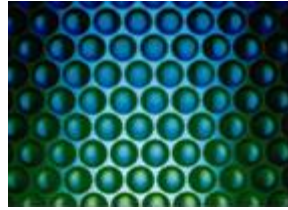
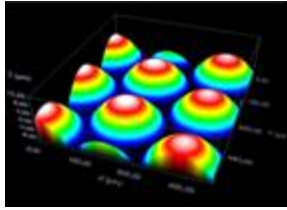
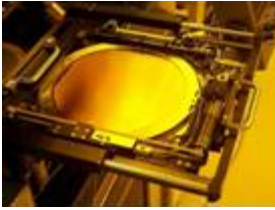
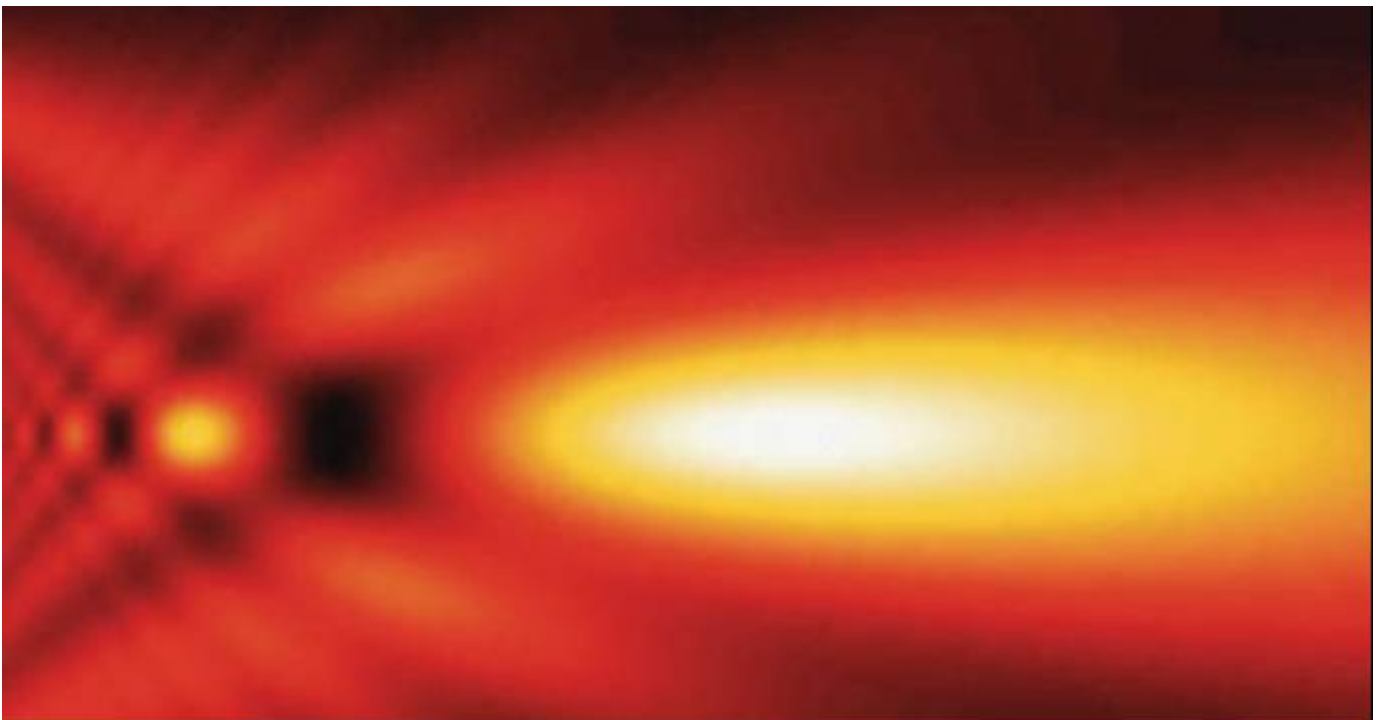


SUSS MicroOptics



MICROLENS ARRAYS – CATALOG 2011

Products & Solutions



Content

1. Microlenses at a glance	3
1.1. Applications	3
1.1.1. Application: Shack Hartmann Wavefront Sensors	4
1.1.2. Application: Laser Beam Homogenizer	4
1.2. Optical Properties	5
1.3. Important indicator : Fresnel Number	6
1.3.3. Fresnel Number and focal length	6
1.3.4. Fresnel Number and beam homogenizing uniformity	7
2. AR-Coatings	7
3. Solutions	8
3.1. Rotating Random Diffuser Systems	8
3.2. Beam Homogenizer Toolbox Kit	9
4. MICROLENS ARRAYS - FUSED SILICA (Quartz)	10
4.1. Circular Lenses, Quadratic Grid	11
4.2. Circular Lenses, Quadratic Grid – Chromium Apertures	12
4.3. Circular Lenses, Hexagonal Grid	13
4.4. Circular Lenses, Hexagonal Grid – Chromium Apertures	14
4.5. Circular Lenses, Linear Array	15
4.6. Cylindrical Microlenses	16
4.7. Crossed-Cylindrical Microlenses	17
4.8. Square Microlenses	18
4.9. Fly’s Eye Condenser	20
4.10. Diffuser plates	21
5. Microlens Arrays – Silicon	22
5.1. Circular Lenses, Linear Array - 1x48 lenses	23
5.2. Square Microlenses	24
6. Accessories - Qioptiq Microbench parts	25
7. Services	26
8. General Terms and Conditions of Sale	27



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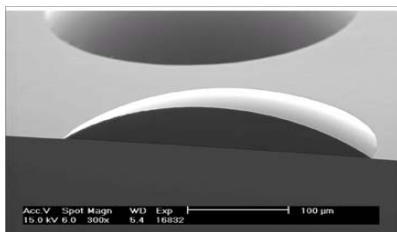
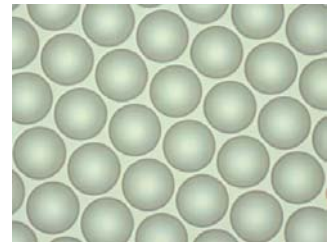
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1. MICROLENSSES AT A GLANCE

Refractive microlenses cover a range of 10 μm to 2 mm lens diameters. Refractive microlenses are an interesting alternative for all applications where miniaturization and reduction of alignment and packaging costs are necessary. A refractive microlens refracts the incident light according to Snell's law, similar as large-scale glass lenses do.



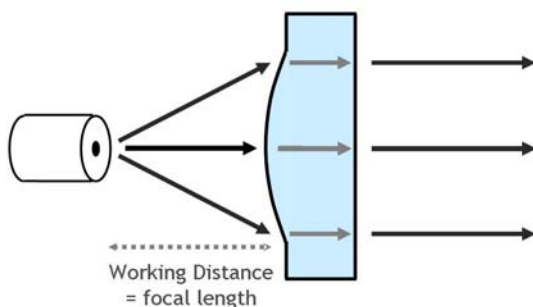
Refractive microlenses are manufactured in Fused Silica, Borofloat (Pyrex) or Silicon using standard semiconductor technologies like photolithography, resist processing and reactive ion etching. These wafer-based manufacturing technologies allow a very accurate shaping of the lens profile and a precise positioning of the lenses within an array. SUSS

MicroOptics is manufacturing in 200 mm (8") wafer technology in cleanroom environment.

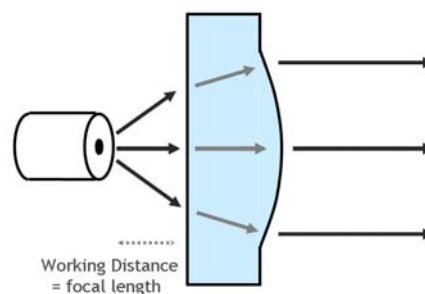
1.1. Applications

Microlenses are used for the collimation, focusing or imaging of light. For example, a microlens images the light from a bundle of single mode optical fibers onto an optical switching device and back in another fiber bundle. The high precision of the lateral array dimensions (better than $\pm 0.25 \mu\text{m}$) allows a very accurate fiber-to-lens positioning in one step. The high-class lens quality and the exceptional lens-to-lens uniformity ensure optimum coupling efficiencies for all optical channels in parallel. Aspherical lens profiles are used to minimize the spherical aberrations for different optical configurations. The choice of the optimum parameters of a microlens array depends very much on the actual design and requirements of your optical system.

a) Lens on Front-Side

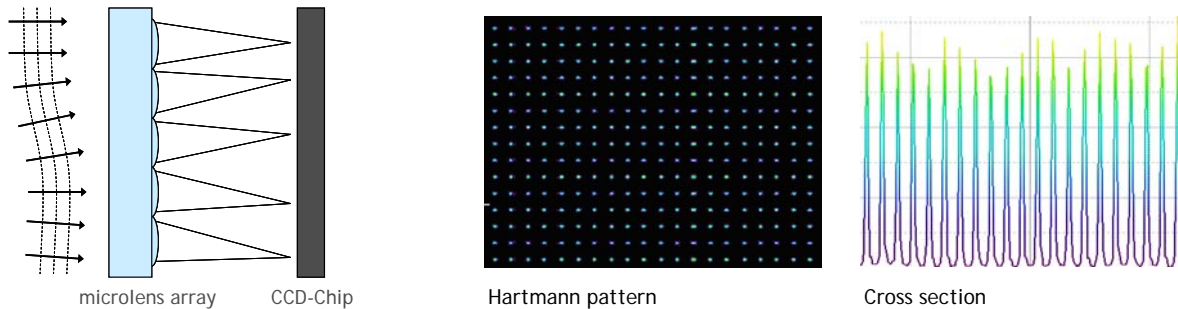


b) Lens on Back-Side



1.1.1. Application: Shack Hartmann Wavefront Sensors

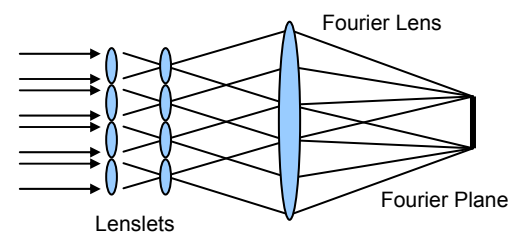
A Shack Hartmann wavefront sensor divides an incident wavefront into a number of beamlets by two-dimensional sub-apertures of a microlens array. Each microlens provides a separate focus on the detector of a CCD camera. The position of each focus spot is displaced by local wavefront aberrations. Shack-Hartmann wavefront sensors measure both intensity distribution and phase distortion in real time and high accuracy. They are widely used in measuring, diagnostic, laser tracking; but also in adaptive optical systems to compensate for phase distortions.



