

Focal length (mm)	Scan field (mm²)	Max. scan angle $\pm\Theta_{x,y}$ (°)	Beam diameter truncated at 1/e² (mm)	Spot diameter at 1/e² (µm)	Mirror distances m1/m2 (mm)	Working distance (mm)	Protective glass	Part No.
100	43 x 43	±12.3	14	14	17/18	96.9	PG19	4401-528-000-21
160	94 x 94	±16.9	14	22	17/16	174.4	PG19	4401-529-000-21
163	96 x 96	±16.9	14	20	17/30	183.7	PG18	4401-527-000-21
254	139 x 139	±15.7	20	24	26/28	294.2	PG17	4401-526-000-21
330	204 x 204	±17.7	20	32	26/28	386.0	PG17	4401-524-000-21
420	259 x 259	±17.7	20	40	26/28	491.7	PG17	4401-525-000-21

Subject to technical changes

LINOS F-Theta-Ronar Lenses 1064/1030-1080 nm

LINOS F-Theta-Ronar lens for 1030-1080 nm, focal length 420 mm

- Fused-silica and optical-glass designs
- Telecentric versions available
- Focal lengths ranging from 70 mm to 420 mm, tolerance ±1 %
- Screw thread M85x1, except 4401-261-000-21: M76x1

- Transmission ≥ 96 % with good performance in VIS-range
- Laser-damage threshold up to 40 J/cm² at 1064 nm, 9 ns, 100 Hz
- Includes interchangeable protective glasses

- All lenses can be used with enlarged beam diameters and different mirror distances. Accordingly the scan fields and spot size diameters will be changed. Please feel free to send us your request.

LINOS F-Theta-Ronar 1030-1080 nm, Fused Silica

Focal length (mm)	Scan field (mm²)	Max. scan angle $\pm\Theta_{x,y}$ (°)	Beam diameter truncated at 1/e² (mm)	Spot diameter at 1/e² (µm)	Mirror distances m1/m2 (mm)	Working distance (mm)	Protective glass	Part No.
70 telecentric	30 x 30	±12.4	14	10	17/12	87.6	PG22	4401-551-000-21
100 telecentric	43 x 43	±12.2	14	15	17/28	137.0	PG14	4401-561-000-21
167 telecentric	84 x 84	±14.8	20	17	26/28	215.4	PG16	4401-513-000-21
255	170 x 170	±19.2	10	50	13/30	317.4	PG14	4401-499-000-21
340	205 x 205	±17.7	14	51	17/29	441.6	PG16	4401-546-000-21
420	254 x 254	±17.3	14	60	26/24	510.9	PG14	4401-508-000-21

Subject to technical changes

LINOS F-Theta-Ronar 1064 nm, Optical glass

Focal length (mm)	Scan field (mm²)	Max. scan angle $\pm\Theta_{x,y}$ (°)	Beam diameter truncated at 1/e² (mm)	Spot diameter at 1/e² (µm)	Mirror distances m1/m2 (mm)	Working distance (mm)	Protective glass	Part No.
100	62 x 62	±17.7	12	16	16/12	97.7	PG2	4401-302-000-21
100 telecentric *	54 x 54	±15.6	15	13	20/32	126.0	PG6	4401-464-000-21
160	99 x 99	±17.7	12	26	16/12	176.2	PG2	4401-301-000-21
163	115 x 115	±20.2	10	32	13/24	185.9	PG5	4401-261-000-21
254	157 x 157	±17.7	20	25	30/16	296.2	PG6	4401-288-000-20
254	165 x 165	±18.4	20	25	26/31	289.5	PG25	4401-557-000-21
330	217 x 217	±18.7	16	40	18/24	387.6	PG6	4401-360-000-21
420	291 x 291	±19.8	15	55	30/16	494.2	PG6	4401-350-000-21

* Entrance lens made of fused silica

Subject to technical changes

LINOS F-Theta-Ronar Lenses 1550/1940-2050 nm

LINOS F-Theta-Ronar lens for 1550 nm, focal length 100 mm

- Fused-silica and optical glass designs
- Telecentric versions available
- Focal lengths ranging from 100 mm to 437 mm, tolerance ±1 %
- Screw thread M85x1

- Transmission ≥ 95 % at 1550 nm
- Transmission ≥ 92 % at 1940-2050 nm
- Laser-damage threshold up to 20 J/cm² at 1064 nm, 12 ns, 100 Hz
- Includes interchangeable protective glasses

- All lenses can be used with enlarged beam diameters and different mirror distances. Accordingly the scan fields and spot size diameters will be changed. Please feel free to send us your request.

