



3D optics

2014

www.opto-engineering.com

Index

3D optics

Opto Engineering designs 3D lenses and projectors equipped with a high-precision tilting mechanism that allows the Scheimpflug condition to be met and to image the whole field of view in perfect focus. The Scheimpflug criterion describes how an object plane that is not parallel to the image plane can be imaged completely in focus. Tilting the Scheimpflug adaptor allows us to see the field of view in focus and also allows for a precise 3D measurement to be made.

A variety of 3D machine vision applications require that structured light be directed onto a sample at a considerable angle from a vertical position. However, when light is projected onto inclined surfaces, the focus is maintained only within a small area close to the centre of the field of view. The rest of the image will show relevant defocusing thus making the 3D measurement inaccurate.

Tilting the light source pattern becomes essential to ensure that the patterned light is properly and evenly focused across the entire sample surface.

3D pattern projectors have been specifically designed by Opto Engineering for 3D profiling and for the measurement of objects with complex structures or inclined planes. They are successfully used in a variety of applications like 3D profiling for quality control, food and packaging inspection, reverse engineering and dimensional measurement of electronic components.

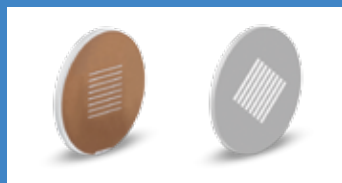
3D projectors can be used with different C-mount lenses however the best results are achieved with bi-telecentric lenses. Very good results can also be obtained with zero distortion macro lenses.

ACCESSORIES

Our 3D optics family is complemented by a full set of accessories:



CLAMPING MECHANICS



PATTERNS



OPTICS

Please refer to our website www.opto-engineering.com to browse our complete product range.

MCSM1-01X

Macro lens with Scheimpflug adjustment

4

TCSM series

3D bi-telecentric lenses with Scheimpflug adjustment

6

LTPRSM series

3D LED pattern projectors with tilt and focus adjustment

8

LTPR series

LED pattern projectors

12

MCSM1-01X

Macro lens with Scheimpflug adjustment



KEY ADVANTAGES

Precision Scheimpflug mount

Image focus is maintained across any tilted plane.

Compatible with any C-mount camera

The back focal length meets the C-mount standard.

Application flexibility

Supports a wide range of magnification factors and viewing angles.

MCSM1-01X is a macro lens expressly designed for 3D measurement and imaging applications where the object plane is not perpendicular to the optical axis. A precise built-in adjustment mechanism allows to accurately meet the Scheimpflug condition and to image tilted planes in perfect focus. This lens offers a wide range of magnifications and view angles. It can be interface with any

structured light source to build up extremely accurate 3D imaging systems. Image sharpness is maintained even when the lens is tilted by a wide angle, since the Scheimpflug adjustment tilts around the horizontal axis of the detector plane. The tiltable mount is compatible with any C-mount camera.

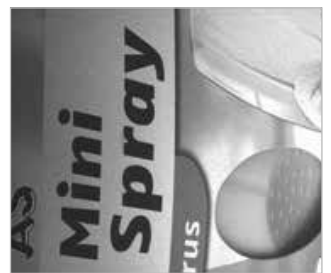
Examples of 3D imaging configuration



MCSM1-01X image a sample from an angled point of view.



Without tilt adjustment, the object is not homogeneously focused.



At the Scheimpflug angle, the image becomes sharp.

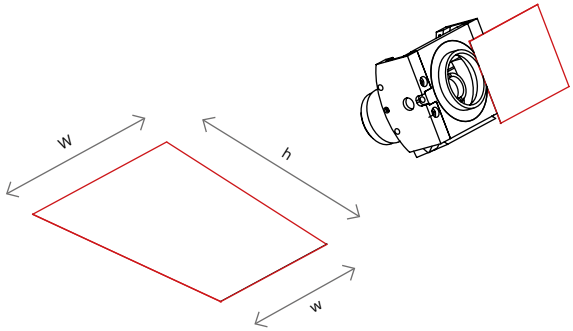


MCSM1-01X combined with a Scheimpflug projector at 90°.

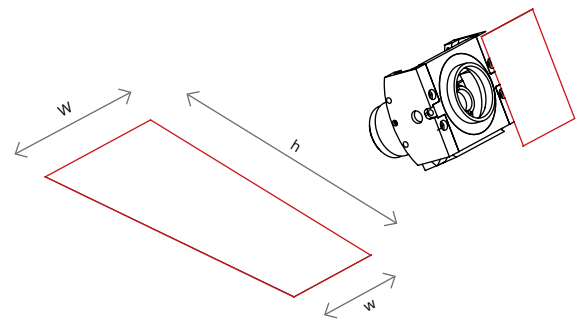


MCSM1-01X working at 45° with a pattern projector for 3D shaping.





Field of view with detector long side set **horizontal**.



Field of view with detector long side set **vertical**.