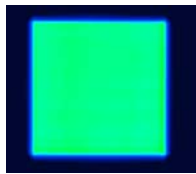
Microlens arrays for Shack Hartmann wavefront sensors usually have small lens apertures to provide high spatial resolution for wavefront sensing. Microlenses with small lens apertures and long focal lengths have low Fresnel Numbers. Low-FN microlenses are more dominated by diffraction effects at the lens aperture than by refraction of the incident light at the lens profile.

1.1.2. Application: Laser Beam Homogenizer

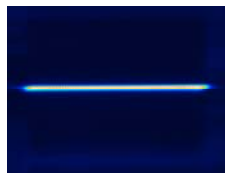
Microlens Laser Beam Homogenizer typically consists of two identical microlens arrays and a large condenser or Fourier lens. The first microlens array divides the incident beam into multiple beamlets and focuses the light onto a second microlens array. The second microlens array is located at one focal length behind the first and serves as a field lens. The second microlens array, in combination with the Fourier lens, images the sub-apertures of the first array into the Fourier plane. All individual images of the first array's sub-apertures superimpose and form a homogeneous "flat-top" illumination in the Fourier plane. Microlens Laser Beam Homogenizer provides a nearly perfect decoupling of the output illumination field from the properties of the incoming beam.



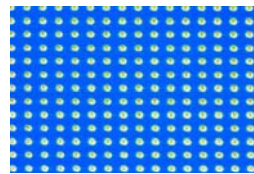
Typical applications are Flat-Top, Spot Patterns, Single Lines and Multi-Lines illumination. The best flat-top uniformity is achieved for non-coherent light sources or lasers with a high M2 value. Array or spot generators work best for well collimated and coherent laser illumination. The number of spots Nx is four times the Fresnel number.



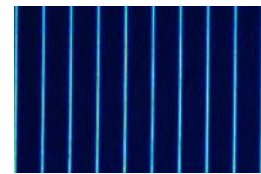
Flat-Top (2D)



Flat-Top (1D)



Spot-Generator

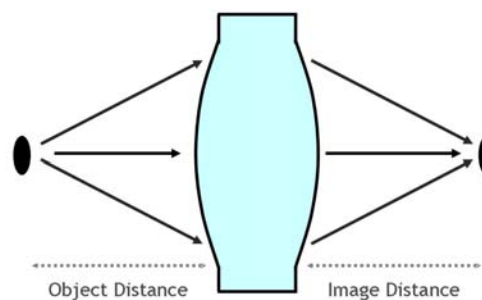
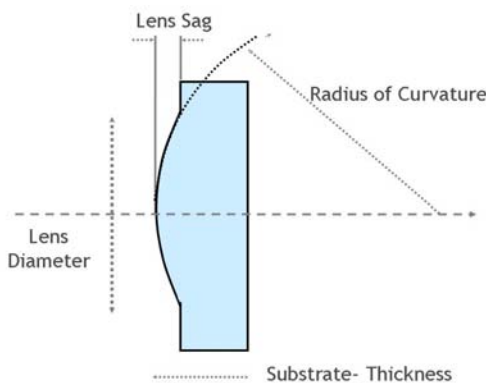


Line-Generator

1.2. Optical Properties

The basic optical properties of a microlens are

- lens diameter $\varnothing = 2a$ (generally a few micron smaller than the lens pitch) and
- effective focal length f_E .



Additional parameters are

- the sag at the lens vertex h ,
- the refractive index n_1 of the bulk material (Fused Silica: refractive index $n_{589\text{nm}} = 1.458$; Silicon: $n_{1.5\mu\text{m}} = 3.478$).
- the radius of curvature R_C or ROC,
- the numerical aperture NA and
- the conic constant k . For spherical lens profiles the conic constant k is 0, k is -1 for parabolic profiles and $k = -(n_1)^2$ for hyperbolic profiles.

$$f_E = \frac{ROC}{n_1 - 1}$$

$$NA \approx \frac{a}{f_E}$$

$$h = ROC - \sqrt{ROC^2 - a^2}$$

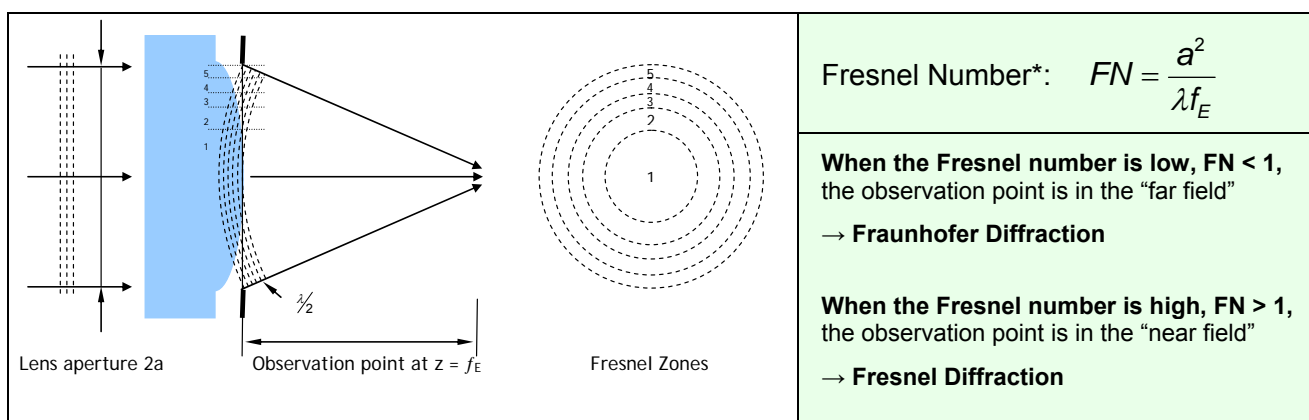
$$ROC = \frac{a^2}{2h} + \frac{(k+1)}{2}h$$

Microlenses in Fused Silica are well suited for the full wavelength spectra from the DUV to the IR (wavelength range: 150 nm to 3 μm). Microlenses in Silicon are suitable for the infrared wavelength range (wavelength range 1.2 μm to 15 μm).

1.3. Important indicator : Fresnel Number

The Fresnel Number, resulting from the optical parameters, is an important indicator to be considered when choosing a microlens array for an application.

Consider a paraxial lens, lens aperture $\varnothing = 2a$, an incident collimated beam, wavelength λ , and an observation point in the focal plane at $z = f_E$. A convergent wavefront is moving from the principal plane, H' , towards the observation point. The aperture can be broken into Fresnel zones, each indicating an optical path difference of one-half wavelength. The Fresnel number, FN, is the number of times the phase cycles through π as seen from the observation point.



*Fresnel Number as defined for a paraxial lens: Lens aperture $\varnothing=2a$, incident collimated beam, observed at the focal point $z = f_E$

Please note that “near” and “far” are relative to the propagation from lens to the observation point.

1.3.3. Fresnel Number and focal length

Microlenses with small lens apertures and long focal lengths (such as Shack Hartmann Arrays) usually have low Fresnel Numbers near 1 and below. These low-FN microlenses are more dominated by diffraction effects at the lens aperture than by refraction of the incident light at the lens profile.

An analysis of the irradiance distribution behind the microlens by using diffraction theory shows that the focal length f_E and the diffraction limited spot diameter \varnothing_{dl} do not describe the optical properties of this low-FN microlens correctly. The diffraction at the aperture of the microlens contributes to the optical power of the lens and leads to a shorter focal length z_m .

Hence, for a given microlens aperture $\varnothing = 2a$ the maximum distance from the microlens array to the focal plane z_m is limited by diffraction at the lens aperture.¹

¹ For further information please read our Techno Sheet 11 - Shack Hartmann which you can find in our download area at www.suss-microoptics.com.

1.3.4. Fresnel Number and beam homogenizing uniformity

For Beam Homogenizing Systems, dominant diffraction effects due to Fresnel diffraction at the microlens array can occur. The Fresnel diffraction is related to the Fresnel number FN. Higher Fresnel numbers give sharper edges and smaller variations of the flat-top profile.

For small microlens apertures and a long focal length, i.e. for microlens beam homogenizers with a Fresnel Number $FN < 10$, the flat top profile might be distorted by Fresnel diffraction at the lens apertures. Thus for small laser beams a beam expander is usually the better solution than using microlens arrays with a very small lens pitch.¹

2. AR-Coatings

On uncoated surfaces for normal incidence, Fresnel reflection losses are $\approx 4\%$ per surface for Fused Silica and $\approx 30\%$ for Silicon. In order to minimize these losses, an antireflection-coating can be applied which can reduce the Fresnel loss for the desired wavelength ranges.

Following coatings are standard coatings:

ARB2-VIS: 400-750nm	Residual reflectance: $< 0.5\%$. Bandwidth: $\approx 50\%$ of central wavelength, measured between 1% residual reflectance points. Damage threshold: $>100\text{J}/\text{cm}^2$ for 10 ns laser pulses (1-on-1) at 1064 nm.
ARB2-NIR: 725-1050nm	Residual reflectance: $<0.5\%$. Bandwidth: $\approx 50\%$ of central wavelength, measured between 1% residual reflectance points. Damage threshold: $>10\text{J}/\text{cm}^2$ for 20 ns laser pulses at 1064 nm.
ARHS-YAG: 1064nm	Residual reflectance $< 0.2\%$ at 0° , $< 0.5\%$ at 45° . Bandwidth $\approx 20\%$ of central wavelength, measured between 1% residual reflectance points. Damage threshold: $>100\text{J}/\text{cm}^2$ for 10 ns laser pulses (1-on-1) at 1064 nm.

