OPTO ENGINEERING

OPTICAL IMAGING TECHNOLOGIES

OPTICS | LIGHTING | ACCESSORIES

CORE
INTERNATIONAL PATENT PENDING

2016

ENGLISH

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RT PRODUCTS

In order to meet all our customers' needs, we have carefully selected a collection of machine vision components from experienced and qualified suppliers to complement our product range.
These products are highlighted throughout the catalog with the "RT" symbol and have been identified by our product managers as "the best available within their category": they range from general purpose fixed focal length lenses to LED illuminators and from high magnification telecentric lenses to resolution targets.
These products will be delivered to you with the same level of competence, quality and technical support that you have come to know and expect from Opto Engineering. Our goal is to turn our knowledge, experience and passion for machine vision into a broad and comprehensive service for our customers.

Optics

Demanding vision tasks such as precision measurement require zero distortion telecentric lenses. Opto Engineering provides the best components from machine vision world covering almost any possible need in precision optics: very high or low magnification, classic and extremely compact in size like FLAT and CORE series, with a standard or long working distances, fixed or variable magnifications like TCZR and TCDP PLUS series, lenses with a Scheimpflug adapter for 3D applications, as well as telecentric lenses with integrated coaxial illumination.

360° view optics are unique lenses tailored for reducing the number of components needed for a vision system. They represent a smart way of solving machine vision task and has become standard in many industries.

Correctly chosen optics is the decisive factor to achieve a high quality image, that is the material used for image processing and a basis for qualifying the object under inspection. Though the final result is also related to the camera sensor resolution and pixel size, a lens and the desired FOV are in many cases the starting point in the choice of machine vision hardware, therefore our motto at Opto Engineering is “OPTICS FIRST”.

TELECENTRIC LENSES

Outstanding optical performance. Unmatched customer service.

Opto Engineering Telecentric lenses represents our core business: these products benefit from a decade-long effort in progressive research & development, resulting in an extensive range of part numbers for a diverse and ever-growing number of applications.

These products achieve the highest optical performances available on the market:

- extra-telecentricity for thick object imaging
- very low distortion for accurate measurements
- excellent resolution for small pixel cameras
- wide field depth for large object displacements
- pre-adjusted back focal length and working distance
- compact and robust design, tailored for industrial environments

TC lenses for matrix detectors also feature:

- bi-telecentric design
- detailed test report for each lens

Refer to specific datasheets available at **www.opto-engineering.com** for product compliancy with regulations, certifications and safety labels.


INTERNATIONAL
PATENT
PENDING

TC series

Bi-telecentric lenses for matrix detectors up to 2/3"

TC series bi-telecentric lenses represent the key component of any measurement system powered by machine vision: these lenses can truly take advantage of high-resolution detectors such as 5 Mpx - 2/3", acquiring images with exceptional fidelity and precision.

Opto Engineering bi-telecentric design allows these optics to achieve pure telecentricity: no magnification change occurs when moving away or towards the subject, making TC series ideal for measurement applications of mechanical parts ranging from extruded aluminium profiles to tiny clock gears.

No other lenses can offer the same optical performances in terms of telecentrity and absence of distortion: additionally you can further enhance depth of field and optical accuracy by pairing our TC lenses with LTCLHP telecentric illuminators.
All of our TC lenses are rigorously tested and supplied with a detailed Test Report: We guarantee that 100% of our TC lenses meet or exceed our written specifications.
Opto Engineering TC series offers the best performance to price ratio available today and is the ideal choice when no compromise can be accepted in terms of reliability and ease of use.
Additionally we supply useful accessories including CMHO clamping mechanics and CMPT mounting plates: mechanical support systems for easy integration in industrial environments, where a solid and secure assembly is mandatory.

KEY ADVANTAGES

High telecentricity for thick object imaging.

Nearly zero distortion for accurate measurements.

Excellent resolution for high resolution cameras.

Simple and robust design for industrial environments.

Easy filter insertion.

Detailed **test report** with **measured** optical parameters.

DO YOU KNOW?

Opto Engineering provides fully localized documentation of the complete product range, with schematics and in-depth specifications. Available for download at:

www.opto-engineering.com

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FULL RANGE OF COMPATIBLE ILLUMINATORS		
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FULL RANGE OF COMPATIBLE ACCESSORIES		
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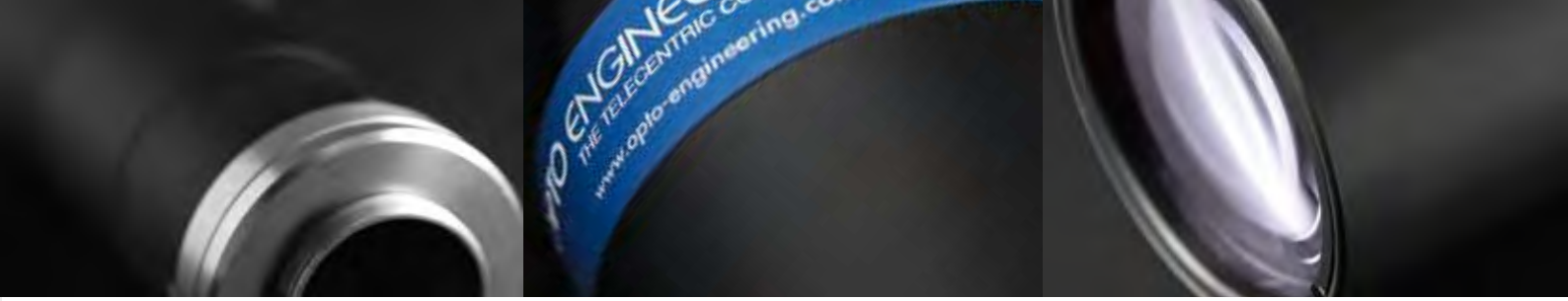