FOV and W.D. selection chart

Mag. (x)	Object tilt (deg)	Mount tilt (deg)	Working distance (mm)	Long detector side horizontal						Long detector side vertical																																																																																																																																																																															
				1/3"		1/2"		2/3"		1/3"		1/2"		2/3"																																																																																																																																																																											
				w x h (mm x mm)	w x h (mm x mm)	w x h (mm x mm)	w x h (mm x mm)	w x h (mm x mm)	w x h (mm x mm)	w x h (mm x mm)	w x h (mm x mm)	w x h (mm x mm)	w x h (mm x mm)	w x h (mm x mm)																																																																																																																																																																											
				Field of view - w (W) x h - (mm x mm)																																																																																																																																																																																					
1	0.0	0.0	46.0	4.80 (4.80) x 3.60	6.40 (6.40) x 4.80	8.80 (8.80) x 6.60	3.60 (3.60) x 4.80	4.80 (4.80) x 6.40	6.60 (6.60) x 8.80	0.75	0.0	0.0	47.8	6.43 (6.43) x 4.82	8.57 (8.57) x 6.42	11.8 (11.8) x 8.83	4.82 (4.82) x 6.43	6.42 (6.42) x 8.57	8.83 (8.83) x 11.8	7.5	5.7	47.8	6.33 (6.52) x 4.84	8.44 (8.70) x 6.45	11.6 (12.0) x 8.87	4.72 (4.92) x 6.45	6.29 (6.56) x 8.60	8.65 (9.02) x 11.8	15.0	15.0	46.0	4.64 (4.95) x 3.61	6.18 (6.60) x 4.81	8.50 (9.08) x 6.61	3.46 (3.75) x 4.81	4.61 (5.00) x 6.41	6.34 (6.88) x 8.81	0.5	0.0	0.0	59.6	9.63 (9.63) x 7.23	12.8 (12.8) x 9.64	17.7 (17.7) x 13.3	7.23 (7.23) x 9.63	9.64 (9.64) x 12.8	13.3 (13.3) x 17.7	10.0	5.0	59.6	9.44 (9.83) x 7.31	12.6 (13.1) x 9.75	17.3 (18.0) x 13.4	7.03 (7.43) x 9.74	9.37 (9.91) x 13.0	12.9 (13.6) x 17.9	20.0	10.4	59.6	9.25 (10.1) x 7.58	12.3 (13.4) x 10.1	17.0 (18.4) x 13.9	6.84 (7.65) x 10.1	9.12 (10.2) x 13.5	12.6 (14.0) x 18.6	30.0	16.1	59.6	9.04 (10.3) x 8.05	12.1 (13.7) x 10.7	16.6 (18.9) x 14.8	6.65 (7.91) x 10.8	8.87 (10.5) x 14.4	12.2 (14.5) x 19.7	0.33	0.0	0.0	83.8	14.6 (14.6) x 10.9	19.4 (19.4) x 14.6	26.7 (26.7) x 20.1	10.9 (10.9) x 14.5	14.6 (14.6) x 19.4	20.1 (20.1) x 26.6	15.0	5.1	83.8	14.1 (14.9) x 11.3	18.9 (19.9) x 15.1	25.9 (27.4) x 20.7	10.5 (11.4) x 15.1	14.0 (15.2) x 20.1	19.3 (20.9) x 27.6	30.0	10.8	83.8	13.7 (15.6) x 12.5	18.2 (20.8) x 16.6	25.1 (28.6) x 22.8	10.0 (12.0) x 16.7	13.4 (16.0) x 22.2	18.4 (22.0) x 30.6	45.0	18.3	83.8	13.1 (16.4) x 14.9	17.5 (21.9) x 19.8	24.1 (30.1) x 27.3	9.52 (12.9) x 20.0	12.7 (17.1) x 26.7	17.5 (23.6) x 36.7	0.2	0.0	0.0	135.3	24.0 (24.0) x 18.0	32.0 (32.0) x 24.0	44.0 (44.0) x 33.0	18.0 (18.0) x 24.0	24.0 (24.0) x 32.0	33.0 (33.0) x 44.0	15.0	3.1	135.3	23.3 (24.8) x 18.6	31.0 (33.0) x 24.8	42.7 (45.4) x 34.2	17.3 (18.8) x 24.9	23.0 (25.1) x 33.1	31.7 (34.5) x 45.6	30.0	6.6	135.3	22.5 (25.7) x 20.7	30.0 (34.3) x 27.7	41.2 (47.2) x 38.0	16.5 (19.8) x 27.8	22.0 (26.4) x 37.0	30.3 (36.3) x 50.9	45.0	11.4	135.3	21.5 (27.1) x 25.3	28.7 (36.2) x 33.7	39.5 (49.7) x 46.4	15.6 (21.3) x 34.1	20.8 (28.4) x 45.4	28.6 (39.0) x 62.5	0.1	0.0	0.0	271.0	47.6 (47.6) x 35.7	63.5 (63.5) x 47.6	87.3 (87.3) x 65.5	35.7 (35.7) x 47.7	47.6 (47.6) x 63.6	65.5 (65.5) x 87.4	15.0	1.6	271.0	46.2 (49.2) x 37.0	61.6 (65.6) x 49.4	84.7 (90.2) x 67.9	34.3 (37.3) x 49.4	45.7 (49.7) x 65.9	62.9 (68.4) x 90.6	30.0	3.4	271.0	44.6 (51.1) x 41.4	59.5 (68.1) x 55.2	81.8 (93.7) x 75.8	32.8 (39.3) x 55.4	43.7 (52.4) x 73.8	60.1 (72.0) x 101.5	45.0	5.8	271.0	42.7 (53.9) x 51.0	56.9 (71.9) x 68.0	78.2 (98.9) x 93.4	30.9 (42.3) x 68.7	41.2 (56.4) x 91.6	56.7 (77.6) x 125.9

TCSM series

3D bi-telecentric lenses with Scheimpflug adjustment



KEY ADVANTAGES

Unique Scheimpflug adjustment

No other lens can perform oblique measurements.

The image is radially undistorted

Linear extension can be perfectly calibrated.

Compatible with any C-mount camera

And compliant to the C-mount standard.

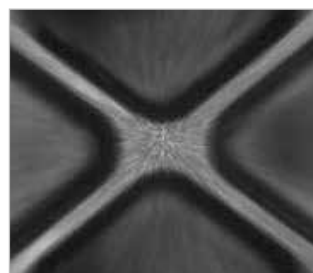
TCSM series is a unique family of bi-telecentric lenses for extremely accurate 3D dimensional measurement systems. All TCSM lenses are equipped with a high-precision Scheimpflug adjustment mechanism that fits any type of C-mount camera. Besides achieving very good focus at wide tilt angles, bi-telecentricity also yields incredibly low distortion. Images are linearly compressed only in one direction,

thus making 3D-reconstruction very easy and exceptionally accurate. The available magnifications range from 0.5x to 0.1x while the angle of view reaches 30°-45° to meet the measurement needs of triangulation-based techniques. The Scheimpflug mount tilts around the horizontal axis of the detector plane to ensure excellent pointing stability and ease of focus.

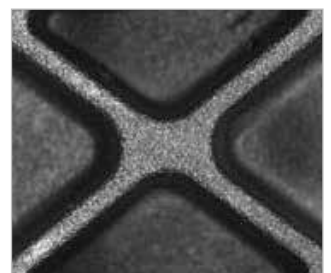
Examples of high-end 3D measurements



TCSM imaging and measuring sloped objects.



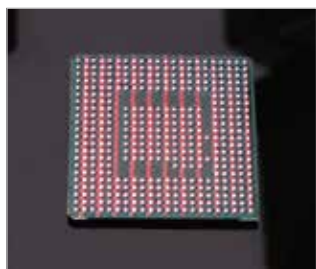
Without tilt adjustment, the object is not homogeneously focused.



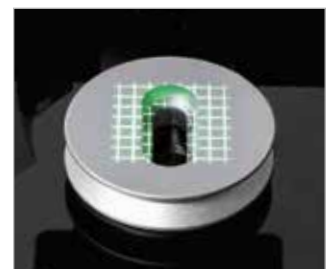
At the Scheimpflug angle, the image becomes sharp.