For purchasing, please refer to section 7 on page 26.

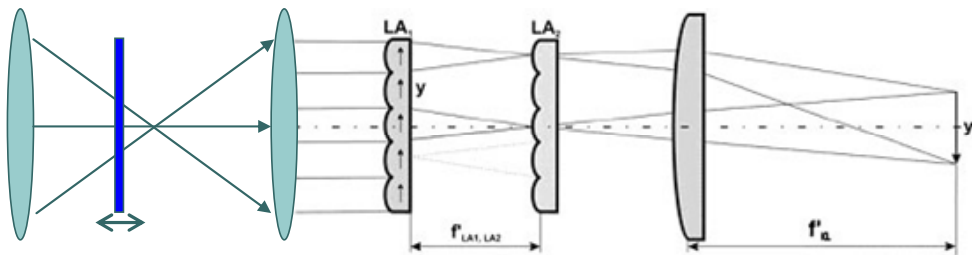
Other coatings can be performed on request, higher charges may apply.

¹ For further information please read our TechInfo Sheet 10 - Beam Homogenizing which you can find in our download area at www.suss-microoptics.com.

3. Solutions

3.1. Rotating Random Diffuser Systems

Interference and speckles are well correlated with the coherence of a laser beam. A random diffuser reduces these undesired effects for applications where light of a cw-laser or multiple pulses from a pulsed laser are integrated at the detector or target. The rotating diffuser plate is usually placed in a separate telescope near the common focus plane.



Rotating random diffuser placed in a separate telescope (left) to reduce coherence and to increase the beam divergence before a microlens beam homogenizer (right).

The diffuser plate is rotating, thus the speckle and interference pattern is changing temporally. By shifting the diffuser position, the field divergence is changed. Time-averaged, the light emitting from the rotating diffuser is similar to an incoherent extended light source.



General specifications - Motor

Micro-Motor DC	Very low vibration and noise level.
Rotation	2600 - 8200 [rpm]. Speed easily adjustable by user.
Tilt of rotation axis	5°
For more information please have a look at SMO Tech Info Sheet 16	

Product N°	Description	Diffuser Size	FWHM	Price per Unit
24-00009	Rotating Ground Glass Diffuser for QIOPTIQ MicroBench, Tilted version, incl. diffusor 1° (13-00022)	Ø 25mm round	1° ± 0.25° FWHM @ 650nm	1'133.00 €
24-00010	Rotating Ground Glass Diffuser for QIOPTIQ MicroBench, Tilted version, incl. diffusor 2° (13-00024)	Ø 25mm round	2° ± 0.25° FWHM @ 650nm	1'133.00 €
24-00066	Rotating Ground Glass Diffuser for QIOPTIQ MicroBench, Tilted version, incl. diffusor 2.5° (13-00028)	Ø 25mm round	2.5° ± 0.25° FWHM @ 650nm	1'133.00 €
24-00067	Rotating Ground Glass Diffuser for QIOPTIQ MicroBench, Tilted version, incl. diffusor 3° (13-00027)	Ø 25mm round	3° ± 0.25° FWHM @ 650nm	1'133.00 €

You can also order our diffuser plates separately, please refer to section 4.10 Diffuser plates (page 21).

Discounts: We allow a discount for larger orders; please contact us for further details.

Delivery time: 1-3 weeks

Diffuser plates can have small minor cosmetically surface imperfections that will not influence on the performance of the rotating diffuser.

3.2. Beam Homogenizer Toolbox Kit

The Beam Homogenizer Toolbox Kit for experiments contains everything you need for your experiments with different lasers and applications. It includes the following elements and systems:



Premounted Beam Homogenizing System	Art. Nr.	Quantity
Square Lenses	18-00201	2
Lens Mount Ring 22,4mm	11-00036	2
Array Mount 10X10	11-00046	2
PcX-Lens; f = 60mm	11-00187	1
Mounting Plate 25mm	11-00010	2
Centering Mounting Plate 25 (x-y-adjustable)	11-00016	1
Rods 150mm	11-00026	2
Premounted Telescope		
PcX-Lens; f = 30mm	11-00248	1
PcX-Lens; f = 100mm	11-00194	1
Mounting Plate 25mm	11-00010	2
Rods 300mm	11-00027	2
Additional mechanical parts		
Cube 25	11-00021	1
Rods 300mm	11-00027	2
Screw driver for Microbench 1.8mm	11-00023	1
Basis Plate 40x80M with Screws	11-00003	2
Holder 25	11-00042	2
Set of threaded pins M2.3x6 (long)	11-00012	2
Set of threaded pins M2.3x3 (short)	11-00011	6
Set of thumbscrews M2.3x4	11-00033	4
Additional optical parts		
Fly's eye condenser (cylindrical) Flat-Top 5	18-00244	2
Fly's eye condenser (cylindrical) Flat-Top 14R5	18-00263	2
Fly's eye condensers (circular, hex. Packaging, chromium)	19-00042	1
Lens Mount Ring 22,4mm	11-00036	5
Array Mount 10X10	11-00046	5
PcX-Lens; f = 100mm	11-00194	1
PcX-Lens; f = 200mm	11-00197	1
Rotating Ground Glass Diffuser		
Rotating Ground Glass Diffuser for LINOS MicroBench, Tilted version, incl. diffuser < 1° FWHM	24-00009	1

Product N°	Description	Price per Unit
24-00013	Beam Homogenizer Toolbox Kit for experiments	5'742.00 €

Discounts: We allow a discount for larger orders; please contact us for further details.

Delivery time: 4-6 weeks

4. MICROLENS ARRAYS - FUSED SILICA (Quartz)

Optical Properties of FUSED SILICA (SiO₂)

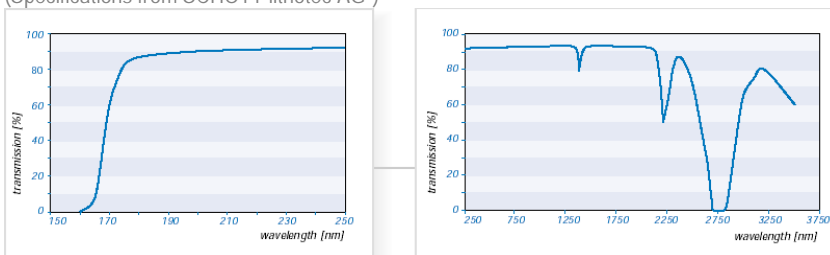
Fused Silica provides excellent optical properties and no bulk absorption from the UV to the Infrared wavelength range.

Refractive Indices													
Wavelength [nm]	193nm	248nm	365nm	486nm	587nm	633nm	852nm	1.06μm	1.31μm	1.53μm	1.97μm	2.32μm	3.37μm
Refractive Index	1.5608	1.5086	1.4745	1.4631	1.4584	1.4570	1.4524	1.4497	1.4469	1.4443	1.4385	1.433	1.41

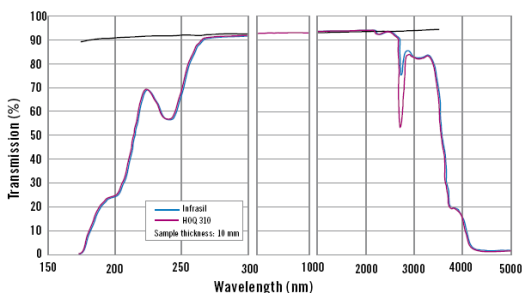
Other Indices					
Linear Thermal Expansion Coefficient $\alpha_{(25^{\circ}\text{C})}$ [10 ⁻⁶ /K]	0.5	Abbé v_d	67.87	Elastic Modulus [GPa]	72
Heat Conductivity $\lambda_{(32^{\circ}\text{C})}$ [W/(m·K)]	1.31	Density ρ [g/cm ³]	2.2	Shear Modulus [GPa]	31.2
Electrical Resistivity (20°C) [10 ¹⁸ Ω·cm]	1.15	Poisson's Ratio μ	0.17	Dielectric Constant ϵ_r	3.8

Optical Transmission

1) Typical Transmission of Schott Lithosil™Q1 including Fresnel reflection losses (10 mm path length)
(Specifications from SCHOTT lithotec AG¹)



2) Typical Transmission of Infrasil including Fresnel reflection losses (10 mm path length)
(Specifications from Heraeus Quarzglas²)



SUSS MicroOptics is using high-quality Fused Silica Wafers (Ø200mm) made of SCHOTT Lithosil™ Q1, Heraeus Infrasil or equivalent.

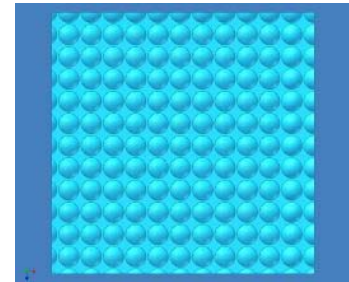
¹ http://www.schott.com/lithotec/english/download/datasheet_fused_silica_.pdf

² [http://www.heraeus-quarzglas.com/hqs1/eng/hqt/hqt_home.nsf/ad6096d7ad7f9fa3412568ba004909cb/1a103566d28d3db1c1256f730038450b/\\$FILE/StandardOptics_EN.pdf](http://www.heraeus-quarzglas.com/hqs1/eng/hqt/hqt_home.nsf/ad6096d7ad7f9fa3412568ba004909cb/1a103566d28d3db1c1256f730038450b/$FILE/StandardOptics_EN.pdf)

4.1. Circular Lenses, Quadratic Grid

General specifications

Substrate Material	Fused Silica (Quartz)
Array Type	Circular lenses
Lens Packaging	Quadratic grid
Lens Type	Refractive, Plano-Convex
Pitch Accuracy	± 0.25 µm
Tolerance on ROC	± 5%
Array clear aperture	1mm smaller than outer tolerances
Applications	Fiber Coupling, Collimation, Imaging...