LINOS F-Theta-Ronar 1550 nm, Optical Glass

Focal length (mm)	Scan field (mm²)	Max. scan angle $\pm\Theta_{x,y}$ (°)	Beam diameter truncated at 1/e² (mm)	Spot diameter at 1/e² (µm)	Mirror distances m1/m2 (mm)	Working distance (mm)	Protective glass	Part No.
100 telecentric *	53 x 53	±15.6	15	20	20/32	127.9	PG20	4401-532-000-21

* Entrance lens made of fused silica

Subject to technical changes

LINOS F-Theta-Ronar 1940-2050 nm, Fused Silica

Focal length (mm)	Scan field (mm²)	Max. scan angle $\pm\Theta_{x,y}$ (°)	Beam diameter truncated at 1/e² (mm)	Spot diameter at 1/e² (µm)	Mirror distances m1/m2 (mm)	Working distance (mm)	Protective glass	Part No.
354	214 x 214	±17.7	14	93	17/28.5	457.5	PG24	4401-569-000-21
437	296 x 296	±19.4	14	120	17/29.5	526.2	PG23	4401-568-000-21

Subject to technical changes

Protective Glasses

- Optimum protection for the optical system
- Coated on both sides
- High transmission for the corresponding wavelength or wavelength range
- High laser-damage threshold
- Short delivery time

Protective Glasses

Protective glass	Protective glass diameter (mm)	Protective glass thickness (mm)	AR coated for λ (nm)	Fused silica	Part No.
PG 2	75	1.6	1064+VIS		4401-301-001-00
PG 4	75	1.5	340-380+633	x	4401-399-005-00
PG 5	100	3	1064+VIS		4401-261-004-00
PG 6	113	3	1064+VIS		4401-288-005-01
PG 7	113	3	532		4401-289-007-00
PG 8	75	1.6	532		4401-304-005-00
PG11	113	3	340-380+633	x	4401-481-005-00
PG13	113	3	515-540	x	4401-496-005-00
PG14	113	3	1030-1080	x	4401-499-005-00
PG15	113	3	340-380+633	x	4401-511-823-00
PG16	132	3	1030-1080	x	4401-513-006-00
PG17	113	3	940-980		4401-524-004-00
PG18	100	3	940-980		4401-527-004-00
PG19	75	1.6	940-980		4401-528-005-00
PG20	113	3	1550		4401-532-005-00
PG21	132	3	515-540	x	4401-517-006-00
PG22	75	1.5	1030-1080	x	4401-551-016-00
PG23	113	3	1940-2050	x	4401-568-004-00
PG24	132	3	1940-2050	x	4401-569-005-00
PG25	113	3	1030-1080		4401-557-004-00

Subject to technical changes

LINOS Beam Expanders

LINOS beam expanders are optical systems for beam forming used in laser material processing. They can vary the diameter and the divergence of a laser beam and allow optimization of focus diameter, focus position and beam propagation.

Qioptiq offers standard versions of manual and motorized variable beam expanders made of fused silica and/or optical glass.

LINOS Beam Expanders are optimally employed in conjunction with LINOS F-Theta-Ronar lenses for applications including:

- Laser structuring of foils
- Laser scribing of ceramic substrates
- Cutting of solar cells
- Micro drilling of sheet metal
- Marking of diverse materials with encodings

All LINOS beam expanders can also be implemented in reverse mode as beam reducers.