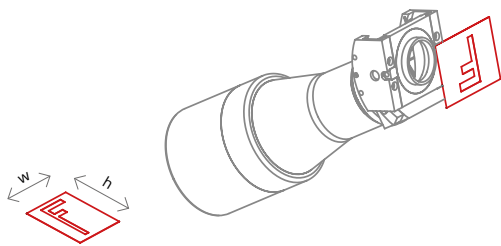


Scheimpflug telecentric optics for both projection and imaging at 90°.

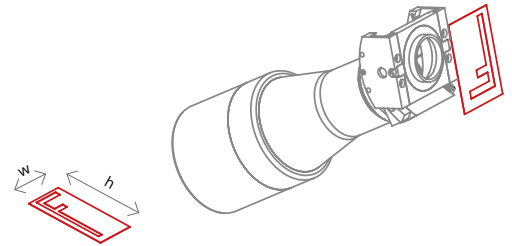


TCSM series lens for straight telecentric pattern projection.





Field of view with detector long side set **horizontal**.



Field of view with detector long side set **vertical**.

Part number	Object tilt (deg)	Mount tilt (deg)	Working distance (mm)	Horizontal		Long detector side horizontal			Long detector side vertical		
				mag (x)	mag (x)	1/3"	1/2"	2/3"	1/3"	1/2"	2/3"
						w x h (mm x mm)	w x h (mm x mm)	w x h (mm x mm)	w x h (mm x mm)	w x h (mm x mm)	w x h (mm x mm)
						Field of view (mm x mm)			Field of view (mm x mm)		
TCSM 016	0.0	0.0	45.3	0.528	0.528	9.09 x 6.82	12.1 x 9.09	16.7 x 12.5	6.82 x 9.09	9.09 x 12.1	12.5 x 16.7
	10.0	5.3		0.528	0.522	9.09 x 6.89	12.1 x 9.19	16.7 x 12.6	6.82 x 9.20	9.09 x 12.3	12.5 x 16.9
	20.0	10.9		0.528	0.506	9.09 x 7.15	12.1 x 9.53	16.7 x 13.1	6.82 x 9.49	9.09 x 12.7	12.5 x 17.4
	30.0	17.0		0.528	0.478	9.09 x 7.54	12.1 x 10.1	16.7 x 13.8	6.82 x 10.0	9.09 x 13.4	12.5 x 18.4
TCSM 024	0.0	0.0	69.2	0.350	0.350	13.7 x 10.3	18.3 x 13.7	25.1 x 18.9	10.3 x 13.7	13.7 x 18.3	18.9 x 25.1
	15.0	5.4		0.350	0.338	13.7 x 10.6	18.3 x 14.2	25.1 x 19.5	10.3 x 14.2	13.7 x 18.9	18.9 x 26.0
	30.0	11.4		0.350	0.308	13.7 x 11.7	18.3 x 15.6	25.1 x 21.4	10.3 x 15.6	13.7 x 20.8	18.9 x 28.5
	45.0	19.3		0.350	0.262	13.7 x 13.7	18.3 x 18.3	25.1 x 25.2	10.3 x 18.3	13.7 x 24.4	18.9 x 33.6
TCSM 036	0.0	0.0	103.5	0.243	0.243	19.7 x 14.8	26.3 x 19.7	36.2 x 27.1	14.8 x 19.7	19.7 x 26.3	27.1 x 36.2
	15.0	3.7		0.243	0.235	19.7 x 15.3	26.3 x 20.4	36.2 x 28.1	14.8 x 20.4	19.7 x 27.2	27.1 x 37.4
	30.0	8.0		0.243	0.213	19.7 x 17.0	26.3 x 22.6	36.2 x 31.1	14.8 x 22.6	19.7 x 30.1	27.1 x 41.4
	45.0	13.6		0.243	0.177	19.7 x 20.4	26.3 x 27.2	36.2 x 37.4	14.8 x 27.1	19.7 x 36.2	27.1 x 49.7
TCSM 048	0.0	0.0	134.6	0.185	0.185	26.0 x 19.5	34.7 x 26.0	47.7 x 35.7	19.5 x 26.0	26.0 x 34.7	35.7 x 47.7
	15.0	2.8		0.185	0.181	26.0 x 20.1	34.7 x 26.8	47.7 x 36.9	19.5 x 26.5	26.0 x 35.3	35.7 x 48.6
	30.0	6.1		0.185	0.161	26.0 x 22.4	34.7 x 29.9	47.7 x 41.1	19.5 x 29.8	26.0 x 39.8	35.7 x 54.7
	45.0	10.5		0.185	0.133	26.0 x 27.1	34.7 x 36.2	47.7 x 49.8	19.5 x 36.1	26.0 x 48.2	35.7 x 66.2
TCSM 056	0.0	0.0	159.3	0.157	0.157	30.6 x 22.9	40.8 x 30.6	56.1 x 42.0	22.9 x 30.6	30.6 x 40.8	42.0 x 56.1
	15.0	2.4		0.157	0.152	30.6 x 23.7	40.8 x 31.7	56.1 x 43.5	22.9 x 31.6	30.6 x 42.2	42.0 x 58.0
	30.0	5.1		0.157	0.136	30.6 x 26.4	40.8 x 35.2	56.1 x 48.4	22.9 x 35.2	30.6 x 46.9	42.0 x 64.5
	45.0	8.8		0.157	0.112	30.6 x 32.1	40.8 x 42.8	56.1 x 58.8	22.9 x 42.8	30.6 x 57.0	42.0 x 78.4
TCSM 064	0.0	0.0	182.0	0.137	0.137	34.9 x 26.2	46.6 x 34.9	64.0 x 48.0	26.2 x 34.9	34.9 x 46.6	48.0 x 64.0
	15.0	2.1		0.137	0.133	34.9 x 27.1	46.6 x 36.2	64.0 x 49.8	26.2 x 36.1	34.9 x 48.2	48.0 x 66.3
	30.0	4.5		0.137	0.119	34.9 x 30.2	46.6 x 40.3	64.0 x 55.4	26.2 x 40.2	34.9 x 53.6	48.0 x 73.7
	45.0	7.8		0.137	0.098	34.9 x 36.8	46.6 x 49.0	64.0 x 67.4	26.2 x 49.0	34.9 x 65.3	48.0 x 89.8
TCSM 080	0.0	0.0	227.0	0.110	0.110	43.6 x 32.7	58.2 x 43.6	80.0 x 60.0	32.7 x 43.6	43.6 x 58.2	60.0 x 80.0
	15.0	1.7		0.110	0.107	43.6 x 33.8	58.2 x 45.0	80.0 x 61.9	32.7 x 45.0	43.6 x 60.0	60.0 x 82.5
	30.0	3.6		0.110	0.096	43.6 x 37.6	58.2 x 50.2	80.0 x 69.0	32.7 x 50.2	43.6 x 67.0	60.0 x 92.1
	45.0	6.3		0.110	0.078	43.6 x 45.9	58.2 x 61.2	80.0 x 84.2	32.7 x 61.2	43.6 x 81.7	60.0 x 112.3
TCSM 096	0.0	0.0	279.0	0.093	0.093	51.4 x 38.5	68.5 x 51.4	94.2 x 70.7	38.5 x 51.4	51.4 x 68.5	70.7 x 94.2
	15.0	1.4		0.093	0.090	51.4 x 39.9	68.5 x 53.2	94.2 x 73.1	38.5 x 53.2	51.4 x 70.9	70.7 x 97.5
	30.0	3.1		0.093	0.081	51.4 x 44.4	68.5 x 59.2	94.2 x 81.5	38.5 x 59.2	51.4 x 79.0	70.7 x 108.6
	45.0	5.3		0.093	0.066	51.4 x 54.4	68.5 x 72.5	94.2 x 99.7	38.5 x 72.4	51.4 x 96.6	70.7 x 132.8