Product N°	Pitch	ROC	NA	AR-Coating	Array-Size	Price per Unit EURO
18-00057	100µm	0.120mm	0.19	no	5mm x 5mm x 1.2mm	€88.00
18-00060	100µm	0.140mm	0.17	no	10mm x 10mm x 0.7mm	€350.00
18-00007	100µm	0.401mm	0.054	no	15mm x 15mm x 1.2mm	€788.00
18-00010	100µm	0.401mm	0.054	no	1.3mm x 1.3mm x 1.2mm	€53.00
18-00002	110µm	0.817mm	0.03	400-800nm	15mm x 15mm x 0.9mm	€878.00
18-00028	110µm	0.86mm	0.03	no	10mm x 10mm x 0.9mm	€350.00
18-00029	110µm	0.86mm	0.03	no	5mm x 5mm x 0.9mm	€88.00
18-00014	110µm	1.561mm	0.015	no	10mm x 10mm x 1.2mm	€350.00
18-00013	110µm	2.650mm	0.012	400-900nm	10mm x 10mm x 1.2mm	€440.00
18-00004	130µm	1.218mm	0.024	no	15mm x 15mm x 0.9mm	€788.00
18-00017	130µm	2.308mm	0.012	400-900nm	10mm x 10mm x 1.2mm	€440.00
18-00012	130µm	4.410mm	0.01	400-900nm	10mm x 10mm x 1.2mm	€440.00
18-00036	130µm	9.67mm	0.003	no	10mm x 10mm x 1.2mm	€350.00
18-00006	150µm	1.646mm	0.02	no	15mm x 15mm x 0.9mm	€788.00
18-00037	150µm	17.383mm	0.002	no	10mm x 10mm x 1.2mm	€350.00
18-00018	150µm	3.063mm	0.011	no	10mm x 10mm x 1.2mm	€350.00
18-00020	150µm	3.063mm	0.011	400-900nm	10mm x 10mm x 1.2mm	€440.00
18-00056	150µm	3.400mm	0.01	no	10mm x 10mm x 1.2mm	€350.00
18-00011	150µm	6.056mm	0.006	400-900nm	10mm x 10mm x 1.2mm	€440.00
18-00030	250µm	0.297mm	0.18	no	10mm x 10mm x 1.2mm	€350.00
18-00032	250µm	0.297mm	0.18	400-750nm	25mm x 3mm x 1.2mm	€353.00
18-00035	250µm	0.297mm	0.18	725-1050nm	2mm x 3.5mm x 1.2mm	€143.00
18-00047	250µm	0.470mm	0.12	no	12mm x 12mm x 0.9mm	€504.00
18-00048	250µm	0.470mm	0.12	1250-1700nm on lens side	12mm x 12mm x 0.9mm	€594.00
18-00043	250µm	0.487mm	0.11	no	10mm x 10mm x 1.2mm	€350.00
18-00046	250µm	0.487mm	0.11	1260-1675nm	2.3mm x 10mm x 1.2mm	€81.00
18-00040	250µm	0.535mm	0.11	no	4.9mm x 4.9mm x 0.9mm	€88.00
18-00041	250µm	0.535mm	0.11	no	6.2mm x 10mm x 0.9mm	€217.00
18-00407	30µm	0.0385mm	0.15	no	15mm x 15mm x 1.2mm	€788.00
18-00292	30µm	0.039mm	0.15	no	10mm x 10mm x 1.2mm	€350.00
18-00025	30µm	0.042mm	0.144	no	2mm x 2mm x 1.2mm	€53.00

Discounts: 5 – 9 Units: -5% 10 – 24 Units: -10% 25 – 49 Units: -15%

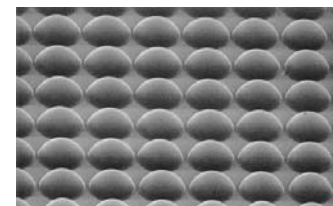
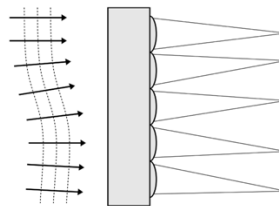
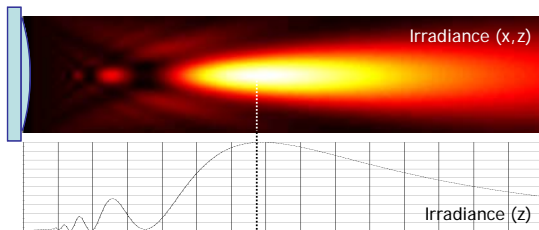
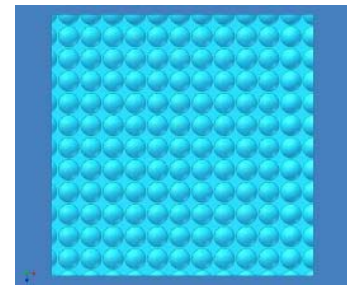
Note: We allow a discount for larger orders; please contact us for further details. If one of the elements above does not meet your specifications, please contact us and we will try to find a better match. If not stated differently all shop items are uncoated. AR-coatings are available for all wavelengths on request.

Delivery time: Stock items within 3-4 days. Please check the delivery time for quantities > 5 units with our sales department.

4.2. Circular Lenses, Quadratic Grid - Chromium Apertures

General specifications

Substrate Material	Fused Silica (Quartz)
Array Type	Circular lenses
Lens Packaging	Quadratic grid, chromium apertures
Lens Type	Refractive, Plano-Convex
Pitch Accuracy	$\pm 0.25 \mu\text{m}$
Tolerance on ROC	$\pm 5\%$
Array clear aperture	1mm smaller than outer tolerances
Applications	Fiber Coupling, Collimation, Imaging...



Product N°	Pitch	ROC	NA	AR-Coating	Array-Size	Price per Unit EURO
19-00037	100 μm	0.060mm	0.36	365-435nm	5mm x 5mm x 1.2mm	€178.00
19-00006	110 μm	1.133mm	0.021	no	12mm x 12mm x 1.2mm	€504.00
19-00031	110 μm	1.18mm	0.02	no	15mm x 15mm x 1.2mm	€788.00
19-00032	110 μm	1.18mm	0.02	no	15mm x 15.8mm x 1.2mm	€830.00
19-00016	110 μm	2.567mm	0.01	no	15mm x 15mm x 0.9mm	€788.00
19-00026	110 μm	2.8mm	0.009	no	15mm x 15mm x 0.9mm	€788.00
19-00028	110 μm	6.188mm	0.004	no	10mm x 10mm x 0.9mm	€350.00
19-00007	130 μm	1.576mm	0.018	no	12mm x 12mm x 1.2mm	€504.00
19-00033	130 μm	1.64mm	0.017	no	15mm x 15mm x 1.2mm	€788.00
19-00003	130 μm	1.711mm	0.017	no	15mm x 15mm x 0.9mm	€788.00
19-00014	130 μm	3.833mm	0.006	no	15mm x 15mm x 0.9mm	€788.00
19-00029	130 μm	5.377mm	0.005	no	10mm x 10mm x 0.9mm	€350.00
19-00030	150 μm	10.518mm	0.003	no	10mm x 10mm x 0.9mm	€350.00
19-00035	150 μm	2.152mm	0.016	no	15mm x 15mm x 1.2mm	€788.00
19-00008	150 μm	2.380mm	0.014	no	10mm x 10mm x 1.2mm	€350.00
19-00004	150 μm	2.491mm	0.013	no	15mm x 15mm x 0.9mm	€788.00
19-00012	150 μm	5.212mm	0.005	no	15mm x 15mm x 0.9mm	€788.00
19-00005	300 μm	30mm	0.002	no	12mm x 12mm x 0.9mm	€504.00
19-00020	75 μm	0.500mm	0	no	12mm x 10mm x 1.2mm	€420.00
19-00021	75 μm	0.500mm	0	no	7mm x 9mm x 1.2mm	€221.00

Discounts: 5 – 9 Units: -5% 10 – 24 Units: -10%

25 – 49 Units: -15%

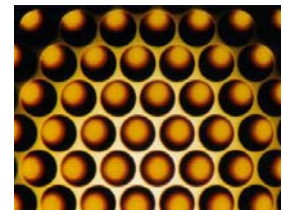
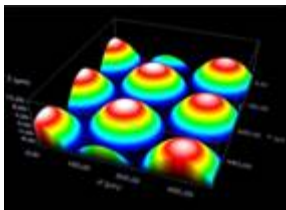
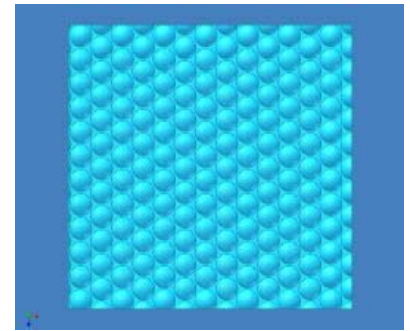
Note: We allow a discount for larger orders; please contact us for further details. If one of the elements above does not meet your specifications, please contact us and we will try to find a better match. If not stated differently all shop items are uncoated. AR-coatings are available for all wavelengths on request.

Delivery time: Stock items within 3-4 days. Please check the delivery time for quantities > 5 units with our sales department.

4.3. Circular Lenses, Hexagonal Grid

General specifications

Substrate Material	Fused Silica (Quartz)
Array Type	Circular lenses
Lens Packaging	Hexagonal grid
Lens Type	Refractive, plano-convex, circular lens base
Pitch Accuracy	$\pm 0.25 \mu\text{m}$
Tolerance on ROC	$\pm 5\%$
Array clear aperture	1mm smaller than outer tolerances
Applications	Fiber Coupling, Collimation, Imaging...