			Detector type					Optical specifications						Dimensions		
Part number	Mag. (x)	Image circle Ø (mm)	1/3'' w x h 4.80 x 3.60 (mm x mm)	1/2.5'' w x h 5.70 x 4.28 (mm x mm)	1/2'' w x h 6.40 x 4.80 (mm x mm)	1/1.8" w x h 7.13 x 5.37 (mm x mm) 7	2/3" - 5 Mpx w x h 8.45 x 7.07 (mm x mm)	WD (mm) 1	wF/# 2	Telecentricity typical (max) (deg) 3	Distortion typical (max) (%) 4	Field depth (mm) 5	CTF @70lp/mm (%)	Mount	Length (mm) 6	Diam. (mm)
			Object field of view (mm x mm) 8													
TC 23 004	2.000	11.0	2.40 x 1.80	2.85 x 2.14	3.20 x 2.40	3.56 x 2.68	4.22 x 3.55	56.0	11	< 0.08 (0.10)	< 0.04 (0.08)	0.23	> 30	C	101.4	28
TC 23 007	1.333	11.0	3.60 x 2.70	4.28 x 3.21	4.80 x 3.60	5.35 x 4.03	6.34 x 5.30	60.1	11	< 0.08 (0.10)	< 0.03 (0.08)	0.5	> 30	C	78.5	28
TC 23 009	1.000	11.0	4.80 x 3.60	5.70 x 4.28	6.40 x 4.80	7.13 x 5.37	8.44 x 7.06	62.2	11	< 0.08 (0.10)	< 0.04 (0.08)	0.9	> 25	C	65.0	28
TC 23 012	0.735	11.0	6.54 x 4.90	7.77 x 5.82	8.72 x 6.54	9.71 x 7.31	11.5 x 9.62	53.9	14	< 0.04 (0.10)	< 0.04 (0.10)	1.2	> 25	C	60.3	28
TC 13 016	0.290	6.0	16.6 x 12.4	Ø = 14.8	Ø = 16.6	Ø = 18.5	n.a.	43.1	8	< 0.04 (0.10)	< 0.04 (0.08)	8	> 40	C	80.9	37.7
TC 12 016	0.385	8.0	12.5 x 9.36	14.8 x 11.1	16.6 x 12.5	18.5 x 14.0	Ø = 18.4	43.1	8	< 0.04 (0.10)	< 0.04 (0.08)	5	> 40	C	93.0	37.7
TC 23 016	0.528	11.0	9.09 x 6.82	10.8 x 8.10	12.1 x 9.09	13.5 x 10.2	16.0 x 13.4	43.1	8	< 0.06 (0.10)	< 0.04 (0.07)	2	> 30	C	112.7	37.7
TC 13 024	0.192	6.0	25.0 x 18.7	Ø = 22.3	Ø = 25	Ø = 28	n.a.	67.2	8	< 0.08 (0.10)	< 0.04 (0.08)	19	> 45	C	105.6	44
TC 12 024	0.255	8.0	18.8 x 14.1	22.4 x 16.8	25.1 x 18.8	28.0 x 21.1	Ø = 27.7	67.2	8	< 0.08 (0.10)	< 0.04 (0.08)	10	> 45	C	117.8	44
TC 23 024	0.350	11.0	13.7 x 10.3	16.3 x 12.2	18.3 x 13.7	20.4 x 15.3	24.1 x 20.2	67.2	8	< 0.08 (0.10)	< 0.04 (0.10)	5	> 45	C	137.5	44
TC 13 036	0.133	6.0	36.0 x 27.0	Ø = 32.0	Ø = 36.0	Ø = 40.2	n.a.	102.5	8	< 0.04 (0.08)	< 0.03 (0.08)	38	> 50	C	133.0	61
TC 12 036	0.177	8.0	27.1 x 20.3	32.2 x 24.1	36.1 x 27.1	40.2 x 30.3	Ø = 39.9	102.5	8	< 0.03 (0.08)	< 0.04 (0.10)	21	> 40	C	145.2	61
TC 23 036	0.243	11.0	19.7 x 14.8	23.4 x 17.6	26.3 x 19.7	29.3 x 22.1	34.7 x 29.0	102.5	8	< 0.04 (0.08)	< 0.04 (0.10)	11	> 40	C	164.9	61
TC 13 048	0.098	6.0	48.8 x 36.6	Ø = 43.5	Ø = 48.8	Ø = 54.6	n.a.	133.4	8	< 0.08 (0.10)	< 0.06 (0.10)	65	> 40	C	167.9	75
TC 12 048	0.134	8.0	35.9 x 26.9	42.5 x 31.9	47.8 x 35.9	53.3 x 40.1	Ø = 52.8	132.9	8	< 0.07 (0.10)	< 0.06 (0.10)	37	> 40	C	181.5	75
TC 23 048	0.184	11.0	26.1 x 19.6	31.0 x 23.3	34.8 x 26.1	38.8 x 29.2	46.0 x 38.4	132.9	8	< 0.08 (0.10)	< 0.05 (0.10)	20	> 40	C	201.0	75
TC 13 056	0.084	6.0	57.1 x 42.8	Ø = 50.9	Ø = 57.1	Ø = 63.9	n.a.	157.8	8	< 0.04 (0.08)	< 0.04 (0.08)	93	> 50	C	191.5	80
TC 12 056	0.114	8.0	42.0 x 31.5	49.9 x 37.4	56.0 x 42.0	62.3 x 46.9	Ø = 61.8	157.8	8	< 0.04 (0.08)	< 0.04 (0.08)	51	> 50	C	205.0	80
TC 23 056	0.157	11.0	30.6 x 22.9	36.3 x 27.2	40.7 x 30.6	45.4 x 34.2	53.8 x 45.0	157.8	8	< 0.05 (0.08)	< 0.03 (0.08)	27	> 45	C	225.0	80
TC 13 064	0.074	6.0	65.2 x 48.9	Ø = 58.1	Ø = 65.2	Ø = 72.9	n.a.	181.9	8	< 0.06 (0.08)	< 0.03 (0.07)	124	> 40	C	212.3	100
TC 12 064	0.100	8.0	48.0 x 36.0	57.0 x 42.7	64.0 x 48.0	71.2 x 53.6	Ø = 70.6	181.8	8	< 0.05 (0.08)	< 0.04 (0.07)	67	> 50	C	225.9	100
TC 23 064	0.138	11.0	34.9 x 26.2	41.5 x 31.1	46.6 x 34.9	51.9 x 39.0	61.4 x 51.4	181.8	8	< 0.05 (0.08)	< 0.03 (0.07)	35	> 50	C	245.5	100
TC 23 072	0.122	11.0	39.2 x 29.4	46.6 x 35.0	52.3 x 39.2	58.3 x 43.9	69.1 x 57.8	226.7	8	< 0.04 (0.08)	< 0.03 (0.07)	45	> 40	C	299.2	116
TC 13 080	0.059	6.0	81.2 x 60.9	Ø = 72.4	Ø = 81.2	Ø = 90.9	n.a.	225.9	8	< 0.05 (0.08)	< 0.03 (0.08)	192	> 40	C	259.2	116
TC 12 080	0.080	8.0	59.8 x 44.8	71.0 x 53.2	79.7 x 59.8	88.7 x 66.8	Ø = 88.0	226.7	8	< 0.03 (0.08)	< 0.04 (0.10)	104	> 50	C	271.5	116
TC 23 080	0.110	11.0	43.5 x 32.6	51.7 x 38.8	58.0 x 43.5	64.6 x 48.7	76.5 x 64.0	226.7	8	< 0.04 (0.08)	< 0.02 (0.10)	55	> 50	C	291.2	116
TC 23 085	0.104	11.0	46.3 x 34.8	55.1 x 41.3	61.8 x 46.3	68.8 x 51.8	81.5 x 68.2	279.7	8	< 0.04 (0.08)	< 0.02 (0.08)	62	> 45	C	344.5	143
TC 13 096	0.050	6.0	96.0 x 72.0	Ø = 85.5	Ø = 96.0	Ø = 107.4	n.a.	279.6	8	< 0.06 (0.08)	< 0.04 (0.10)	268	> 50	C	303.3	143
TC 12 096	0.068	8.0	70.6 x 52.9	83.8 x 62.9	94.1 x 70.6	104.8 x 78.9	Ø = 103.9	278.6	8	< 0.06 (0.08)	< 0.03 (0.08)	145	> 45	C	317.0	143
TC 23 096	0.093	11.0	51.4 x 38.5	61.0 x 45.8	68.5 x 51.4	76.3 x 57.5	90.4 x 75.6	278.6	8	< 0.06 (0.08)	< 0.04 (0.08)	77	> 40	C	336.6	143
TC 23 110	0.079	11.0	60.5 x 45.4	71.8 x 53.9	80.6 x 60.5	89.8 x 67.6	106.4 x 89.0	334.5	8	< 0.06 (0.08)	< 0.03 (0.07)	106	> 40	C	430.4	180
TC 13 120	0.038	6.0	125 x 93.9	Ø = 111.6	Ø = 125.2	Ø = 140	n.a.	334.5	8	< 0.06 (0.08)	< 0.04 (0.10)	450	> 45	C	398.1	180
TC 12 120	0.052	8.0	92.1 x 69.1	109.4 x 82.0	122.8 x 92.1	136.7 x 103.0	Ø = 135.5	334.5	8	< 0.06 (0.08)	< 0.04 (0.10)	247	> 45	C	402.7	180
TC 23 120	0.072	11.0	67.0 x 50.3	79.6 x 59.7	89.4 x 67.0	99.5 x 75.0	117.9 x 98.7	334.5	8	< 0.07 (0.08)	< 0.04 (0.10)	131	> 35	C	422.4	180
TC 23 130	0.068	11.0	70.9 x 53.2	84.2 x 63.2	94.5 x 70.9	105.3 x 79.3	124.7 x 104.3	396.0	8	< 0.05 (0.08)	< 0.04 (0.10)	146	> 40	C	490.0	200
TC 13 144	0.033	6.0	146.7 x 110.1	Ø = 130.8	Ø = 146.7	Ø = 164.2	n.a.	396.0	8	< 0.05 (0.08)	< 0.04 (0.10)	606	> 45	C	448.8	200
TC 12 144	0.044	8.0	107.9 x 80.9	128.2 x 96.2	143.9 x 107.9	160.3 x 120.7	Ø = 158.9	396.0	8	< 0.05 (0.08)	< 0.05 (0.08)	339	> 35	C	462.1	200
TC 23 144	0.061	11.0	78.6 x 58.9	93.3 x 70.0	104.8 x 78.6	116.7 x 87.9	138.3 x 115.7	396.0	8	< 0.05 (0.08)	< 0.04 (0.08)	180	> 40	C	481.9	200
TC 23 172	0.051	11.0	94.6 x 71.0	112.4 x 84.3	126.1 x 94.6	140.5 x 105.8	166.5 x 139.3	526.9	8	< 0.05 (0.08)	< 0.04 (0.10)	260	> 40	C	630.3	260
TC 13 192	0.025	6.0	195.8 x 146.9	Ø = 174.6	Ø = 195.8	Ø = 219.1	n.a.	527.0	8	< 0.06 (0.08)	< 0.04 (0.10)	1050	> 45	C	589.2	260
TC 12 192	0.033	8.0	144.1 x 108.0	171.1 x 128.3	192.1 x 144.1	213.9 x 161.1	Ø = 212.0	526.9	8	< 0.06 (0.08)	< 0.04 (0.08)	603	> 45	C	602.6	260
TC 23 192	0.046	11.0	104.9 x 78.6	124.6 x 93.4	139.8 x 104.9	155.7 x 117.3	184.5 x 154.4	526.9	8	< 0.06 (0.08)	< 0.05 (0.08)	320	> 35	C	622.3	260
TC 23 200	0.044	11.0	110.0 x 82.5	130.7 x 98.0	146.7 x 110.0	163.3 x 123.0	193.5 x 161.9	492.8	8	< 0.06 (0.08)	< 0.05 (0.10)	352	> 40	C	792.0	322
TC 23 240	0.037	11.0	130.8 x 98.1	155.4 x 116.6	174.4 x 130.8	194.3 x 146.3	230.2 x 192.6	492.8	8	< 0.03 (0.08)	< 0.04 (0.08)	498	> 45	C	775.1	322