LTPRSM series

3D LED pattern projectors with tilt and focus adjustment



KEY ADVANTAGES

Scheimpflug tilt adjustment

For homogeneous focusing of the pattern features.

Tilt adjustment compatible with C-mount optics

Focus is maintained even when the pattern is tilted.

Light condenser focusing mechanism

For excellent optical coupling and light throughput.

Enhanced optical power

Due to the high numerical aperture condenser lens.



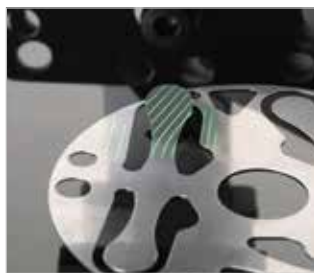
LTPRSM series are LED pattern projectors specifically designed for the most demanding 3D profiling and measurement applications. Triangulation techniques require that structured light be directed onto a sample at a considerable angle from vertical. Tilting the light source pattern becomes essential to ensure that the patterned light is properly and homogeneously focused across the entire

sample surface. LTPRSM pattern projectors integrate a precision tilting mechanism based on the Scheimpflug condition. This also ensures that the focus doesn't change when the pattern is tilted. Moreover, the internal focus mechanism offers the maximum optical throughput. The projected light path is effectively coupled to the pupil aperture of any C-mount lens.

Examples of setup and applications



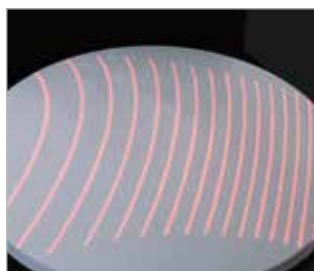
Configuration with zero distortion macro lenses.



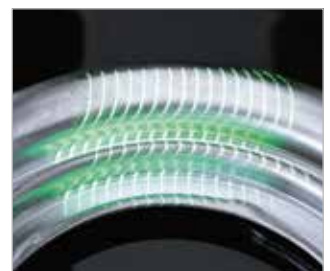
Configuration with bi-telecentric lenses.

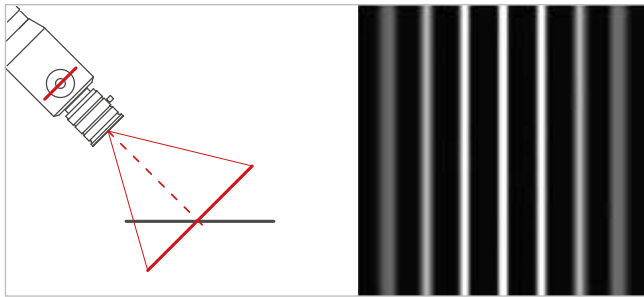


LTPRSM pattern projector with a standard C-mount lens.

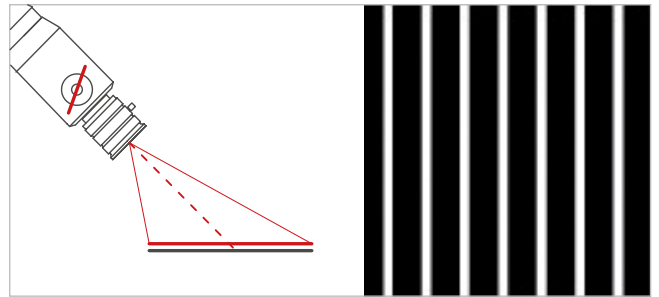


Scheimpflug telecentric optics for both projection and imaging at 90°.

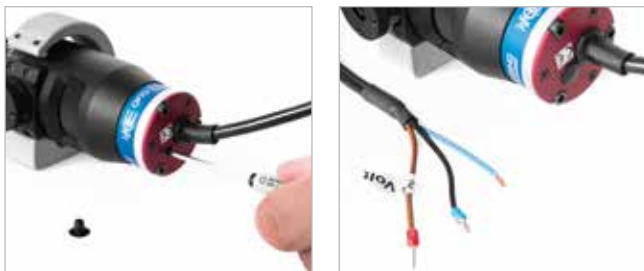




Without tilt adjustment the pattern features are only partly focused.



With the Scheimpflug adjustment focus is maintained across the entire plane.