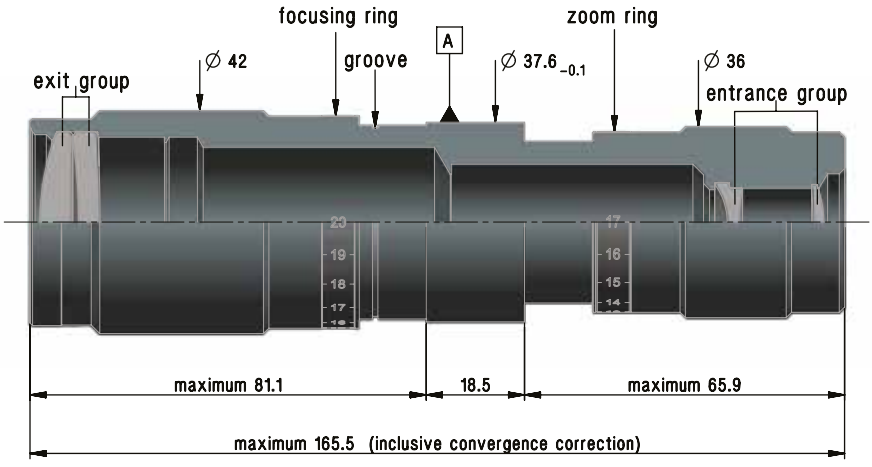
Manual version

Continuous magnification between 2x and 8x or between 2x and 10x are available. In addition Qioptiq offers manual variable beam expanders with fused-silica entrance lenses for higher laser resistance.

The back focal length of F-Theta-Ronar or Focus-Ronar lenses can be modified by changing the divergence of the incoming laser beam. Fine focusing of the beam expander compensates the focal length tolerances of other optical components as well as divergence of the laser source.

Handling

Zoom and focusing rings of the LINOS manual variable beam expanders are set according to product specific graphs. The expansion factor is adjusted by turning the focusing ring and zoom ring. To focus the beam expansion, only the focusing ring should be adjusted. The beam expander is mounted on surface A. Please take care that the laser beam is centered on the entrance lens and parallel to the optical axis of the beam expander (x/y tilt adjustment).



Variable beam expander

Motorized version

The motorized variable beam expanders of second generation are precise and easy to integrate. They are used in automatic production processes or in application laboratories. The controller is integrated into the beam expander.

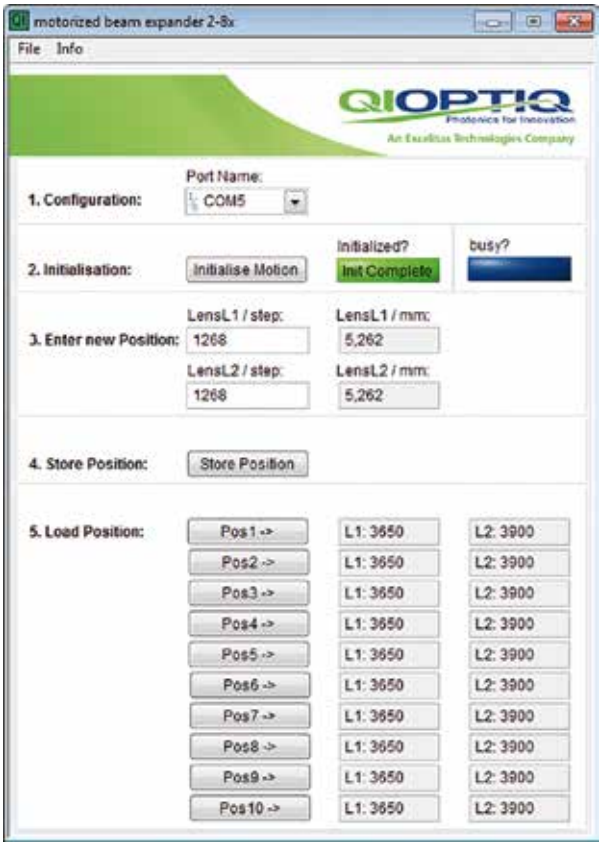
For high-power or short-pulse laser applications full fused-silica designs are available with excellent transmission and thermal resistance performance. The special coating with low absorption and high transmission for these fused-silica beam expanders covers complete wavelength ranges of 340-360 nm, 515-540 nm and 1030-1080 nm. Additionally Qioptiq offers the motorized beam expanders made of optical-glass versions for the wavelengths 532 nm and 1064 nm. The customer can select between three electrical interfaces (SubD9/RS232, Phoenix Contact/RS232 or USB 2.0).