Product N°	Pitch	ROC	NA	AR-Coating	Array-Size	Price per Unit EURO
18-00085	22 μm	0.034mm	0.13	no	10mm x 10mm x 1.2mm	€350.00
18-00087	250 μm	0.350mm	0.17	no	5mm x 5mm x 0.9mm	€88.00
18-00088	250 μm	0.380mm	0.15	no	10mm x 10mm x 1.2mm	€350.00
18-00090	250 μm	0.380mm	0.15	no	2.7mm x 1.0mm x 1.2mm	€350.00
18-00063	250 μm	0.422mm	0.13	no	10mm x 10mm x 0.9mm	€350.00
18-00065	250 μm	0.422mm	0.13	no	5mm x 5mm x 1.2mm	€88.00
18-00068	250 μm	0.450mm	0.12	no	10mm x 10mm x 0.9mm	€350.00
18-00070	250 μm	0.454mm	0.12	830nm	10mm x 10mm x 0.9mm	€440.00
18-00082	250 μm	0.835mm	0.07	no	10mm x 10mm x 1.2mm	€350.00
18-00084	250 μm	0.835mm	0.07	no	20mm x 20mm x 1.2mm	€1'400.00
18-00071	30 μm	0.042mm	0.144	no	10mm x 10mm x 1.2mm	€350.00
18-00073	30 μm	0.042mm	0.144	725-1050nm	5mm x 5mm x 1.2mm	€178.00
18-00075	30 μm	0.042mm	0.144	no	13mm x 13mm x 1.2mm	€592.00
18-00077	30 μm	0.042mm	0.144	no	10mm x 10mm x 0.9mm	€350.00
18-00079	30 μm	0.042mm	0.144	no	2mm x 2mm x 0.9mm	€53.00
18-00062	600 μm , lens dia 250 μm	0.172mm	0.33	no	16mm x 16mm x 0.5mm	€896.00

Discounts: 5 – 9 Units: -5% 10 – 24 Units: -10%

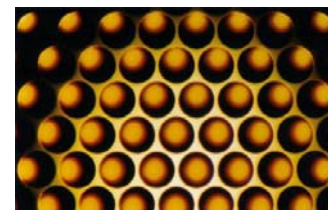
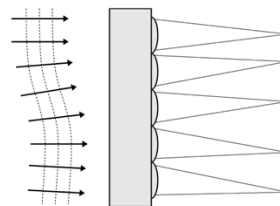
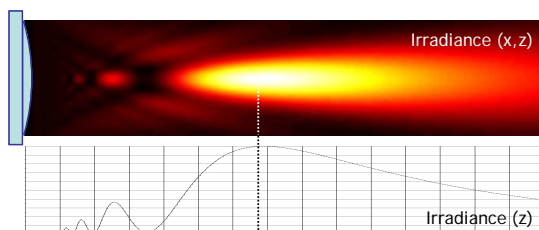
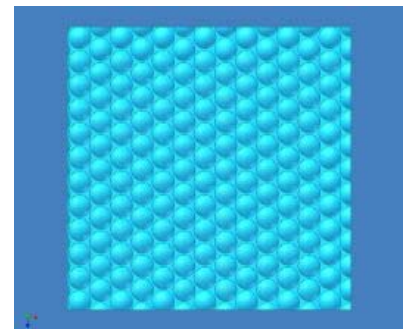
25 – 49 Units: -15%

Note: We allow a discount for larger orders; please contact us for further details. If one of the elements above does not meet your specifications, please contact us and we will try to find a better match. If not stated differently all shop items are uncoated. AR-coatings are available for all wavelengths on request.

Delivery time: Stock items within 3-4 days. Please check the delivery time for quantities > 5 units with our sales department.

4.4. Circular Lenses, Hexagonal Grid - Chromium Apertures

General specifications	
Substrate Material	Fused Silica (Quartz)
Array Type	Circular lenses
Lens Packaging	Hexagonal grid, chromium apertures
Lens Type	Refractive, Plano-Convex
Pitch Accuracy	$\pm 0.25 \mu\text{m}$
Tolerance on ROC	$\pm 5\%$
Array clear aperture	1mm smaller than outer tolerances
Applications	Fiber Coupling, Collimation, Imaging...



Product N°	Pitch	ROC	NA	AR-Coating	Array-Size	Price per Unit EURO
19-00039	22 μm	34 μm	0.13	no	10mm x 10mm x 1.2mm/0.9mm	350.00 €
19-00038	650 μm	14.8mm	0.01	@400-900nm	14,5mm x 18,5mm x 1.2mm	1'029.00 €

Discounts: 5 – 9 Units: -5% 10 – 24 Units: -10%

25 – 49 Units: -15%

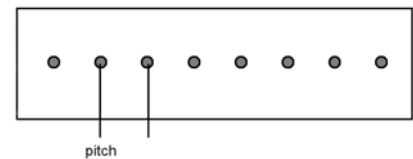
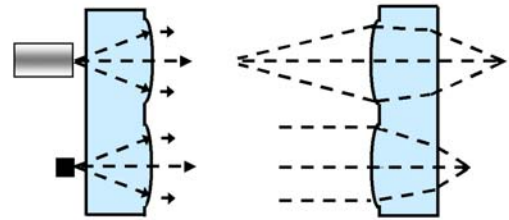
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Delivery time: Stock items within 3-4 days. Please check the delivery time for quantities > 5 units with our sales department.

4.5. Circular Lenses, Linear Array

General specifications

Substrate Material	Fused Silica (Quartz)
Array Type	Circular lenses
Lens Packaging	Linear array
Lens Type	Refractive, Plano-Convex
Pitch Accuracy	$\pm 0.25 \mu\text{m}$
Tolerance on ROC	$\pm 5\%$
Array clear aperture	1mm smaller than outer tolerances
Applications	Singe Mode Fiber Coupler



Product N°	Pitch	ROC	NA	AR-Coating	Array-Size	Price per Unit	Specials
18-00092	250 μm	330 μm	0.17	@1250-1650nm	4mm x 14mm x 0.9mm	286.00 €	1x48 lenses
18-00091	127 μm	315 μm	0.09	@1280-1620nm	1mm x 6.5mm x 1.2mm	143.00 €	3x48 lenses

Discounts: 5 – 9 Units: -5% 10 – 24 Units: -10%

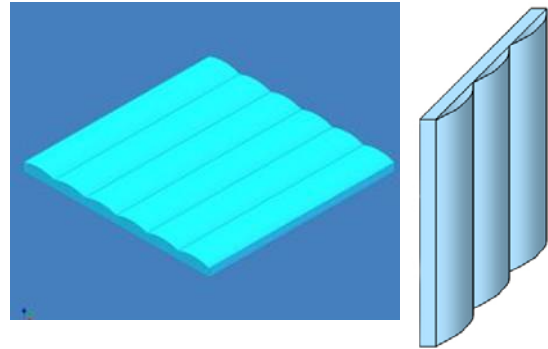
25 – 49 Units: -15%

Note: We allow a discount for larger orders; please contact us for further details. If one of the elements above does not meet your specifications, please contact us and we will try to find a better match. If not stated differently all shop items are uncoated. AR-coatings are available for all wavelengths on request.

Delivery time: Stock items within 3-4 days. Please check the delivery time for quantities > 5 units with our sales department.

4.6. Cylindrical Microlenses

General specifications	
Substrate Material	Fused Silica (Quartz)
Array Type	Cylindrical lenses
Lens Type	Refractive, Plano-Convex
Lens Profile	Parabolic
Pitch Accuracy	$\pm 0.25 \mu\text{m}$
Tolerance on ROC	$\pm 5\%$
Array clear aperture	1mm smaller than outer tolerances
Far-Field	Flat-Top
Application	Beam Homogenizing & Shaping, Slow Axis Collimation



Product N°	Pitch	ROC	AR-Coating	Array-Size	Price per Unit EURO
18-00104	1015 μm	16.7mm	no	10mm x 10mm x 1.2mm	€350.00
18-00127	1015 μm	58.4mm	no	10mm x 10mm x 1.2mm	€350.00
18-00103	1015 μm	6500 μm	no	10mm x 10mm x 1.2mm	€350.00
18-00099	170 μm	0.280mm	830nm	1.6mm x 18mm x 0.9mm	€191.00
18-00101	170 μm	0.320mm	830nm	1.6mm x 18mm x 0.9mm	€191.00
18-00102	170 μm	0.360mm	830nm	1.6mm x 18mm x 0.9mm	€191.00
18-00100	170 μm	0.500mm	830nm	1.6mm x 18mm x 0.9mm	€191.00
18-00107	200 μm	0.46mm	no	5mm x 1.2mm x 0.9mm	€53.00
18-00128	250 μm	0.711mm	no	10mm x 10mm x 1.2mm	€350.00
18-00129	250 μm	0.711mm	no	\varnothing 12mm x 1.2mm	€396.00
18-00131	300 μm	0.380mm	no	10mm x 10mm x 1.2mm	€350.00
18-00133	300 μm	0.380mm	no	8mm x 16mm x 1.2mm	€448.00
18-00135	300 μm	3.6mm	no	10mm x 10mm x 1.2mm	€350.00
18-00112	500 μm	1.5mm	no	10mm x 10mm x 1.2mm	€350.00
18-00118	500 μm	1.5mm	1550nm	4mm x 6mm x 1mm	€174.00
18-00120	500 μm	1.5mm	no	\varnothing 25mm x 1.2mm	€1'715.00
18-00094	500 μm	2.04mm	no	10mm x 10mm x 1mm	€350.00
18-00121	500 μm	3mm	no	10mm x 10mm x 1.2mm	€350.00
18-00139	500 μm	51mm	no	13.9mm x 18.9mm x 1.2mm	€919.00
18-00109	500 μm	5mm	no	10mm x 10mm x 1.2mm	€350.00
18-00136	500 μm	6.7mm	no	14mm x 14mm x 1.2mm	€686.00
18-00137	500 μm	6.7mm	400-900nm	14mm x 14mm x 1.2mm	€776.00

Some of these arrays are also available in \varnothing 12mm round and \varnothing 25mm round.