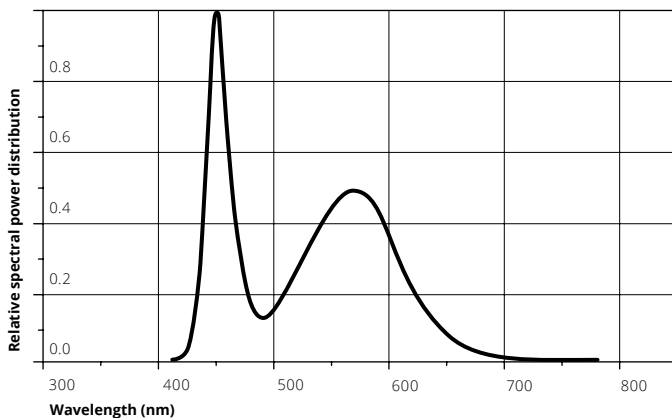


Electrical features

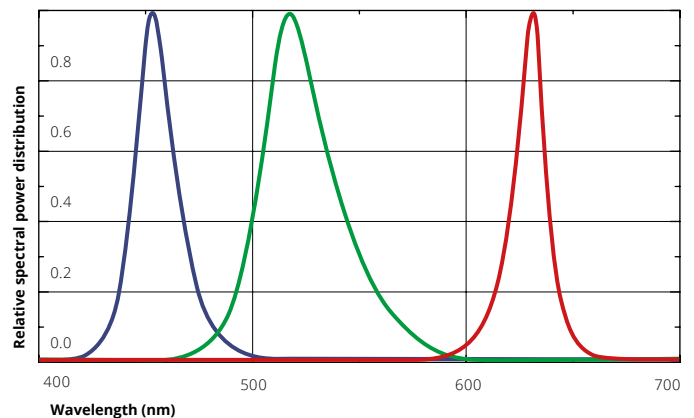
These LED devices integrate built-in switching electronics that control the current flow through the LED and which can be easily tuned by the user. This ensures both high light stability and a longer lifetime of the product.

The inner circuitry can be bypassed to directly drive the LED. Simply connect the black and blue wires to your power supply instead of the black and brown ones, ensuring that maximum rates are not exceeded.

Typical emission spectrum of white LEDs



Typical emission spectrum of R,G,B LEDs



Part number	Optical properties		Device power ratings			LED power ratings		
	Light color, peak wavelength		Minimum DC voltage (V)	Maximum DC voltage (V)	Power consumption (W)	Forward voltage (V)	Forward current (mA)	Max pulse current @10% duty / 1kHz (mA)
LTPRSM 3W-R	red, 630 nm		12	24	< 3	2.6	700	< 1800
LTPRSM 3W-G	green, 520 nm		12	24	< 3	3.8	700	< 1800
LTPRSM 3W-B	blue, 460 nm		12	24	< 3	3.8	700	< 1800
LTPRSM 3W-W	white		12	24	< 3	3.8	700	< 1800

LTPRSM series

Product insight



Stripe patterns

PT 0000 0300 P:
8 lines in projection area



PTST 050 450 P:
16 lines in projection area



PTST 050 200 P:
32 lines in projection area



PTST 050 100 P:
53 lines in projection area



PTST 050 050 P:
80 lines in projection area



Grid patterns

PT 0000 0400 P:
8x8 lines in projection area



PRGR 050 450 P:
16x16 lines in projection area



PTGR 050 200 P:
32x32 lines in projection area



PTGR 050 100 P:
53x53 lines in projection area



PTGR 050 050 P:
80x80 lines in projection area



The projection pattern placed inside the unit can be changed and integrated with ease: just remove the C-mount adaptor by loosening the set-screws and fix the pattern by screwing the retaining ring.

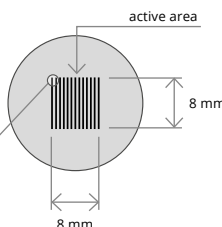
Different types of stripe and grid patterns are available; the chart shows the line thickness (0.05 mm) and the gap between neighboring lines for each pattern type.

When these features are projected, they become 1/M times larger, with "M" being the magnification of the projection lens. The number of lines mentioned after each part number indicates the number of features on the active area of the pattern

Pattern specifications

Photolithography patterns

Substrate	Soda lime glass
Coating	Chrome
Geometrical accuracy	2 μm
Edge sharpness	1.4 μm



SETUP

Visit our website for device setup instructions.
www.opto-engineering.com

Accessories / Compatibility



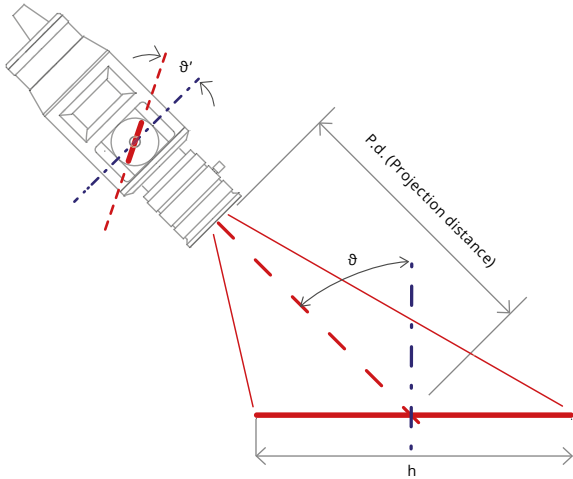
Patterns



Bi-telecentric lenses



Macro and standard lenses

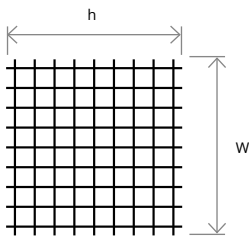


LTPRSM series units can be interfaced with any type of optics, but the best results are achieved with bi-telecentric lenses. The projection area is undistorted since tilting the pattern causes a linear extension along only one direction.

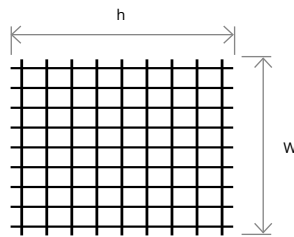
Excellent results can also be obtained with zero distortion macro lenses; here, the magnification changes along both axes, but image resolution and distortion still easily allows 3D reconstruction.

With non bi-telecentric lenses, a square pattern becomes a trapezoid in the projection plane, whose parallel sides are indicated as "w" and "W" in the drawings below.

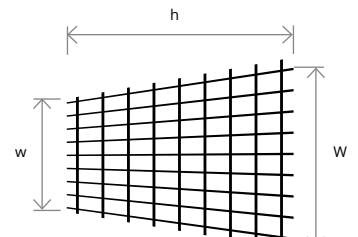
The projection area shown in the chart are also a good approximation for standard C-mount lenses used as macro lenses (eventually equipped with spacers).