Motorized beam expander with Phoenix Contact interface

Software

The Windows™-based software developed with LabView allows an easy control of the motorized beam expander. After initialization, the desired expansion is achieved by moving the two independent stepper motors. The lens positions for the magnification range of 2-8x are listed for each motorized beam expander type in provided tables. Ten individual pre-sets can be stored.

The beam expander can also be directly controlled under other operating systems via the serial interface (e.g. terminal program). All serial interface commands are listed in the manual.



Windows™ software mask for easy control of motorized beam expansion.

Further information is available at:
www.qioptiq-shop.com including 3D CAD data, product-specific graphs of variable beam expanders and the manual for the motorized beam expanders.

LINOS Variable Magnification Beam Expanders

LINOS Beam expander with a variable expansion factor 2x to 8x for 1064 nm

- Continuous variation of magnification 2x...8x or 2x...10x
- Choice between fused-silica or glass entrance lens
- Continuous variation of exit-beam divergence
- Wavelengths 355 nm, 532 nm, 633/780/830/980 nm or 1064 nm
- Precise scales allow reliable settings and high repeatability
- Max. exit-beam diameter 31 mm
- Max. length 165.5 mm
- Max. diameter 42.0 mm
- Mounting diameter $37.6_{-0.1}$ mm, reference on surface A (see page 14)

LINOS Variable Magnification Beam Expanders 2x...8x

Wavelength (nm)	Max. entrance-beam diameter at 1/e² (mm)	Entrance lens made of	Part No.
355	3.4	Fused silica	4401-402-000-20
532	4	Fused silica	4401-446-000-20
532	8	Optical glass	4401-257-000-20
633/780/ 830/980	8	Optical glass	4401-258-000-20
1064	4	Fused silica	4401-359-000-20
1064	8	Optical glass	4401-256-000-20

Entrance-beam diameter max. = 31 mm / zoom factor.

Subject to technical changes

LINOS Variable Magnification Beam Expanders 2x...10x

Wavelength (nm)	Max. entrance-beam diameter at 1/e² (mm)	Entrance lens made of	Part No.
1064	8	Optical glass	4401-531-000-20

Entrance-beam diameter max. = 31 mm / zoom factor.

Subject to technical changes

LINOS Motorized Beam Expanders

LINOS Motorized beam expander

- Continuous variable magnification 2x...8x
- Fused-silica or optical-glass designs
- Continuous variation of exit-beam divergence
- Wavelengths 340-360 nm, 515-540 nm or 1030-1080 nm
- Software running on the Windows™ platform (XP, Win7, Win8)
- Reduce machine setup times by auto matic change of magnification
- Maintains laser-protection class during readjustment of the beam expander
- All-in-one design, controller integrated
- CE and ROHS conform
- IP 20
- Exit-beam diameter: max. 31 mm
- 10 individual pre-sets for magnification and divergence
- Pointing stability < 0.5 mrad
- Fast adjustment from 2x to 8x about 7 sec
- Mechanical dimensions: length 203 mm, width 58 mm, height 55.5 mm
- Mechanical interface via high-precision holes 6^{H7} (recommended) or mounting diameter 39_{h11}
- Different electronic interfaces: SubD9/ RS232, USB 2.0, Phoenix Contact/ RS232
- Baud rate: 9600 bit/sec
- Power input 7–12 V, Phoenix Contact 7-24 V
- Entrance-beam diameter max. = 31 mm / zoom factor

LINOS Motorized Beam Expander, Fused Silica

Wavelength (nm)	Max. entrance-beam diameter at 1/e² (mm)	PC Interface	Part No.
340 - 360	6	SubD9/ RS232	4401-516-000-20
340 - 360	6	Phoenix Contact/ R232	4401-516-000-21
340 - 360	6	USB 2.0	4401-516-000-22
515 – 540	8	SubD9/ RS232	4401-515-000-20
515 – 540	8	Phoenix Contact/ R232	4401-515-000-21
515 – 540	8	USB 2.0	4401-515-000-22
1030 – 1080	8	SubD9/ RS232	4401-514-000-20
1030 – 1080	8	Phoenix Contact/ R232	4401-514-000-21
1030 – 1080	8	USB 2.0	4401-514-000-22

Entrance-beam diameter max. = 31 mm / zoom factor.