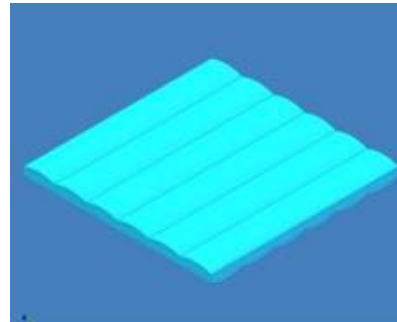
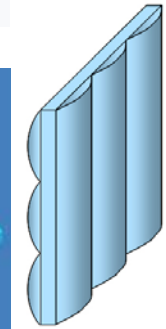
Discounts: 5 – 9 Units: -5% 10 – 24 Units: -10%

25 – 49 Units: -15%

Note: We allow a discount for larger orders; please contact us for further details. If one of the elements above does not meet your specifications, please contact us and we will try to find a better match. If not stated differently all shop items are uncoated. AR-coatings are available for all wavelengths on request.

Delivery time: Stock items within 3-4 days. Please check the delivery time for quantities > 5 units with our sales department.

4.7. Crossed-Cylindrical Microlenses



General specifications

Substrate Material	Fused Silica (Quartz)
Array Type	Crossed-cylindrical lenses
Lens Type	Refractive, Bi-Convex
Lens Profile	Parabolic
Pitch Accuracy	$\pm 0.25 \mu\text{m}$
Tolerance on ROC	$\pm 5\%$
Array clear aperture	1mm smaller than outer tolerances
Far-Field	Flat-Top
Application	beam homogenizing and shaping

Product N°	Pitch	ROC	AR-Coating	Array-Size	Price per Unit EURO
18-00142	1015 μm	61mm	no	10mm x 10mm x 1.2mm	€380.00
18-00148	300 μm	3.6mm	no	5mm x 10mm x 0.9mm	€190.00
18-00147	300 μm	3.6mm	no	10mm x 10mm x 0.9mm	€380.00
18-00149	300 μm	3.6mm	no	13mm x 13mm x 0.9mm	€642.00
18-00143	300 μm	6.8mm	no	10mm x 10mm x 0.9mm	€380.00
18-00144	300 μm	6.8mm	no	5mm x 10mm x 0.9mm	€190.00
18-00145	300 μm	6.8mm	725-1050nm	12mm x 12mm x 0.9mm	€637.00

Discounts: 5 – 9 Units: -5% 10 – 24 Units: -10%

25 – 49 Units: -15%

Note:

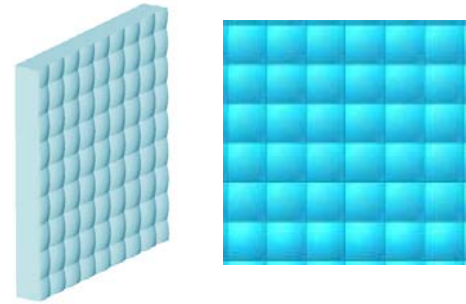
We allow a discount for larger orders; please contact us for further details. If one of the elements above does not meet your specifications, please contact us and we will try to find a better match. If not stated differently all shop items are uncoated. AR-coatings are available for all wavelengths on request.

Delivery time:

Stock items within 3-4 days. Please check the delivery time for quantities > 5 units with our sales department.

4.8. Square Microlenses

General specifications	
Substrate Material	Fused Silica (Quartz)
Array Type	Square microlenses, up to 98% fill factor
Lens Type	Refractive, Plano-Convex
Lens Profile	Parabolic
Pitch Accuracy	$\pm 0.25 \mu\text{m}$
Tolerance on ROC	$\pm 10\%$ in x- and y-direction
Array clear aperture	1mm smaller than outer tolerances
Far-Field	Flat-Top
Application	Beam Homogenizing and shaping



Product N°	Pitch	ROC	AR-Coating	Array-Size	Price per Unit EURO
18-00181	1015 μm	100mm	no	10mm x 10mm x 1.2mm	€380.00
18-00182	1015 μm	100mm	1064nm	10mm x 10mm x 1.2mm	€470.00
18-00150	1015 μm	11mm/13mm	no	10mm x 10mm x 1.2mm	€380.00
18-00153	1015 μm	11mm/13mm	no	5mm x 5mm x 1.2mm	€95.00
18-00183	1015 μm	28mm	no	10mm x 10mm x 1.2mm	€380.00
18-00185	1015 μm	28mm	193-248nm	10mm x 10mm x 1.2mm	€470.00
18-00187	1015 μm	28mm	1200-1700nm	10mm x 10mm x 1.2mm	€470.00
18-00188	1015 μm	28mm	no	5mm x 5mm x 1.2mm	€95.00
18-00215	1015 μm	55mm	no	10mm x 10mm x 1.2mm	€380.00
18-00175	1015 μm	70mm	no	10mm x 10mm x 1.2mm	€380.00
18-00178	1015 μm	70mm	400-900nm	10mm x 10mm x 1.2mm	€470.00
18-00179	1015 μm	70mm	193-248nm	10mm x 10mm x 1.2mm	€470.00
18-00180	1015 μm	70mm	no	5mm x 5mm x 1.2mm	€95.00
18-00154	300 μm	14mm	263nm	10mm x 10mm x 1.2mm	€470.00
18-00155	300 μm	14mm	263nm	15mm x 15mm x 1.2mm	€945.00
18-00156	300 μm	14mm	263nm	11mm x 16mm x 1.2mm	€759.00
18-00157	300 μm	2.2mm	no	10mm x 10mm x 1.2mm	€380.00
18-00158	300 μm	2.2mm	193	10mm x 10mm x 1.2mm	€470.00
18-00161	300 μm	2.2mm	193-248nm	10mm x 10mm x 1.2mm	€470.00

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Product N°	Pitch	ROC	AR-Coating	Array-Size	Price per Unit EURO
18-00170	300µm	2.2mm	no	10mm x 10mm x 0.9mm	€380.00
18-00211	300µm	2.35mm	no	10mm x 10mm x 1.2mm	€380.00
18-00221	300µm	4mm	no	10mm x 10mm x 1.2mm	€380.00
18-00224	300µm	4mm	no	5mm x 10mm x 1.2mm	€190.00
18-00216	300µm	8.6mm	no	10mm x 10mm x 1.2mm	€380.00
18-00197	500µm	10mm	no	10mm x 10mm x 1.2mm	€380.00
18-00200	500µm	10mm	no	11mm x 16mm x 1.2mm	€669.00
18-00196	500µm	14.3mm/6.5mm	no	10mm x 10mm x 1.2mm	€380.00
18-00225	500µm	15mm	no	10mm x 10mm x 1.2mm	€380.00
18-00226	500µm	15mm	193nm	10mm x 10mm x 1.2mm	€470.00
18-00193	500µm	20mm	no	10mm x 10mm x 1.2mm	€380.00
18-00213	500µm	56mm	no	10mm x 10mm x 1.2mm	€380.00
18-00201	500µm	6.3 mm	no	10mm x 10mm x 1.2mm	€380.00
18-00202	500µm	6.3 mm	193nm	10mm x 10mm x 1.2mm	€470.00
18-00230	500µm	7mm	no	10mm x 10mm x 1.2mm	€380.00
18-00232	500µm	7mm	1064nm	10mm x 10mm x 1.2mm	€470.00
18-00239	500µm	7mm	no	13mm x 13mm x 1.2mm	€642.00

Discounts: 5 – 9 Units: -5% 10 – 24 Units: -10%

25 – 49 Units: -15%

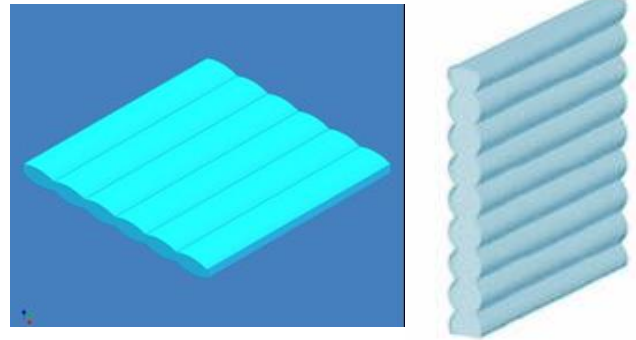
Note: We allow a discount for larger orders; please contact us for further details. If one of the elements above does not meet your specifications, please contact us and we will try to find a better match. If not stated differently all shop items are uncoated. AR-coatings are available for all wavelengths on request.

Delivery time: Stock items within 3-4 days. Please check the delivery time for quantities > 5 units with our sales department.

4.9. Fly's Eye Condenser

General specifications

Substrate Material	Fused Silica (Quartz)
Array Type	Cylindrical lenses, Fly's Eye Type
Lens Type	Refractive, Bi-Convex
Lens Profile	Parabolic
Pitch Accuracy	± 0.25 µm
Tolerance on ROC	± 5%
Array clear aperture	1mm smaller than outer tolerances
Far-Field	Flat-Top
Application	Beam Homogenizing



Product N°	Fly's Eye Type	Pitch	ROC	AR-Coating	Array-Size	Price per Unit EURO
18-00244	cylindrical	250µm	0.75mm	no	10mm x 10mm x 2.25mm	€380.00
18-00245	cylindrical	250µm	0.75mm	193nm	10mm x 10mm x 2.25mm	€470.00
18-00248	cylindrical	250µm	0.75mm	193-248nm	10mm x 10mm x 2.25mm	€470.00
18-00251	cylindrical	250µm	0.75mm	no	5mm x 5mm x 2.25mm	€95.00
18-00252	cylindrical	250µm	0.75mm	no	5mm x 10mm x 2.25mm	€190.00
18-00254	cylindrical	250µm	0.75mm	no	30mm x 30mm x 2.25mm	€2'380.00
18-00257	cylindrical	250µm	0.75mm	no	15mm x 25mm x 2.25mm	€855.00
18-00258	cylindrical	250µm	0.75mm	no	∅ 21mm x 2.25mm	€1'315.00
18-00265	cylindrical	300µm	0.385mm	no	10mm x 10mm x 1.2mm	€380.00
18-00271	cylindrical	400µm	0.700mm	no	10mm x 10mm x 2.25mm	€380.00
18-00272	cylindrical	400µm	0.700mm	no	15mm x 15mm x 2.25mm	€855.00
18-00276	cylindrical	70µm	0.220mm	no	10mm x 10mm x 0.7mm	€380.00
18-00277	cylindrical	70µm	0.220mm	no	5mm x 5mm x 0.7mm	€95.00
18-00275	circular, hex. Packaging, no chromium	250µm	0.177mm	no	10mm x 10mm x 0.5mm	€380.00
18-00390	circular, hex. Packaging, no chromium	275µm	0.193mm	no	10mm x 10mm x 0.6mm	€350.00

Discounts: 5 – 9 Units: -5% 10 – 24 Units: -10%

25 – 49 Units: -15%

Note: We allow a discount for larger orders; please contact us for further details. If one of the elements above does not meet your specifications, please contact us and we will try to find a better match. If not stated differently all shop items are uncoated. AR-coatings are available for all wavelengths on request.