Original pattern features



Projection area with a bi-telecentric lens



Projection area with a macro lens

Projection area with bi-telecentric lenses (TC series)

Part number	Projection distance P.d. (mm)	$\theta = 0^\circ$		$\theta = 15^\circ$		$\theta = 30^\circ$		$\theta = 45^\circ$	
		Projection area W x h (mm x mm)	Pattern tilt θ' (deg)	Projection area W x h (mm x mm)	Pattern tilt θ' (deg)	Projection area W x h (mm x mm)	Pattern tilt θ' (deg)	Projection area W x h (mm x mm)	Pattern tilt θ' (deg)
TC 23 009	63.3	8.0 x 8.0	0	8.0 x 8.0	15.0	8.0 x 8.0	30.0	8.0 x 8.0	45.0
TC 23 016	45.3	15.2 x 15.2	0	15.2 x 15.4	8.1	15.2 x 16.8	17.0	15.2 x 20.0	27.8
TC 23 024	69.2	22.9 x 22.9	0	22.9 x 23.6	5.4	22.9 x 26.0	11.4	22.9 x 30.5	19.3
TC 23 036	103.5	32.9 x 32.9	0	32.9 x 34.0	3.7	32.9 x 37.7	8.0	32.9 x 45.3	13.6
TC 23 048	134.6	43.3 x 43.3	0	43.3 x 44.7	2.8	43.3 x 49.8	6.1	43.3 x 60.3	10.5
TC 23 056	159.3	51.0 x 51.0	0	51.0 x 52.8	2.4	51.0 x 58.6	5.1	51.0 x 71.3	8.8
TC 23 064	182.0	58.2 x 58.2	0	58.2 x 60.3	2.1	58.2 x 67.1	4.5	58.2 x 81.7	7.8
TC 23 080	227.0	72.7 x 72.7	0	72.7 x 73.8	1.7	72.7 x 83.6	3.6	72.7 x 102.0	6.3
TC 23 096	279.0	85.6 x 85.6	0	85.6 x 88.6	1.4	85.6 x 98.7	3.1	85.6 x 120.9	5.3

Projection area with macro (MC3-03x and MC series) and standard lenses

Mag. (x)	Projection distance (mm)	$\theta = 0^\circ$			$\theta = 15^\circ$			$\theta = 30^\circ$			$\theta = 45^\circ$		
		w (mm)	(W) x h (mm x mm)	Pattern tilt θ' (deg)	w (mm)	(W) x h (mm x mm)	Pattern tilt θ' (deg)	w (mm)	(W) x h (mm x mm)	Pattern tilt θ' (deg)	w (mm)	(W) x h (mm x mm)	Pattern tilt θ' (deg)
1	46.0	8.0	(8.0) x 8.0	0	7.7	(8.3) x 8.0	15.0	7.5	(8.6) x 8.1	30.0	7.3	(8.9) x 8.1	45.0
0.75	48.0	10.7	(10.7) x 10.7	0	10.3	(11.1) x 10.9	11.4	10.0	(11.6) x 11.4	23.5	9.6	(12.1) x 12.3	37.0
0.5	60.0	16.1	(16.1) x 16.1	0	15.5	(16.7) x 16.5	7.6	14.9	(17.5) x 17.9	16.2	14.3	(18.4) x 20.7	26.7
0.33	92.0	24.3	(24.3) x 24.3	0	23.4	(25.3) x 25.1	5.1	22.5	(26.5) x 27.8	10.8	21.4	(28.1) x 33.3	18.3
0.2	136.0	40.1	(40.1) x 40.1	0	38.6	(41.6) x 42.1	3.1	37.0	(43.6) x 46.2	6.6	35.1	(46.6) x 56.8	11.4
0.1	275.0	79.5	(79.5) x 79.5	0	76.6	(82.6) x 82.4	1.6	73.5	(86.6) x 92.3	3.4	69.6	(92.6) x 114.2	5.8

LTPR series

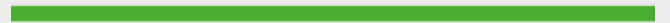
LED pattern projectors



KEY ADVANTAGES

Perfectly sharp edges

LTPR series ensures thinner lines, sharper edges and more homogeneous illumination than lasers.



With laser emitters the illumination decays both across the line cross section and along the line width.



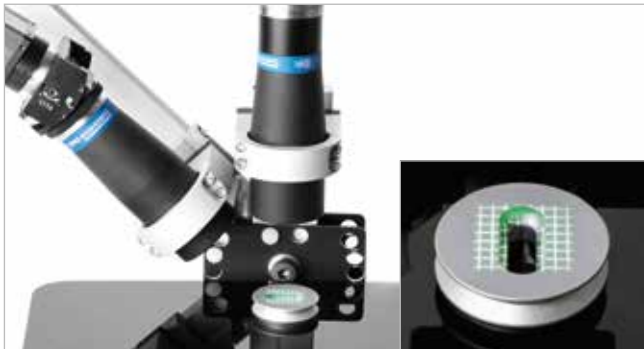
Laser emitters lines are thicker and show blurred edges; diffraction and speckle effects are also present.



LTPR series are the most advanced and efficient devices for pattern projection and structured light applications, such as 3D reconstruction. Unlike laser sources, which typically show poor line sharpness and power distribution inhomogeneity as well as scattering and diffraction effects, LTPR pattern projectors overcome

all of these problems by integrating LED sources and precisely engraved masks. Any kind of pattern shape can be easily supplied, integrated and projected by these devices. Different colors, including IR, are available and the size of the projection area can be easily modified by interchanging the projection optics.