Camera phase adjustment feature is available **upon request** (for all part numbers except TC23004, TC23007, TC23009, TC23012)

1 Working distance: distance between the front end of the mechanics and the object. Set this distance within +/- 3% of the nominal value for maximum resolution and minimum distortion.
2 Working F-number (wF/#): the real F-number of a lens when used as a macro. Lenses with smaller apertures can be supplied on request.
3 Maximum slope of chief rays inside the lens: when converted to milliradians, it gives the maximum measurement error for any millimeter of object displacement. Typical (average production) values and maximum (guaranteed) values are listed.
4 Percent deviation of the real image compared to an ideal, undistorted image: typical (average production) values and maximum (guaranteed) values are listed.
5 At the borders of the field depth the image can be still used for measurement but, to get a perfectly sharp image, only half of the nominal field depth should be considered. Pixel size used for calculation is 5.5 µm.
6 Measured from the front end of the mechanics to the camera flange.
7 With 1/1.8" (9 mm diagonal) detectors, the FOV of TC 12 yyy lenses may show some vignetting at the image corners, as these lenses are optimized for 1/2" detectors (8 mm diagonal).
8 For the fields with the indication "Ø =", the image of a circular object of such diameter is fully inscribed into the detector.

Ordering information

It's easy to select the right lens for your application: our part numbers are coded as **TC xx yyy**, where **xx** defines the camera sensor size (13 = 1/3", 12 = 1/2", 23 = 2/3") and **yyy** refers to the width dimension of the object field of view (FOV), in millimeters. For instance, a TC 12 064 features a field of view of 64 (x 48) mm with a 1/2" camera sensor.

TC CORE series

Ultra compact bi-telecentric lenses up to 2/3"

NEW

INTERNATIONAL PATENT PENDING

KEY ADVANTAGES

Excellent optical performances
TC CORE bi-telecentric lenses deliver excellent optical performances as other comparable Opto Engineering bi-telecentric lenses.

Extremely compact
TC CORE lenses are up to 70% smaller than other telecentric lenses on the market.

Designed for flexibility and smart integration
TC CORE lenses integrate a camera phase adjustment and can be mounted on multiple sides with or without clamps, allowing to cut the costs.

Save you money
Systems integrating TC CORE lenses take much less space, resulting in lower manufacturing, shipping and storage costs.

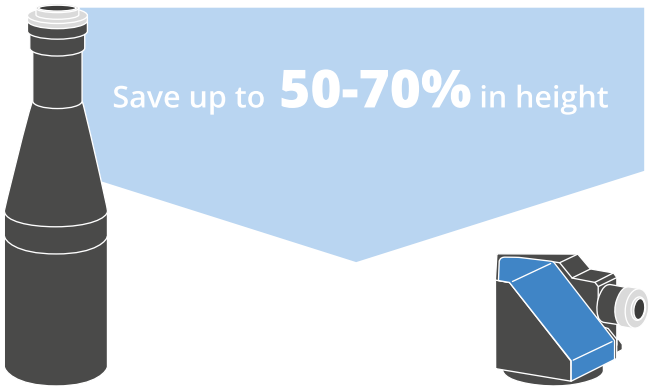
Boost your sales
A smaller vision system or measurement machine is the solution preferred by the industry.

TC CORE bi-telecentric lenses for sensors up to 2/3" feature a truly revolutionary ultra compact opto-mechanical design.

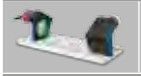
These lenses deliver high-end optical performances and at the same time are up to 70% smaller than other double-sided telecentric lenses on the market, thus allowing to significantly downsize a vision system.
The unique shape has been expressly developed for maximum mounting flexibility.

TC CORE lenses can be mounted in different directions using any of the 4 sides even without clamps, allowing to cut the system's cost, and can be easily fitted or retrofitted even into very compact machines.

TC CORE bi-telecentric lenses can also be coupled with the new ultra compact LTCLHP CORE series telecentric illuminators to build super small yet extremely accurate measurement systems.



Comparison of a "classic" telecentric lens present on the market and a TC CORE bi-telecentric lens: TC CORE lens delivers best optical performances and is extremely compact.

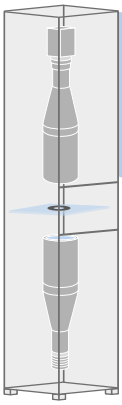
SEE ALSO		
	TCBENCH CORE series	p. 27
FULL RANGE OF COMPATIBLE ILLUMINATORS		
	LTCLHP CORE series	p. 108
FULL RANGE OF COMPATIBLE ACCESSORIES		
	Mounting mechanics CMHOCR and CMPTCR series	p. 165

Multiple lens surfaces can be used for mounting thanks to the M6 threaded holes located on 4 sides. Mounting is direct without clamps, allowing to cut the costs.

Front CMHOCR clamp available for added mounting flexibility.

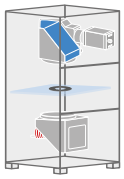
Built-in phase adjustment allows to easily align the camera sensor.

Off-line precision measurement systems:



Integrates a classic telecentric lens and a classic telecentric illuminator present on the market.

Save up to
50-70%
in height



Integrates a TC CORE bi-telecentric lens and LTCLHP CORE telecentric illuminator.

ADVANTAGES

Save more

- Lower manufacturing cost due to less material employed
- Less space required for storage and use
- Lower shipment expenses due to smaller size
- Lower transportation risks

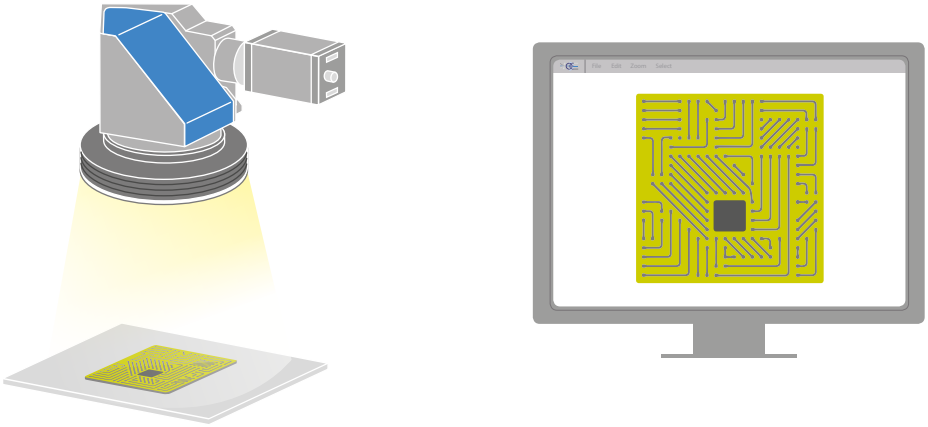
Sell more

- A smaller vision system or measurement machine is preferred by the industry

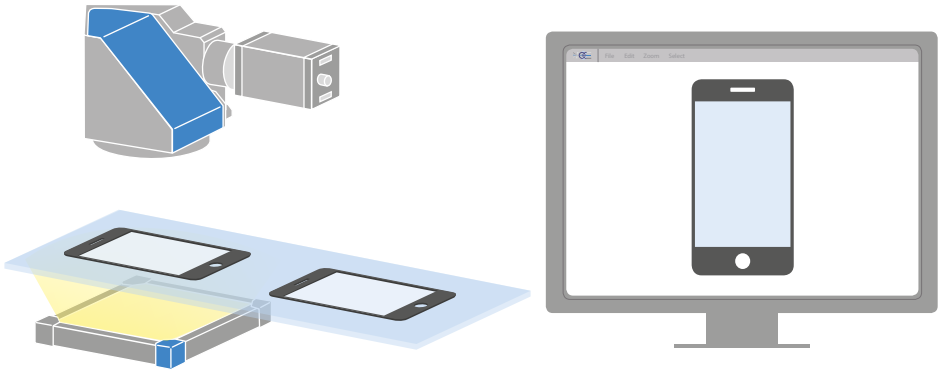
TC CORE series

Ultra compact bi-telecentric lenses up to 2/3"