Delivery time: Stock items within 3-4 days. Please check the delivery time for quantities > 5 units with our sales department.

4.10. Diffuser plates

General specifications – Diffuser plates

Substrate Material	Fused Silica (Quartz), Silicon
Lens Type	Refractive, Plano-Convex
Incoming Beam Diameter	4-6mm max
Application	Reduces coherence and interference effects



Product N°	Diffuser Size	FWHM	Price per Unit EURO
13-00006	10mmx10mm	< 1.6° FWHM @ 650nm	€80.00
13-00013	5mmx5mm	< 0.5° FWHM @ 650nm	€40.00
13-00017	5mmx5mm	< 1° FWHM @ 650nm	€40.00
13-00018	5mmx5mm	< 0.8° FWHM @ 650nm	€40.00
13-00019	5mmx5mm	< 1.6° FWHM @ 650nm	€40.00
13-00022	Outer Ø 25mm - Inner Ø 3,2mm	1° ± 0.25° FWHM @ 650nm	€392.00
13-00024	Outer Ø 25mm - Inner Ø 3,2mm	2° ± 0.25° FWHM @ 650nm	€392.00
13-00028	Outer Ø 25mm - Inner Ø 3,2mm	2.5° ± 0.25° FWHM @ 650nm	€392.00
13-00027	Outer Ø 25mm - Inner Ø 3,2mm	3° ± 0.25° FWHM @ 650nm	€392.00

Discounts: 5 – 9 Units: -5% 10 – 24 Units: -10%

25 – 49 Units: -15%

Note: We allow a discount for larger orders; please contact us for further details. If one of the elements above does not meet your specifications, please contact us and we will try to find a better match. If not stated differently all shop items are uncoated. AR-coatings are available for all wavelengths on request.

Delivery time: Stock items within 3-4 days. Please check the delivery time for quantities > 5 units with our sales department.

Diffuser plates can have small minor cosmetically surface imperfections that will not influence on the performance of the rotating diffuser.

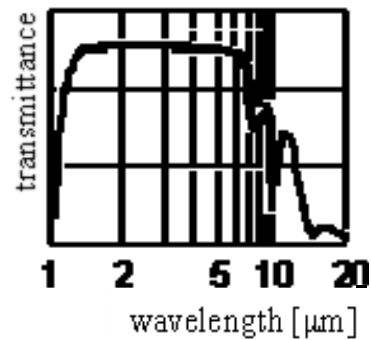
5. Microlens Arrays - Silicon

Optical Properties of Silicon (Si)

Refractive Indices										
Wavelength [nm]	1μm	1.31μm	1.55μm	1.71μm	2.15μm	3.5μm	4μm	6μm	8.5μm	11μm
Refractive Index n_{λ} [20°C]	3.57	3.503	3.478	3.466	3.448	3.428	3.426	3.420	3.418	3.412

Other Indices					
Linear Thermal Expansion Coefficient $\alpha_{(25^{\circ}-100^{\circ}\text{C})}$ [10 ⁻⁶ /K]	2.55- 4.15	Dielectric Constant ϵ_r at 10 GHz	13	Elastic Modulus [GPa]	131
Heat Conductivity $\lambda_{(32^{\circ}\text{C})}$ [W/(m·K)]	163.3	Density ρ [g/cm ³]	2.33	Shear Modulus [GPa]	80
Transmission Range for Wafer 0.5mm thickness [nm]	1.2- 15μm	Poisson's Ratio μ	0.266	Bulk Modulus [GPa]	102

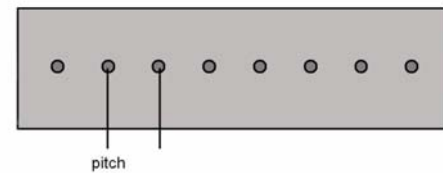
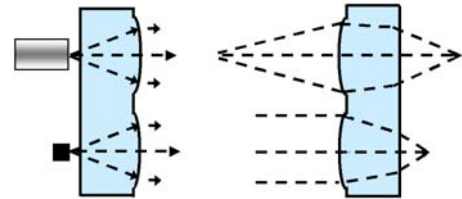
Optical Transmission



5.1. Circular Lenses, Linear Array - 1x48 lenses

General Specifications

Substrate Material	Silicon
Array Type	Circular lenses
Lens Packaging	Linear array
Lens Type	Refractive, Plano-Convex
Application	Fiber Coupling, Collimation, Imaging
Pitch Accuracy	$\pm 0.25 \mu\text{m}$
Tolerance on ROC	$\pm 5\%$
Array clear aperture	1mm smaller than outer tolerances



Product N°	Pitch	ROC	NA	AR-Coating	Array-Size	Price per Unit EURO
18-00282	1250 μm	885 μm	0.68	@1250-1650nm	3mm x 12mm x 0.5mm	216.00 €
18-00281	1250 μm	930 μm	0.65	no	3mm x 12mm x 0.5mm	126.00 €
18-00283	1250 μm	950 μm	0.65	@1250-1650nm	3mm x 12mm x 0.5mm	216.00 €
18-00284	250 μm	1.65mm	0.18	@1.2-10 μm	4mm x 14mm x 0.5mm	286.00 €

Discounts: 5 – 9 Units: -5% 10 – 24 Units: -10%

25 – 49 Units: -15%

Note:

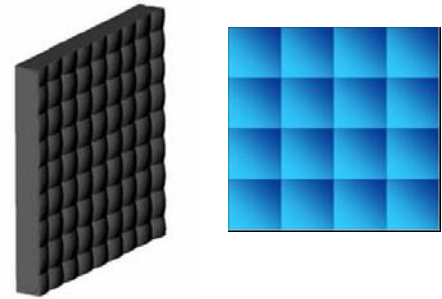
We allow a discount for larger orders; please contact us for further details. If one of the elements above does not meet your specifications, please contact us and we will try to find a better match. If not stated differently all shop items are uncoated. AR-coatings are available for all wavelengths on request.

Delivery time:

Stock items within 3-4 days. Please check the delivery time for quantities > 5 units with our sales department.

5.2. Square Microlenses

General specifications	
Substrate Material	Silicon
Array Type	Square Microlenses Up to 98% Fill Factor
Lens Type	Refractive, Plano-Convex, Square
Lens Profile	Parabolic
Pitch Accuracy	$\pm 0.25 \mu\text{m}$
Tolerance on ROC	$\pm 10\%$ in x- and y-direction
Array clear aperture	1mm smaller than outer tolerances
Far-Field	Flat-Top
Applications	Beam Homogenizing



Product N°	Pitch	ROC	Div. Angle	AR-Coating	Array-Size	Price per Unit EURO
18-00290	1015 μm	100mm	$\pm 0.75^\circ$	@3 μm - 5 μm	14mm x 14mm x 0.5mm	835.00 €

Discounts: 5 – 9 Units: -5% 10 – 24 Units: -10%

25 – 49 Units: -15%





Note: We allow a discount for larger orders; please contact us for further details. If one of the elements above does not meet your specifications, please contact us and we will try to find a better match. If not stated differently all shop items are uncoated. AR-coatings are available for all wavelengths on request.

Delivery time: Stock items within 3-4 days. Please check the delivery time for quantities > 5 units with our sales department.

6. Accessories - Qioptiq Microbench parts

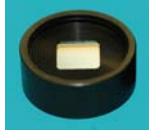
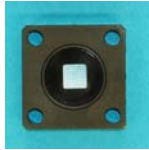
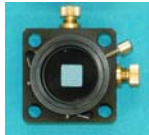
All parts are offered without microlens arrays. This selection is non exhaustive and only represents the standard components used for microoptics; however several other Qioptiq components can also be assembled. For more information, please contact us or check out www.qioptiq.com.

SINGLE PARTS

Product N°	Description	Price per Unit EURO	Images
11-00045	Microbench mount for microlens arrays 5mm x 5mm (Free aperture ca. 4mm x 4mm)	45.00 €	
11-00046	Microbench mount for microlens arrays 10mm x 10mm (Free aperture ca. 9mm x 9mm)	45.00 €	
11-00036	Lens mount ring 22,4mm	25.00 €	
11-00010	Mounting Plate 25	45.00 €	
11-00016	Centering Mounting Plate 25 (x-y-adjustable)	130.00 €	
11-00023	Screw driver for Microbench 1.8mm	25.00 €	
11-00008	Nanobench mount for microlens arrays 5mm x 5mm (Free aperture ca. 4mm x 4mm)	45.00 €	
11-00009	Nanobench mount for microlens arrays 10mm x 10mm (Free aperture ca. 9mm x 9mm)	45.00 €	

Delivery time: Stock items within 3-4 days. Please check the delivery time for quantities > 5 units with our sales department.