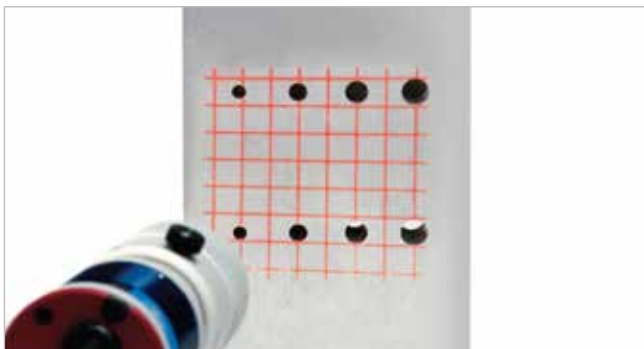
Examples of setup and applications



3D reconstruction



Visualization & mapping



Mechanical alignment



Telecentric pattern projection

Every kind of shape can be projected

Standard patterns



Stripe 0.5 mm line thickness



Edge



Grid 0.05 mm line thickness



Line 0.5 mm line thickness



Custom patterns

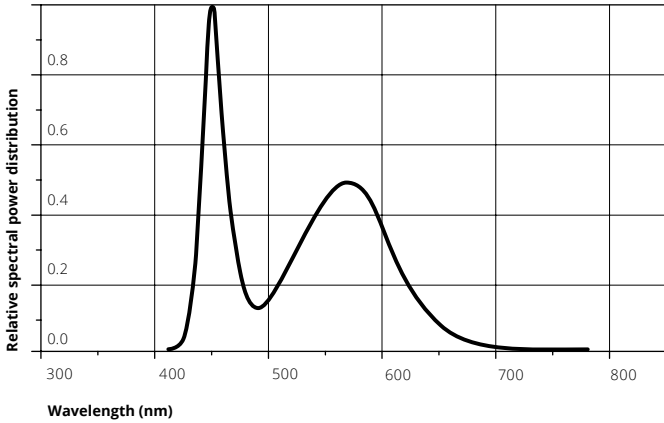


Electrical features

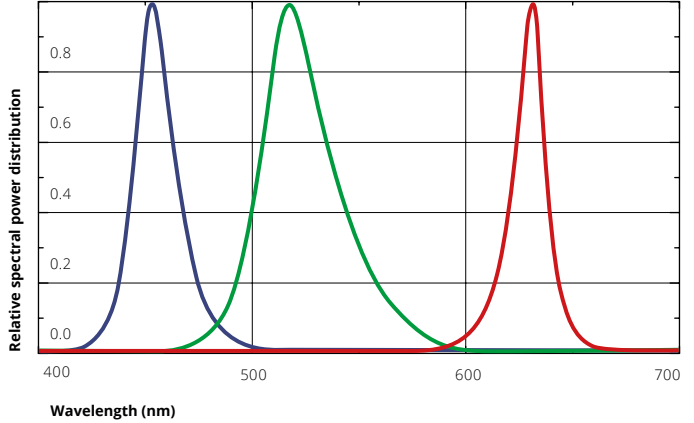
These LED devices integrate built-in switching electronics that control the current flow through the LED and which can be easily tuned by the user. This ensures both high light stability and a longer lifetime of the product.

The inner circuitry can be bypassed in order to directly drive the LED. Simply connect the black and blue wires to your power supply instead of the black and brown ones, ensuring that the maximum rates are not exceeded.

Typical emission spectrum of white LEDs



Typical emission spectrum of R,G,B LEDs



Part number	Light color, wavelength peak	Device power ratings			LED power ratings		
		Minimum DC Voltage (V)	Maximum DC Voltage (V)	Power consumption (W)	Forward voltage (V)	Forward current (mA)	Max pulse current @10% duty / 1kHz (mA)
1W VIS PATTERN PROJECTORS							
LTPR 36-R	red, 630 nm	12	24	< 2	2,3	300	< 1800
LTPR 36-G	green, 520 nm	12	24	< 2	3,5	350	< 1800
LTPR 36-B	blue, 460 nm	12	24	< 2	3,5	350	< 1800
LTPR 36-W	white	12	24	< 2	3,5	350	< 1800
3W VIS PATTERN PROJECTORS							
LTPR 3W-R	red, 630 nm	12	24	< 3	2,6	700	< 1800
LTPR 3W-G	green, 520 nm	12	24	< 3	3,8	700	< 1800
LTPR 3W-B	blue, 460 nm	12	24	< 3	3,8	700	< 1800
LTPR 3W-W	white	12	24	< 3	3,8	700	< 1800
IR PATTERN PROJECTORS (*)							
LTPR 36-IR890	IR, 890 nm	12	24	< 2	1,6	500	n.a.
LTPR 36-IR940	IR, 940 nm	12	24	< 2	1,6	500	n.a.

(*) -IRxxx versions:

peak emission wavelength xxx nm | optical bandpass +/- 20 nm FWHM | class IIIb LED product

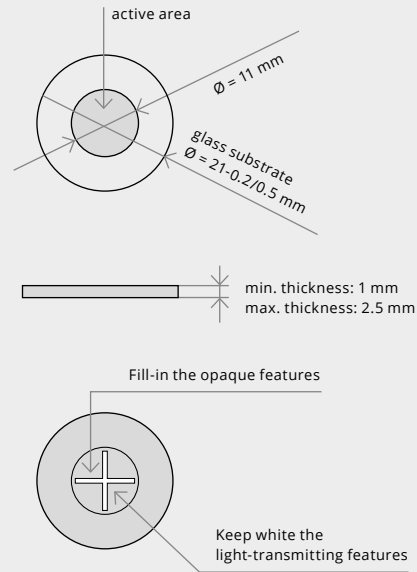
LTPR series

Product insight



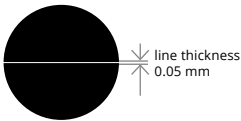
Custom-made pattern

Custom-made patterns can be supplied on request. A drawing with accurate geometrical information must be submitted (please refer to the instructions here below).

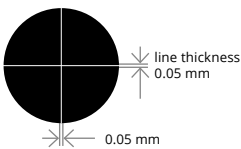


Photolithography patterns

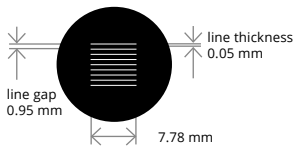
P/N: PT 0000 0100 P - Line pattern



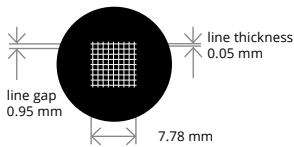
P/N: PT 0000 0200 P - Cross pattern



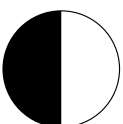
P/N: PT 0000 0300 P - Stripe pattern



P/N: PT 0000 0400 P - Grid pattern

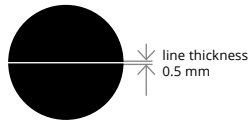


P/N: PT 0000 0500 P - Edge pattern

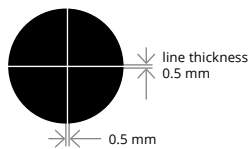


Laser engraved patterns

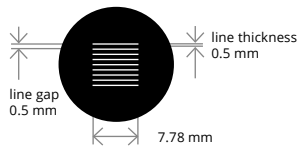
P/N: PT 0000 0100 L - Line pattern



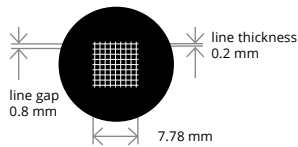
P/N: PT 0000 0200 L - Cross pattern



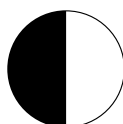
P/N: PT 0000 0300 L - Stripe pattern



P/N: PT 0000 0400 L - Grid pattern



P/N: PT 0000 0500 L - Edge pattern



Pattern selection

The projection pattern can be easily integrated into the LTPR projection unit by unscrewing the retaining ring that holds the pattern itself.

This simple procedure makes it easy to interchange different patterns on the same projection unit. The pattern outer diameter is 21 mm, while the active projection area is a circle of 11 mm: all the significant features of the pattern are drawn inside this circle.

The projection area will have the same aspect ratio as the pattern. The projection accuracy depends both on the pattern manufacturing accuracy and lens distortion.