Subject to technical changes

LINOS Motorized Beam Expander, Optical Glass

Wavelength (nm)	Max. entrance-beam diameter at 1/e² (mm)	PC Interface	Part No.
532	8	SubD9/ RS232	4401-502-000-23
532	8	Phoenix Contact/ R232	4401-502-000-21
532	8	USB 2.0	4401-502-000-22
1064	8	SubD9/ RS232	4401-503-000-20
1064	8	Phoenix Contact/ R232	4401-503-000-21
1064	8	USB 2.0	4401-503-000-22

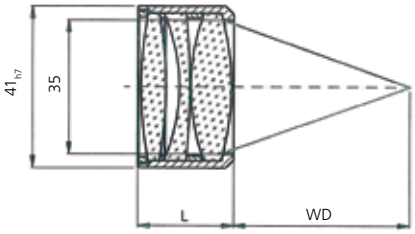
Entrance-beam diameter max. = 31 mm / zoom factor.

Subject to technical changes

LINOS Quartz Focus-Ronar Lenses for 355 nm

Focussing lenses are optimized for high precision applications, as used in laser systems for welding, cutting, drilling and structuring.

- Focal lengths ranging from 58 mm to 120 mm
- Flexible lens exchange without any adjustment
- Three-lens-element designs
- Full fused-silica designs
- Diffraction limited up to 17.5 mm ($1/e^2$) entrance-beam diameter
- High clear aperture 35 mm
- Housing diameter 41mm
- Transmission ≥ 98%
- Damage threshold 6 J/cm² with pulse duration of 5 ns, 100 Hz



LINOS Quartz Focus-Ronar 355 nm

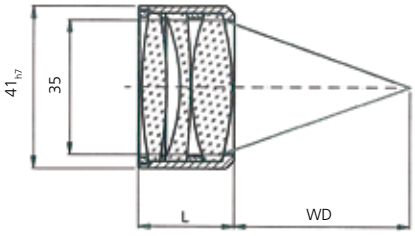
Focal length (mm)	Length L (mm)	Working distance WD (mm)	Part No.
58	26.7	48.9	4401-519-000-20
77	25.1	68.8	4401-521-000-20
90	25.1	81.7	4401-522-000-20
120	24.7	112.1	4401-523-000-20

Subject to technical changes

LINOS Focus-Ronar Lenses 1064 nm + 532 nm

Focussing lenses are optimized for high precision applications, as used in laser systems for welding, cutting, drilling and structuring.

- Focal lengths ranging from 58 mm to 120 mm
- Flexible lens exchange without any adjustment
- Three-lens-element designs
- High clear aperture 35 mm
- Housing diameter 41_{h7} mm
- The coating is optimized for 1064 nm, T ≥ 97% and T(532 nm) ≥ 96%
- Good inspection per formance at VIS wavelengths
- Laser-damage threshold 10 J/cm² at 1064 nm, 9 ns, 100 Hz
- Laser-damage threshold 6 J/cm² at 532 nm, 6 ns, 100 Hz



LINOS Focus-Ronar 1064 + 532 nm

Focal length (mm)	Length L (mm)	Working distance for 1064 nm (mm)	Working distance for 532 nm (mm)	Part No.
58	24.6	48.3	47.7	4401-505-000-20
77	18.9	72.2	71.5	4401-486-000-20
90	33.6	73.7	73.3	4401-490-000-20
120	24.0	110.7	109.8	4401-420-000-20

Subject to technical changes

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