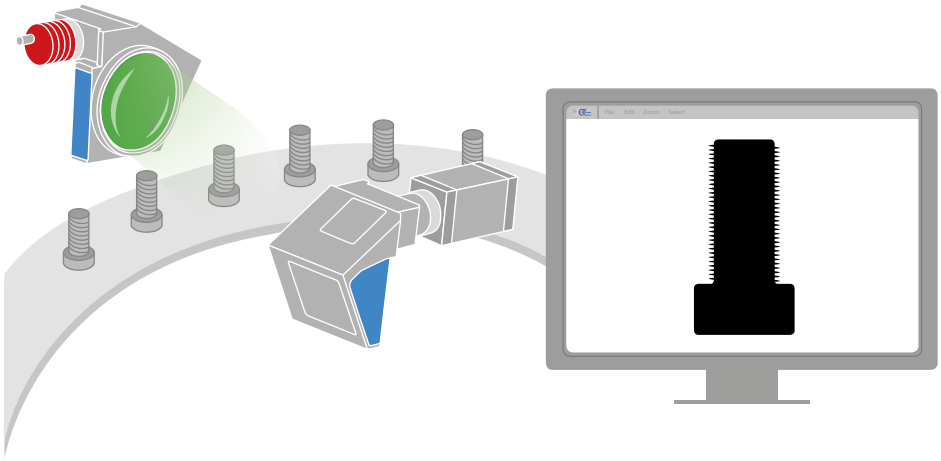
Application examples



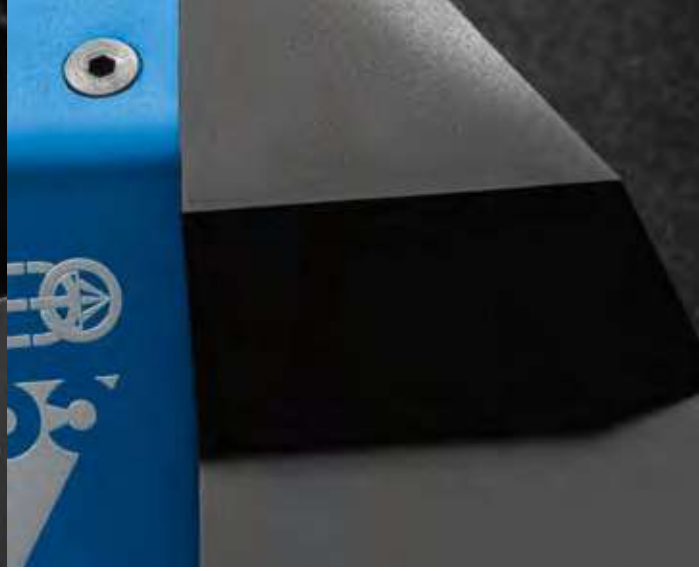
Electronic board inspection:
TC CORE with top ringlight.



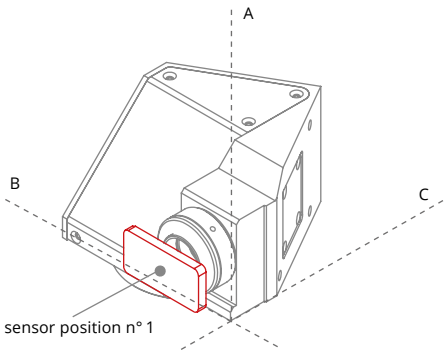
Smartphone glass inspection:
TC CORE mounted directly
on a plate and a flat backlight.

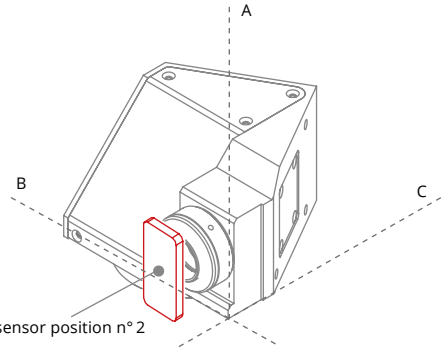


Screw measurement on a rotary
glass table: TC CORE lens
and LTCLHP CORE illuminator.



TC CORE lens dimensions (A, B, C) and correct position of the sensor in relation to the lens:





The long side of sensor has to be aligned along axis B (position n°1) or axis A (pisition n°2).

			Detector type					Optical specifications						Dimensions			
Part number	**Mag.**	**Image circle**	**1/3" w x h**	**1/2.5" w x h**	**1/2" w x h**	**1/1.8" w x h**	**2/3" - 5 MP w x h**	**WD**	**wF/#**	**Telecentricity** typical (max)	**Distortion** typical (max)	**Field depth**	**CTF** @70 lp/mm	**Mount**	**A**	**B**	**C**
	(x)	Ø (mm)	4.8 x 3.6 (mm × mm)	5.70 x 4.28 (mm × mm)	6.4 x 4.8 (mm × mm)	7.13 x 5.37 (mm × mm)	8.45 x 7.07 (mm × mm)	(mm) 1	2	(deg) 3	(%) 4	(mm) 5	(%)		(mm)	(mm)	(mm)
			Object field of view (mm x mm) 6														
TCCR 12 048	0.134	8.0	35.9 x 26.9	42.5 x 31.9	47.8 x 35.9	53.3 x 40.1	Ø = 52.8	132.9	8	< 0.07 (0.10)	< 0.06 (0.10)	37	> 40	C	77	106	115
TCCR 23 048	0.184	11.0	26.1 x 19.6	31.0 x 23.3	34.8 x 26.1	38.8 x 29.2	46.0 x 38.4	132.9	8	< 0.08 (0.10)	< 0.05 (0.10)	20	> 40	C	77	106	135
TCCR 12 056	0.114	8.0	42.0 x 31.5	49.9 x 37.4	56.0 x 42.0	62.3 x 46.9	Ø = 61.8	157.8	8	< 0.04 (0.08)	< 0.04 (0.10)	51	> 50	C	94	110	125
TCCR 23 056	0.157	11.0	30.6 x 22.9	36.3 x 27.2	40.7 x 30.6	45.4 x 34.2	53.8 x 45.0	157.8	8	< 0.05 (0.08)	< 0.03 (0.10)	27	> 45	C	94	110	145
TCCR 12 064	0.100	8.0	48.0 x 36.0	57.0 x 42.7	64.0 x 48.0	71.2 x 53.6	Ø = 70.6	181.8	8	< 0.05 (0.08)	< 0.04 (0.10)	67	> 50	C	101	122	133
TCCR 23 064	0.138	11.0	34.9 x 26.2	41.5 x 31.1	46.6 x 34.9	51.9 x 39.0	61.4 x 51.4	181.8	8	< 0.05 (0.08)	< 0.03 (0.10)	35	> 50	C	101	122	153
TCCR 12 080	0.080	8.0	59.8 x 44.8	71.0 x 53.2	79.7 x 59.8	88.7 x 66.8	Ø = 88.0	226.7	8	< 0.03 (0.08)	< 0.04 (0.10)	104	> 50	C	119	145	159
TCCR 23 080	0.110	11.0	43.5 x 32.6	51.7 x 38.8	58.0 x 43.5	64.6 x 48.7	76.5 x 64.0	226.7	8	< 0.04 (0.08)	< 0.02 (0.10)	55	> 50	C	119	145	172
TCCR 12 096	0.068	8.0	70.6 x 52.9	83.8 x 62.9	94.1 x 70.6	104.8 x 78.9	Ø = 103.9	278.6	8	< 0.06 (0.08)	< 0.03 (0.10)	145	> 45	C	139	172	183
TCCR 23 096	0.093	11.0	51.4 x 38.5	61.0 x 45.8	68.5 x 51.4	76.3 x 57.5	90.4 x 75.6	278.6	8	< 0.06 (0.08)	< 0.04 (0.10)	77	> 40	C	139	172	197

1 Working distance: distance between the front end of the mechanics and the object. Set this distance within +/- 3% of the nominal value for maximum resolution and minimum distortion.
2 Working F-number (wF/#): the real F-number of a lens when used as a macro. Lenses with smaller apertures can be supplied on request.
3 Maximum slope of chief rays inside the lens: when converted to milliradians, it gives the maximum measurement error for any millimeter of object displacement. Typical (average production) values and maximum (guaranteed) values are listed.
4 Percent deviation of the real image compared to an ideal, undistorted image: typical (average production) values and maximum (guaranteed) values are listed.
5 At the borders of the field depth the image can be still used for measurement but, to get a perfectly sharp image, only half of the nominal field depth should be considered. Pixel size used for calculation is 5.5 µm.
6 For the fields with the indication "Ø =", the image of a circular object of such diameter is fully inscribed into the detector.

TCUV series

UV bi-telecentric lenses

TCUV series bi-telecentric lenses are specifically designed to ensure the highest image resolution today available in the machine vision world.

No other lenses in the market can efficiently operate with pixels as small as 2 microns. For this reason TCUV bi-telecentric lenses are a MUST for all those using high resolution cameras and seeking for the highest system accuracy.

Common lenses and traditional telecentric lenses operate in the visible light (VIS) range. The maximum resolution of a lens is given by the cut-off frequency, that is the spatial frequency at which the lens is no longer able to yield sufficient image contrast.

Since the cut-off frequency is inversely proportional to the light wavelength, common optics are useless with very small pixel sizes (such as 1.75 microns) which are becoming increasingly popular among industrial cameras.

KEY ADVANTAGES

Extremely high resolution for cameras with very small pixels.

High telecentricity for thick object imaging.

Nearly zero distortion for accurate measurements.