ASSEMBLED PARTS

Product N°	Elements included	Price per Unit EURO	Images
11-00051	Lens mount ring (11-00036) + Microbench mount for microlens arrays 5mm x 5mm (11-00045)	70.00 €	
11-00052	Lens mount ring (11-00036) + Microbench mount for microlens arrays 10mm x 10mm (11-00046)	70.00 €	
11-00053	Mounting plate 25mm invariable (11-00010) + Lens mount ring (11-00036) + Microbench mount for microlens arrays 5mm x 5mm (11-00045)	110.00 €	
11-00054	Mounting plate 25mm invariable (11-00010) + Lens mount ring (11-00036) + Microbench mount for microlens arrays 10mm x 10mm (11-00046)	110.00 €	
11-00055	Centering Mounting Plate 25 x-y-adjustable (11-00016) + Lens Mount Ring (11-00036) + Microbench mount for microlens arrays 5mm x 5mm (11-00045)	200.00 €	
11-00056	Centering Mounting Plate 25 x-y-adjustable (11-00016) + Lens Mount Ring (11-00036) + Microbench mount for microlens arrays 10mm x 10mm (11-00046)	200.00 €	

Please note that these parts do not contain microlens arrays.

Delivery time: Stock items within 3-4 days. Please check the delivery time for quantities > 5 units with our sales department.

7. Services

Product N°	Description	Price per Unit EURO
22-00030	Gluing of a microlens array to the mount (only available if the array and lens mount are purchased at the same time). Additional lead time: 1 week.	0.00 €
22-00007	AR-Coating 400-750nm, R<0.5%, doublesided. Only available for uncoated microlens arrays or diffusers purchased at the same time. Price per piece. Additional lead time: 7-8 weeks	90.00 €
22-00008	AR-Coating 725-1050nm, R<0.5%, doublesided. Only available for uncoated microlens arrays or diffusers purchased at the same time. Price per piece. Additional lead time: 7-8 weeks	90.00 €
22-00009	AR-Coating 1064nm, R<0.2%, doublesided. Only available for uncoated microlens arrays or diffusers purchased at the same time. Price per piece. Additional lead time: 7-8 weeks	90.00 €

8. General Terms and Conditions of Sale

1. General

1.1 All supplies and services of SUSS MicroOptics SA are subject to the conditions stated hereafter. General Conditions and Terms of Sale of the customer are of no validity.

2. Quotation/Order Confirmation

2.1 Unless otherwise clearly stated in writing, quotations made by SUSS MicroOptics are free of any commitment. The contract is concluded only when SUSS MicroOptics confirms an order.

2.2 Orders without prior quotation are binding for SUSS MicroOptics only when SUSS MicroOptics confirms the order. This applies also if a customer modifies a quotation made by SUSS MicroOptics.

2.3 The customer shall, at the latest when receiving the quotation, draw the attention of SUSS MicroOptics to the standards and regulations applicable to the execution of the supplies and services, to their operation as well as to the health and safety of the personnel.

3. Documentation

3.1 Information given in catalogues, on data sheets or other paper work in accompaniment of the quotation are mere indications and as such are not binding, unless otherwise specified.

3.2 In special cases SUSS MicroOptics shall be entitled to make constructive changes and employ other materials in case of deficient base material, provided such changes do not contradict the outweighing interests of the customer previously notified to SUSS MicroOptics.

3.3 SUSS MicroOptics shall retain all rights of property and copy right on documents put at the disposition of the customer; the customer shall not use nor copy nor show them to a third party for a purpose different from the one intended by SUSS MicroOptics. These documents do not entitle to copy single parts of the devices. These documents shall be returned to SUSS MicroOptics on its first request.

4. Prices, Packing, Insurance

4.1 Unless otherwise clearly agreed upon in writing, all prices shall be calculated in CHF (VAT excluded) and shall be deemed to be net ex works excluding packing, without any deduction whatsoever (ex works, Incoterms 2000). Any and all additional charges, such as, but not limited to, freight charges, insurance premiums, fees for export, transit, import and other permits, as well as for certifications, shall be borne by the customer. Likewise, the customer shall bear any and all taxes, fees, levies, customs duties and the like which are levied out of or in connection with the contract, or shall refund them to SUSS MicroOptics against adequate evidence in case SUSS MicroOptics is liable for them.

4.2 The customer shall inform SUSS MicroOptics, with the order at the latest, of special wishes regarding forwarding, transport and insurance. Transport shall be at the risk and at the expense of the customer. Objections regarding forwarding or transport shall be immediately submitted upon receipt of the supplies or of the shipping documents by the customer to the last carrier.

4.3 The customer shall be responsible for taking insurance against risks of any kind.

5. Passing of benefit and risk

5.1 The benefit and the risk of the supplies shall pass to the customer at latest by the date of their leaving the works. The same applies for partial deliveries.

5.2 If dispatch is delayed due to reasons beyond SUSS MicroOptics' control, the risk of the supplies shall pass to the customer at the time when SUSS MicroOptics notifies the customer that supplies are ready for dispatch.

6. Lead times / delivery time

6.1 Lead time shall start on the day when all commercial and technical points for the fulfillment of the order have been settled with the customer, all official formalities have been completed, all payments due up front have been credited to an account of SUSS MicroOptics and SUSS MicroOptics has received all documentation to be provided by the customer.

Lead time shall be deemed to be observed - provided the customer has fulfilled all his contractual obligations - if by that time SUSS MicroOptics has handed supplies over to the first carrier or alternatively has sent a notice to the customer informing him that supplies are ready for dispatch. Partial deliveries shall be authorized. Any delay of delivery does not entitle the customer to any rights or claims.

6.2 If dispatch is delayed upon request of the customer or for any other reason beyond the SUSS MicroOptics' control, SUSS MicroOptics shall store the supplies at the risk and at the expense of the customer and invoice it as dispatched net ex works. Furthermore SUSS MicroOptics shall be entitled - passed an acceptable delay - to dispose otherwise of the supplies and to deliver the customer with an accordingly extended delivery time.

6.3 If delivery is delayed by force majeure delivery time is accordingly extended. Cases of force majeure are reputed to be serious events or circumstances which cannot be attributed to the supplier, such as but not limited to total or partial suspension of activity of SUSS MicroOptics' suppliers, mobilization, war, terrorism, natural disaster, strikes, fire, blocking of import or export, lack of authorization or permission, as well as all other unforeseeable events.

7. Terms of payment

7.1 In the absence of contrary provisions, indicated in writing in the quotation or the order confirmation, invoices are to be settled net, without any deduction, within 10 days of receipt. Partial deliveries will be invoiced accordingly.

7.2 Payments shall be credited exclusively to an account of SUSS MicroOptics. Additional fees or other expenses resulting from a different mode of payment previously agreed upon (e.g. cheque or bill of exchange) shall be borne by the customer.

7.3 If the customer does not pay according to due date, he shall be in default without formal notice and shall be liable for default interest at a rate of 4 per cent above the current discount rate of the Swiss National Bank. The right to claim further damage caused by default is reserved.

8. Retention of Title

8.1 SUSS MicroOptics retains all rights of property on all sold products until receipt of full payment of the purchase price. If in the country of the supplier the validity of retention of title is subject to special formal regulations or other conditions, the customer shall be responsible for taking them into account and fulfill them.

8.2 All products of SUSS MicroOptics are unique elements that may not be replicated or copied in any form. An agreement from SUSS MicroOptics is required before these elements can be copied or replicated in any form. A license fee will apply.

9. Warranty

9.1 The warranty period of SUSS MicroOptics is 12 months and runs from the day of delivery or upon termination of assembly and during the specified time. The warranty shall extend and be limited to all defects which occur as a proven result from bad quality material, faulty design or poor workmanship. It is however limited to replacement or repair of defective parts or products or to refunding of the invoice price of non-replaceable or - according to SUSS MicroOptics' choice, non-replaced products. Any other claim not expressly mentioned such as damage, reduction in price, termination of or withdrawal from the contract is excluded.

SUSS MicroOptics accepts no further responsibility. This in particular refers, but shall not be limited to, loss of production, loss of use, loss of orders, loss of profit and other direct or indirect or consequential damage or third parties damage.

9.2 SUSS MicroOptics can assume no responsibility for modifications or repairs which have not been carried out by SUSS MicroOptics' personnel or by specialists appointed by SUSS MicroOptics. The customer loses all claims of warranty if any modifications or repairs have been carried out by people not specifically appointed by SUSS MicroOptics.

10. Claims

10.1 The customer shall inspect the supplies and services thoroughly within 14 days after receipt and shall immediately notify SUSS MicroOptics in writing of any deficiencies; the same applies to possible hidden deficiencies which only appear later. If the customer fails to do so, the supplies and services shall be deemed to have been accepted and all respective warranty claims become extinct.

10.2 Shipments damaged during transport must be accepted without guarantee and immediately be reported to the shipping agent in order to establish a certified report. Otherwise the customer shall lose all and any warranty claim.

10.3 If protected rights of third parties are infringed by drawings or information passed on to SUSS MicroOptics by the customer, only the customer shall be liable for this infringement and shall liberate SUSS MicroOptics from all claims.

11. Exclusion of further liability

11.1 All cases of breach of contract as well as all rights and claims on the part of the customer, irrespective on what legal grounds they are based, are exhaustively covered by these general terms and conditions of sale.

12. Export, Re-Export

12.1 SUSS MicroOptics supplies are intended for use in the indicated country. Any export, re-export or re-import thereof is prohibited without written authorization from SUSS MicroOptics. This more particularly applies to products whose export is prohibited by the Swiss, the German or the US-government or to equipment comprising material whose export, re-export or re-import is prohibited by the applicable law.

13. Place of Legal Venue and Applicable Law

13.1 The contract shall be governed by Swiss substantive law. The applicability of the UN Agreement dated April 11th, 1980 for contracts governing international Purchase of Goods is excluded.

13.2 Exclusive place of jurisdiction shall be in the Commercial Court in CH-8000 Zürich.

SUSS MicroOptics SA