The edge sharpness of the projected pattern depends on both the lens resolution and the engraving technique: Laser-engraved patterns (part numbers ending in "L") or Photolithography-engraved patterns (part numbers ending in "P") can be chosen depending on the type of application.

Pattern specifications

Photolithography patterns

Substrate	Soda lime glass
Coating	Chrome
Geometrical accuracy	2 μm
Edge sharpness	1.4 μm

Laser engraved patterns

Substrate	Borofloat glass
Coating	Dichroic mirror
Geometrical accuracy	50 μm
Edge sharpness	50 μm

SETUP

Visit our website for device setup instructions.
www.opto-engineering.com

Accessories / Compatibility



Patterns



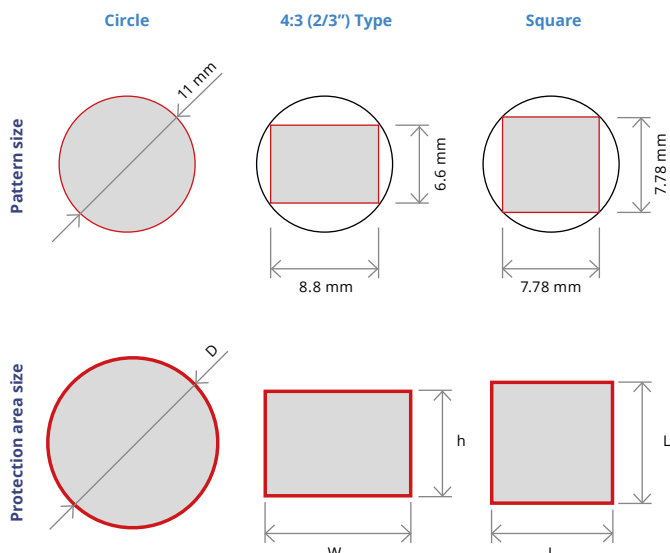
OEPL optics



Bi-telecentric lenses



Standard C-mount lenses



Projection lens selection

The pattern drawing which has to be projected must be inscribed in a 11 mm diameter circle, same diagonal of a 2/3" detector.

For example, the pattern drawing could cover the entire 11 mm diameter area or be like a 8.8 x 6.6 mm rectangle or, again, be a square whose side is 7.78 mm.

Unless the projection optics introduces significant distortion, the shape of the projected pattern will preserve the features and aspect ratio of the engraved pattern. The projected area dimensions will be "M" times the original dimensions of the pattern, where M is the optical magnification at which the selected projection lens is operating. LTPR series can integrate most types of high resolution lenses. Besides our OEPL optics, specifically designed for this application, any high resolution C-mount lens for 2/3" detectors (11 mm image diagonal) can be used.

Telecentric lenses for 2/3" detectors can also be interfaced, thus providing telecentric projection of the pattern and enabling unparalleled performances in 3D measurement applications. C-mount lenses and telecentric optics can be connected to the unit by means of the mount adaptor included in the product package. Here below is a list of the projection diameters and the recommended projection distances with different types of optics.

OEPL optics

Part number	Lens description	Minimum Projection	Maximum Projection
		distance (P.d.) (mm)	distance (P.d.) (mm)
OEPL 18	18° projection, full angle	300	800
OEPL 25	25° projection, full angle	250	600
OEPL 38	38° projection, full angle	200	500
OEPL 50	50° projection, full angle	100	300

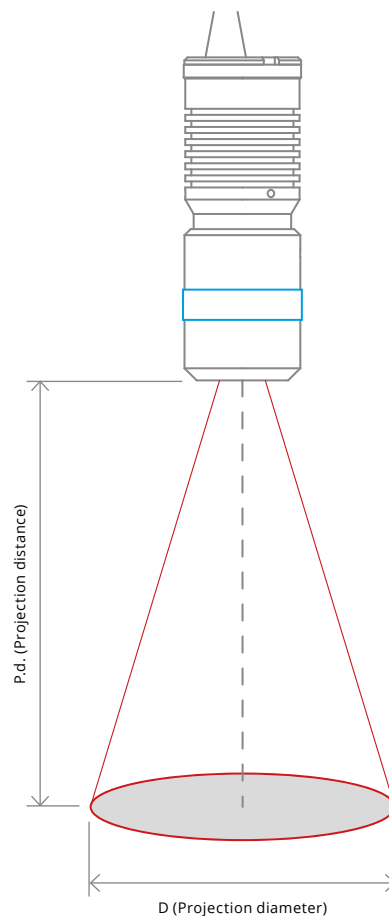
Telecentric lenses

	TC 23 004	TC 23 007	TC 23 009	TC 23 016	TC 23 024	TC 23 036
P.d. (mm)	57.1	61.2	63.3	45.3	69.2	103.5
D (mm)	5.5	8.3	11.0	20.8	31.4	45.2
	TC 23 048	TC 23 056	TC 23 064	TC 23 072	TC 23 080	TC 23 096
P.d. (mm)	134.6	159.3	182.3	227.7	227.7	279.6
D (mm)	59.8	70.0	80.0	89.9	99.7	117.8

2 / 3" C-mount lenses

P.d.	@50	@75	@100	@150	@200	@250	@300	@400	@500
	mm	mm	mm	mm	mm	mm	mm	mm	mm
Focal length	D (Projection diameter)								
	(mm)								
6 mm	81	127	172	264					
8 mm	58 (*)	92	127	195	264	333			
12 mm	35 (*)	58 (*)	81	127	172	218	264		
16 mm		41 (*)	58 (*)	92 (*)	127	161	195	264	333
25 mm				55 (*)	77 (*)	99 (*)	121 (*)	165	209 (*)
35 mm						68 (*)	83 (*)	115	146

(*) = spacers may be needed to compensate back focal length



Contact us

EUROPE

**Opto Engineering
Europe headquarters**
Circonvallazione Sud, 15
46100 Mantova, IT
phone: +39 0376 699111
contact@opto-engineering.com

**Opto Engineering
Germany**
Agnes-Pockels-Bogen, 1
80992 München, DE
phone: +49 0 89 18930918
de@opto-engineering.com

UNITED STATES

**Opto Engineering
USA**
11261 Richmond Ave
Ste G-108 - Houston, TX 77082
phone: +1 832 2129391
us@opto-engineering.com

ASIA

**Opto Engineering
China**
Room 2405, n°885, Renmin RD
Huangpu District 200010
Shanghai, China
phone: +86 21 61356711
info@deepview.cn

**Opto Engineering
India**
contact@opto-engineering.com

**Opto Engineering
Korea**
kr@opto-engineering.com