Application examples

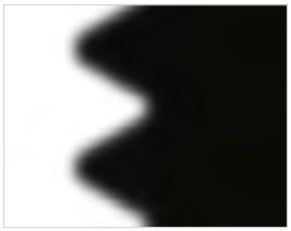


Image captured with a lens operating in the visible range.

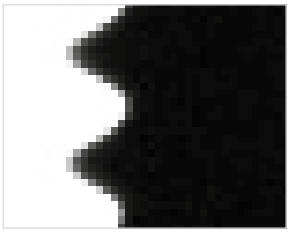
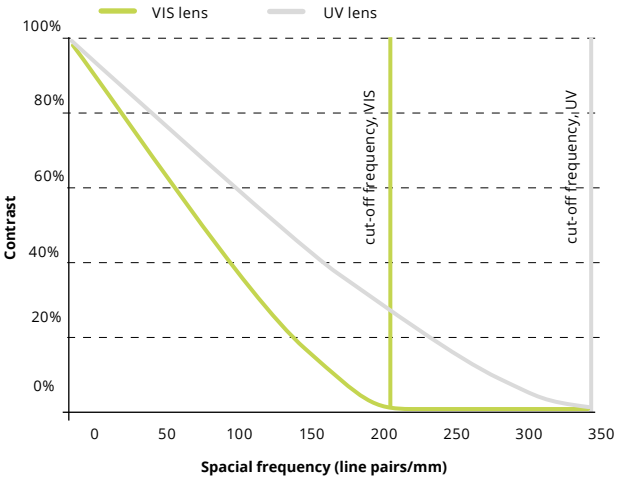
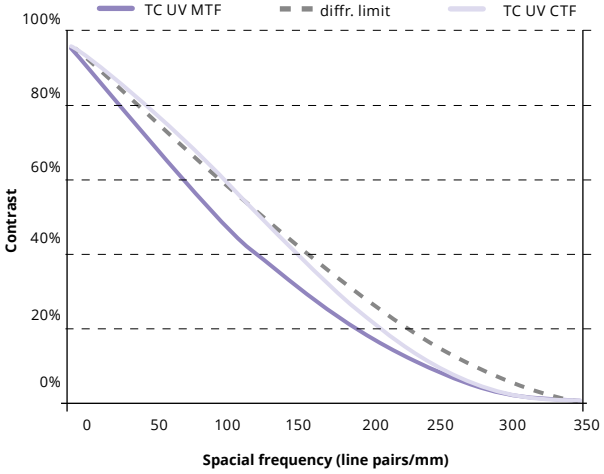


Image taken with a TCUV bi-telecentric lens.

FULL RANGE OF COMPATIBLE ACCESSORIES		
	CMHO series	p. 162



The graph shows the limit performances (diffraction limit) of two lenses operating at working F/# 8.
The standard lens operates at 587 nm (green light) while the UV lens operates at 365 nm.



The CTF function, which expresses the contrast ratio at a given spatial frequency is much higher with TCUV lenses.
The vertical bars show the cut-off frequencies of each lens: TCUV lenses still yield some contrast up to 340 lp/ mm.

		Detector type					Optical specifications						Dimensions		
Part number	**Mag.**	**1/3" w x h** 4.80 x 3.60 (mm x mm)	**1/2.5" w x h** 5.70 x 4.28 (mm x mm)	**1/2" w x h** 6.40 x 4.80 (mm x mm)	**1/1.8" w x h** 7.13 x 5.37 (mm x mm) **8**	**2/3" w x h** 8.80 x 6.60 (mm x mm)	**WD** (mm) **1**	**wF/#** **2**	**Telecentricity** typical (max) (deg) **3**	**Distortion** typical (max) (%) **4**	**Field depth** (mm) **5**	**CTF** @70lp/mm (%) **6**	**Mount**	**Length** (mm) **7**	**Diam.** (mm)
		Object field of view (mm x mm) **9**													
TCUV 12 036	0.175	27.4 x 20.5	32.2 x 24.1	36.5 x 27.4	40.6 x 30.6	Ø = 37.6	98.7	8	< 0.1	< 0.08	21.0	> 60	C	142.3	61.0
TCUV 23 036	0.241	19.9 x 14.9	23.4 x 17.6	26.6 x 19.9	29.6 x 22.3	36.5 x 27.4	98.7	8	< 0.1	< 0.08	11.0	> 60	C	160.4	61.0
TCUV 12 048	0.133	36.0 x 27.0	42.5 x 31.9	47.9 x 36.0	53.4 x 40.2	Ø = 49.4	130.7	8	< 0.08	< 0.08	37.0	> 60	C	176.1	75.0
TCUV 23 048	0.183	26.2 x 19.6	31.0 x 23.3	34.9 x 26.2	38.9 x 29.3	48.0 x 36.0	130.7	8	< 0.08	< 0.08	20.0	> 60	C	160.4	75.0
TCUV 12 056	0.114	42.0 x 31.5	49.9 x 37.4	56.1 x 42.0	62.4 x 47.0	Ø = 57.8	154.0	8	< 0.1	< 0.08	51.0	> 60	C	198.4	80.0
TCUV 23 056	0.157	30.6 x 22.9	36.3 x 27.2	40.8 x 30.6	45.4 x 34.2	56.1 x 42.1	154.0	8	< 0.1	< 0.08	27.0	> 60	C	160.4	80.0
TCUV 12 064	0.100	48.0 x 36.0	57.0 x 42.7	64.0 x 48.0	71.3 x 53.7	Ø = 66	176.0	8	< 0.08	< 0.08	66.0	> 60	C	219.7	100.0
TCUV 23 064	0.137	34.9 x 26.2	41.5 x 31.1	46.6 x 34.9	51.9 x 39.1	64.1 x 48.0	176.0	8	< 0.08	< 0.08	35.0	> 60	C	160.4	100.0
TCUV 12 080	0.080	59.8 x 44.8	71.0 x 53.2	79.7 x 59.8	88.8 x 66.9	Ø = 82.2	221.0	8	< 0.08	< 0.08	102.0	> 60	C	264.3	116.0
TCUV 23 080	0.110	43.5 x 32.6	51.7 x 38.8	58.0 x 43.5	64.5 x 48.6	79.7 x 59.8	221.0	8	< 0.08	< 0.08	54.0	> 60	C	160.4	116.0

1 Working distance: distance between the front end of the mechanics and the object. Set this distance within +/- 3% of the nominal value for maximum resolution and minimum distortion.
2 Working F-number (wF/#): the real F-number of a lens when used as a macro. Lenses with smaller apertures can be supplied on request.
3 Maximum slope of chief rays inside the lens: when converted to milliradians, it gives the maximum measurement error for any millimeter of object displacement. Typical (average production) values and maximum (guaranteed) values are listed.
4 Percent deviation of the real image compared to an ideal, undistorted image: typical (average production) values and maximum (guaranteed) values are listed.
5 At the borders of the field depth the image can be still used for measurement but, to get a very sharp image, only half of the nominal field depth should be considered.
6 Nominal value.
7 Measured from the front end of the mechanics to the camera flange.
8 With 1/1.8" (9 mm diagonal) detectors, the FOV of TCUV 12 XX lenses may show some vignetting at the image corners, as these lenses are optimized for 1/2" detectors (8 mm diagonal).
9 For the fields with the indication "Ø =", the image of a circular object of such diameter is fully inscribed into the detector.

TCSM series

3D bi-telecentric lenses with Scheimpflug adjustment

KEY ADVANTAGES

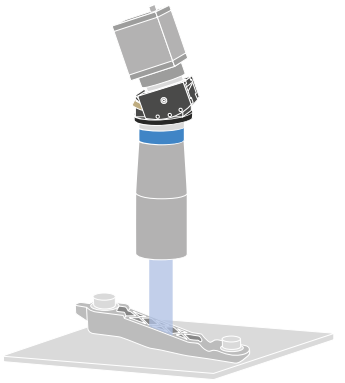
Unique Scheimpflug adjustment
No other lens can perform oblique measurements.

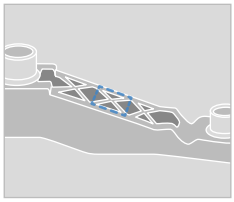
The image is radially undistorted
Linear extension can be perfectly calibrated.

Compatible with any C-mount camera
C-mount standard compliant.

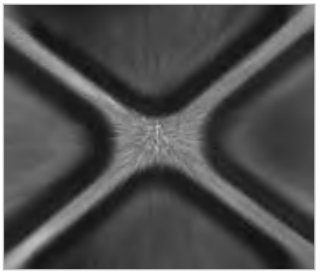
TCSM series is a unique family of bi-telecentric lenses for extremely accurate 3D dimensional measurement systems. All TCSM lenses are equipped with a high-precision Scheimpflug adjustment mechanism that fits any type of C-mount camera. Besides achieving very good focus at wide tilt angles, bi-telecentricity 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

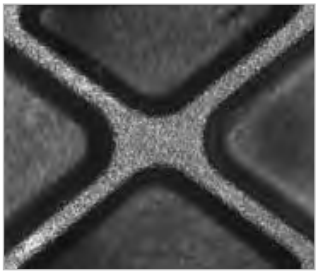




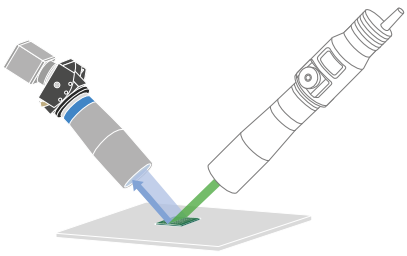
TCSM imaging and measuring sloped objects.

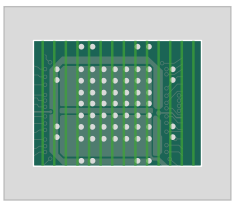


Without tilt adjustment, the object is not homogeneously focused.

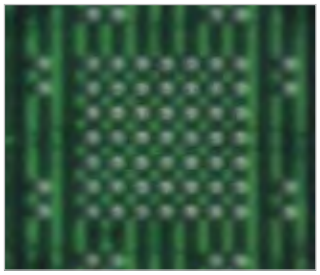


At the Scheimpflug angle, the image becomes sharp.

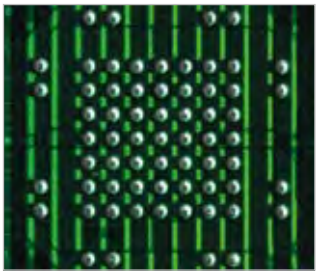




Scheimpflug telecentric optics for both projection and imaging at 90°.



Without tilt adjustment, the object is not homogeneously focused.



At the Scheimpflug angle, the image becomes sharp.

SEE ALSO

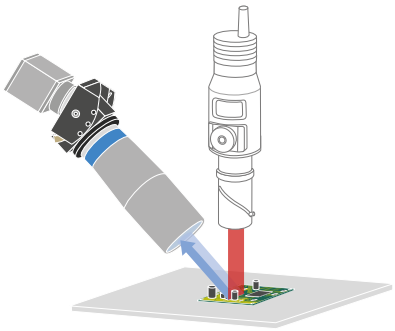

MCSM1-01X series p. 74

FULL RANGE OF COMPATIBLE PRODUCTS FOR 3D APPLICATIONS

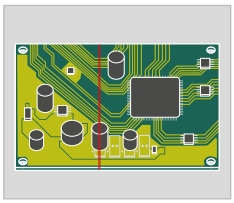

LED pattern projectors p. 142

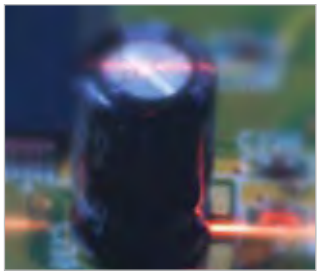
FULL RANGE OF COMPATIBLE ACCESSORIES


CMHO series p. 162



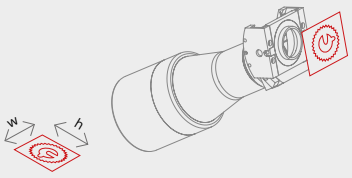
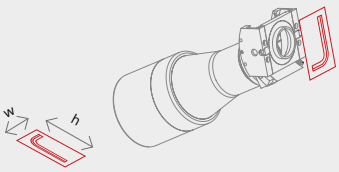
TCSM series lens for straight telecentric pattern projection.





Without tilt adjustment, the object is not homogeneously focused.

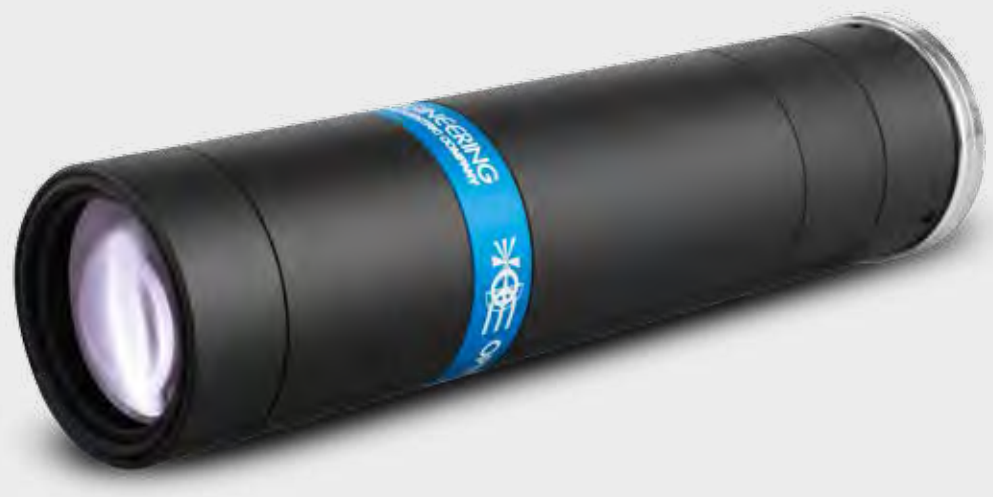
At the Scheimpflug angle, the image becomes sharp.

Part number	Object tilt (deg)	Mount tilt (deg)	WD (mm) [1]	Horizontal mag (x)	Vertical mag (x)	Long detector side horizontal — Field of view - w x h (mm x mm) 1/3" w x h 4.80 x 3.60 (mm x mm)	1/2" w x h 6.40 x 4.80 (mm x mm)	2/3" w x h 8.80 x 6.60 (mm x mm)	Long detector side vertical — Field of view - w x h (mm x mm) 1/3" w x h 3.60 x 4.80 (mm x mm)	1/2" w x h 4.80 x 6.40 (mm x mm)	2/3" w x h 6.60 x 8.80 (mm x mm)
											
TCSM 016	0.0	0.0	43.1	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	67.2	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	102.5	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	132.9	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	157.8	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	181.8	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	226.7	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	278.6	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

1 Working distance: distance between the front end of the mechanics and the object.
Set this distance within +/- 3% of the nominal value for maximum resolution and minimum distortion.

TCLWD series

Long working distance telecentric lenses for 2/3" detectors



TCLWD is a range of telecentric lenses specifically designed for electronic and semiconductor Automated Optical Inspection (AOI) and tool pre-setting machines.

All these lenses feature a working distance of 135 mm while ensuring excellent optical resolution, high telecentricity and low distortion, thus matching and even exceeding the industrial requirements for the target applications.

The long working distance allows for extra space, which is essential if you need to install illumination, pick-up tools or provide the necessary separation from hazardous production processes.

In addition to the long working distance, TCLWD optics deliver a numerical aperture large enough to take advantage of high resolution / small pixel size cameras, making these lenses a perfect match for general-purpose 2D measurement systems.

KEY ADVANTAGES

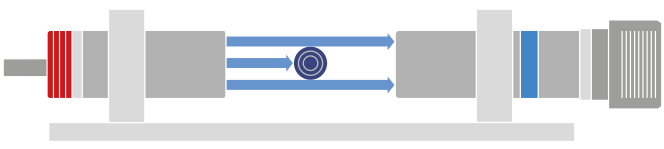
Long working distance
Perfect for electronic components inspection and tool pre-setting machines.

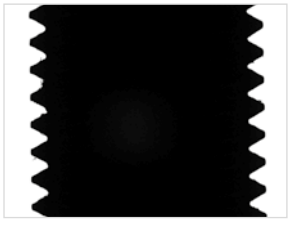
High numerical aperture
For small pixel size / high resolution detectors.

Easy rotational phase adjustment
Robust and precise tuning of the lens-camera phase.

Full range of compatible products
Fits LTCLHP telecentric illuminators, CMHO clamping supports and LTRN ring illuminators.

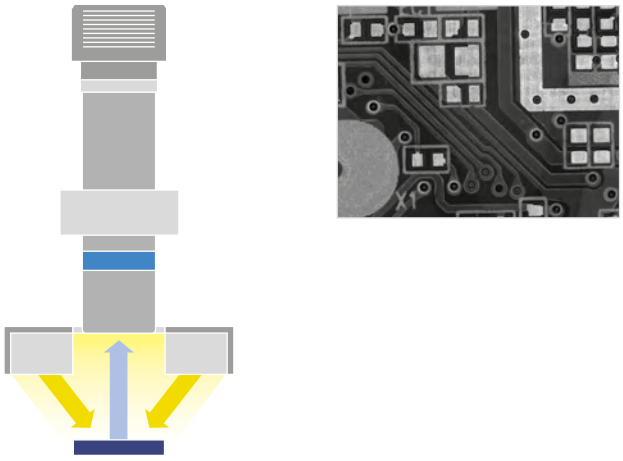
Application examples



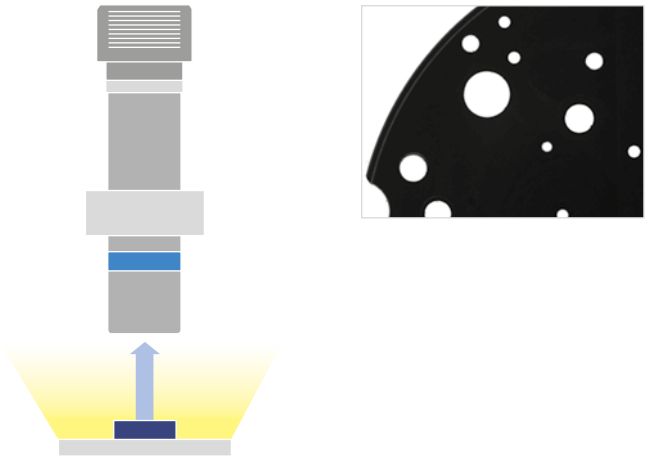


A TCLWD050 lens assembled with a CMHO016 clamping mechanics and back-illuminated by a LTCLHP016-G telecentric illuminator forming an inspection system for measurement of mechanical components such as milling tools and screws.

FOR OTHER LONG WORKING DISTANCE TELECENTRIC LENSES, SEE ALSO	
TCVLWD series	p. 30
FULL RANGE OF COMPATIBLE ILLUMINATORS	
Backlights LTBP, LTBC, LTBFC	p. 132-138
COMPATIBLE CLAMPING MECHANICS	
Mounting clamp CMHO016	p. 162



A TCLWD lens in combination with LTRN016 ring illuminator inspecting an electronic board.



A TCLWD lens measuring a clock gear with backlight illumination.

			Detector type					Optical specifications						Dimensions		
			1/3''	1/2.5''	1/2''	1/1.8''	2/3'' - 5 Mpx									
Part number	**Mag.**	**Image circle**	**w x h** 4.80 x 3.60	**w x h** 5.70 x 4.28	**w x h** 6.40 x 4.80	**w x h** 7.13 x 5.37	**w x h** 8.45 x 7.07	**WD**	**wF/#**	**Telecentricity** typical (max)	**Distortion** typical (max)	**Field depth**	**CTF** @35lp/mm	**Mount**	**Length**	**Diam.**
	(x)	Ø (mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm)		(deg)	(%)	(mm)	(%)		(mm)	(mm)
								1	**2**	**3**	**4**	**5**			**6**	
			Object field of view (mm x mm)													
TCLWD 050	0.50	11.0	9.60 x 7.20	11.4 x 8.56	12.8 x 9.60	14.3 x 10.7	16.9 x 14.1	132.3	12	0.04 (0.06)	0.1 (0.20)	4	> 60	C	130.7	37.7
TCLWD 066	0.66	11.0	7.27 x 5.45	8.64 x 6.48	9.70 x 7.27	10.8 x 8.14	12.8 x 10.7	132.3	12	0.04 (0.06)	0.1 (0.20)	2.3	> 58	C	149.3	37.7
TCLWD 075	0.75	11.0	6.40 x 4.80	7.60 x 5.71	8.53 x 6.40	9.51 x 7.16	11.3 x 9.43	132.3	12	0.04 (0.06)	0.1 (0.20)	1.8	> 55	C	155.0	37.7
TCLWD 100	1.00	11.0	4.80 x 3.60	5.70 x 4.28	6.40 x 4.80	7.13 x 5.37	8.45 x 7.07	132.3	12	0.04 (0.06)	0.05 (0.10)	1	> 60	C	126.0	37.7
TCLWD 150	1.50	11.0	3.20 x 2.40	3.80 x 2.85	4.27 x 3.20	4.75 x 3.58	5.63 x 4.71	132.3	16	0.04 (0.06)	0.05 (0.10)	0.6	> 50	C	140.4	37.7
TCLWD 250	2.50	11.0	1.92 x 1.44	2.28 x 1.71	2.56 x 1.92	2.85 x 2.15	3.38 x 2.83	132.3	20	0.04 (0.06)	0.05 (0.10)	0.3	> 40	C	157.0	37.7
TCLWD 350	3.50	11.0	1.37 x 1.03	1.63 x 1.22	1.83 x 1.37	2.04 x 1.53	2.41 x 2.02	132.3	24	0.04 (0.06)	0.05 (0.10)	0.2	> 30	C	174.7	37.7

1 Working distance: distance between the front end of the mechanics and the object. Set this distance within +/- 3% of the nominal value for maximum resolution and minimum distortion.
2 Working F-number (wF/#): the real F-number of a lens when used as a macro. Lenses with smaller apertures can be supplied on request.
3 Maximum slope of chief rays inside the lens: when converted to milliradians, it gives the maximum measurement error for any millimeter of object displacement. Typical (average production) values and maximum (guaranteed) values are listed.
4 Percent deviation of the real image compared to an ideal, undistorted image: typical (average production) values and maximum (guaranteed) values are listed.
5 At the borders of the field depth the image can be still used for measurement but, to get a perfectly sharp image, only half of the nominal field depth should be considered. Pixel size used for calculation is 5.5 µm.
6 Measured from the front end of the mechanics to the camera flange.

Ordering information

It's easy to select the right lens for your application: our part numbers are coded as **TCLWD xxx**, where **xxx** defines the magnification (050 = 0.50, 066 = 0.66, 075 = 0.75, ...). For instance, a TCLWD 050 features a 0.50 magnification.

TCCX series

Telecentric lenses with built-in coaxial illumination

KEY ADVANTAGES

Large numerical aperture
For small pixel size camera resolution.

Long working distance
Tailored for electronic components inspection.

Compact built-in illumination
Ideal for high-end applications in semiconductor industry.

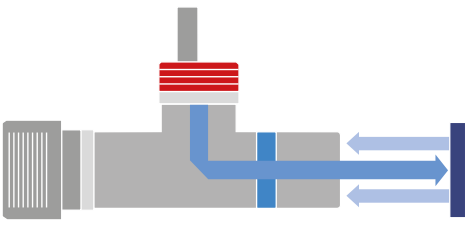
Easy rotational phase adjustment
Robust and precise tuning of the camera phase.

TCCX series is a range of lenses designed for flat surface measurement and defect inspections that offers the same magnifications and working distance of TCLWD series while adding integrated coaxial light.
Such lighting configuration is required to homogeneously illuminate uneven surfaces and detecting small surface defects such as scratches or grooves, finding application in many industries: from electronic and semiconductor to glass and mechanics.
All these lenses operate at a working distance of 135 mm while their large numerical aperture enables the superior resolution needed for small pixel cameras, matching and even exceeding the industrial requirements of on- and off-line applications.
The built-in LED source, equipped with advanced electronics, provides excellent illumination stability and homogeneity, key factors for the reliability of any machine vision system.
The unique optical design minimizes the back-reflection issues of conventional coaxial illumination systems: this makes TCCX the perfect choice especially when highly reflective flat surfaces (approx. > 30% reflectance) are involved.

Application examples include recognition of silicon wafers pattern and inspection of LCD displays, polished metal surfaces, plastic and glass panels, and many other.

FOR OTHER MAGNIFICATIONS COAXIAL TELECENTRIC LENSES SEE ALSO		
	TCCXHM, TCCXLM series	p. 31
FULL RANGE OF COMPATIBLE ILLUMINATORS		
	Backlights LTBP, LTBC, LTBFC	p. 132-138
FULL RANGE OF COMPATIBLE ACCESSORIES		
	Mounting mechanics CMHO series	p. 162

Application examples



TCCX lens clamped inspecting objects with coaxial illumination.

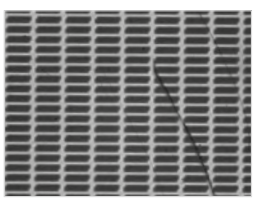
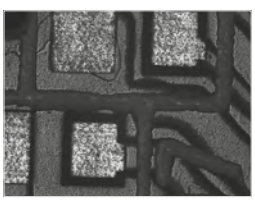


Image of an LCD display taken with a TCCX250 lens.



Details of an electronic board imaged with a TCCX lens with green illumination.

Scratches on a stainless steel surface emphasized by coaxial illumination.

Precise light intensity tuning

Easily and precisely tune the light intensity level thanks to the leadscrew multi-turn trimmer positioned in the back.

Direct LED control

The built-in electronics can be bypassed in order to drive the LED directly for use in continuous or pulsed mode.
When bypassed, built-in electronics behave as an open circuit allowing direct control of the LED source.

Electrical specifications

	Light	Device power ratings				LED power ratings		
Part number	**Light color, wavelength peak**	**DC voltage**		**Power consumption**	**Max LED fwd current**	**Forward voltage**		**Max pulse current**
		min (V)	max (V)	(W)	(mA)	typ. (V)	max (V)	(mA)
		1			2	3		4
TCCX xxx-G	green, 520 nm	12	24	< 2.5	350	3.3	4.00	2000
TCCX xxx-W	white	12	24	< 2.5	350	2.78	n.a.	2000

1 Tolerance ± 10%.
2 Used in continuous (not pulsed) mode.
3 At max forward current. Tolerance is ±0.06V on forward voltage measurements.
4 At pulse width <= 10 ms, duty cycle <= 10% condition.
Built-in electronics board must be bypassed (see tech info online).

			Detector type					Optical specifications						Dimensions		
Part number	**Mag.** (x)	**Image circle** Ø (mm)	**1/3" w x h** 4.80 x 3.60 (mm x mm)	**1/2.5" w x h** 5.70 x 4.28 (mm x mm)	**1/2" w x h** 6.40 x 4.80 (mm x mm)	**1/1.8" w x h** 7.13 x 5.37 (mm x mm)	**2/3" - 5 Mpx w x h** 8.45 x 7.07 (mm x mm)	**WD** (mm) 1	**wF/#** 2	**Telecentricity** typical (max) (deg) 3	**Distortion** typical (max) (%) 4	**Field depth** (mm) 5	**CTF** @35lp/mm (%)	**Mount**	**Length** (mm) 6	**Diam.** (mm)
			Object field of view (mm x mm)													
TCCX 050-G	0.50	11	9.60 x 7.20	11.4 x 8.56	12.8 x 9.60	14.3 x 10.7	16.9 x 14.1	132.3	12	0.04 (0.06)	0.1 (0.20)	4	> 60	C	131.2	37.7
TCCX 050-W	0.50	11	9.60 x 7.20	11.4 x 8.56	12.8 x 9.60	14.3 x 10.7	16.9 x 14.1	132.3	12	0.04 (0.06)	0.1 (0.20)	4	> 60	C	131.2	37.7
TCCX 066-G	0.66	11	7.27 x 5.45	8.64 x 6.48	9.70 x 7.27	10.8 x 8.14	12.8 x 10.7	132.3	12	0.04 (0.06)	0.1 (0.20)	2.3	> 58	C	149.8	37.7
TCCX 066-W	0.66	11	7.27 x 5.45	8.64 x 6.48	9.70 x 7.27	10.8 x 8.14	12.8 x 10.7	132.3	12	0.04 (0.06)	0.1 (0.20)	2.3	> 58	C	149.8	37.7
TCCX 075-G	0.75	11	6.40 x 4.80	7.60 x 5.71	8.53 x 6.40	9.51 x 7.16	11.3 x 9.43	132.3	12	0.04 (0.06)	0.1 (0.20)	1.8	> 55	C	155.5	37.7
TCCX 075-W	0.75	11	6.40 x 4.80	7.60 x 5.71	8.53 x 6.40	9.51 x 7.16	11.3 x 9.43	132.3	12	0.04 (0.06)	0.1 (0.20)	1.8	> 55	C	155.5	37.7
TCCX 100-G	1.00	11	4.80 x 3.60	5.70 x 4.28	6.40 x 4.80	7.13 x 5.37	8.45 x 7.07	132.3	12	0.04 (0.06)	0.05 (0.10)	1	> 60	C	132.9	37.7
TCCX 100-W	1.00	11	4.80 x 3.60	5.70 x 4.28	6.40 x 4.80	7.13 x 5.37	8.45 x 7.07	132.3	12	0.04 (0.06)	0.05 (0.10)	1	> 60	C	132.9	37.7
TCCX 150-G	1.50	11	3.20 x 2.40	3.80 x 2.85	4.27 x 3.20	4.75 x 3.58	5.63 x 4.71	132.3	16	0.04 (0.06)	0.05 (0.10)	0.6	> 50	C	147.2	37.7
TCCX 150-W	1.50	11	3.20 x 2.40	3.80 x 2.85	4.27 x 3.20	4.75 x 3.58	5.63 x 4.71	132.3	16	0.04 (0.06)	0.05 (0.10)	0.6	> 50	C	147.2	37.7
TCCX 250-G	2.50	11	1.92 x 1.44	2.28 x 1.71	2.56 x 1.92	2.85 x 2.15	3.38 x 2.83	132.3	20	0.04 (0.06)	0.05 (0.10)	0.3	> 40	C	163.9	37.7
TCCX 250-W	2.50	11	1.92 x 1.44	2.28 x 1.71	2.56 x 1.92	2.85 x 2.15	3.38 x 2.83	132.3	20	0.04 (0.06)	0.05 (0.10)	0.3	> 40	C	163.9	37.7
TCCX 350-G	3.50	11	1.37 x 1.03	1.63 x 1.22	1.83 x 1.37	2.04 x 1.53	2.41 x 2.02	132.3	24	0.04 (0.06)	0.05 (0.10)	0.2	> 30	C	181.5	37.7
TCCX 350-W	3.50	11	1.37 x 1.03	1.63 x 1.22	1.83 x 1.37	2.04 x 1.53	2.41 x 2.02	132.3	24	0.04 (0.06)	0.05 (0.10)	0.2	> 30	C	181.5	37.7

1 Working distance: distance between the front end of the mechanics and the object. Set this distance within +/- 3% of the nominal value for maximum resolution and minimum distortion.
2 Working F-number (wF/#): the real F-number of a lens when used as a macro. Lenses with smaller apertures can be supplied on request.
3 Maximum slope of chief rays inside the lens: when converted to milliradians, it gives the maximum measurement error for any millimeter of object displacement. Typical (average production) values and maximum (guaranteed) values are listed.
4 Percent deviation of the real image compared to an ideal, undistorted image: typical (average production) values and maximum (guaranteed) values are listed.
5 At the borders of the field depth the image can be still used for measurement but, to get a perfectly sharp image, only half of the nominal field depth should be considered. Pixel size used for calculation is 5.5 µm.
6 Measured from the front end of the mechanics to the camera flange.

Ordering information

It's easy to select the right lens for your application: our part numbers are coded as **TCCX xxx-y**, where **xxx** defines the magnification (050 = 0.50, 066 = 0.66, 075 = 0.75, ...) and **y** defines the source color ("-G" stands for "green light", "W" stands for "white light"). For instance, a TCCX 050-G features a 0.50 magnification with a green light source.

TCCXQ series

High resolution telecentric assembly with coaxial illumination

TCCXQ optical assemblies integrate the high optical performances of TC telecentric lenses and the LTCLHP series ability to provide accurate and reliable illumination.

Pairing these two Opto Engineering flagship products results in a system completely free from straylights and back-reflections, while marking superior optical performances (in terms of resolution, telecentricity and distortion) even at the highest magnifications.

This optical layout also minimizes the overall height of the system, while the placement of the camera port allows for easy phase and back-focal adjustments.

TCCXQ assemblies can successfully employed in high accuracy measurement applications as well as Automated Optical Inspection (AOI) setups.

KEY ADVANTAGES

Completely stray-light free
Compatible with both reflective and diffusive surface objects imaging.

High resolution
For sharp edge imaging and small imperfections detection.

Bi-telecentric design
Same degree of measurement accuracy as standard bi-telecentric lenses.

Optimal light collimation
For precise direct light measurement applications.

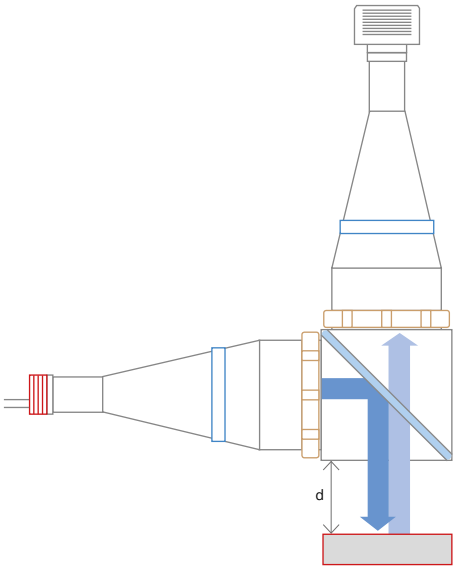
TCCXQ 066-G, formed by TCLWD 066, CMBS 016, LTCLHP 016-G.

FOR OTHER COAXIAL SOLUTIONS SEE ALSO		
	TCCX series	p. 20
	LTCXC series	p. 141

Electrical specifications

	Light	Device power ratings				LED power ratings		
Part number	**Light color, wavelength peak**	**DC voltage**		**Power consumption**	**Max LED fwd current**	**Forward voltage**		**Max pulse current**
		min	max			typ.	max	
		(V)	(V)	(W)	(mA)	(V)	(V)	(mA)
		1			**2**	**3**		**4**
TCCXQ xxx-G	green, 520 nm	12	24	< 2.5	350	3.3	4.00	2000
TCCXQ xxx-W	**white**	12	24	< 2.5	350	2.78	n.a.	2000

1 Tolerance ± 10%.
2 Used in continuous (not pulsed) mode.
3 At max forward current. Tolerance is ±0.06V on forward voltage measurements.
4 At pulse width <= 10 ms, duty cycle <= 10% condition.
Built-in electronics board must be bypassed (see tech info online).



TCCXQ 011-x

			Available colours		Detector type					Optical specifications	Mechanical specifications			
					1/3"	**1/2.5"**	**1/2"**	**1/1.8"**	**2/3" - 5 Mpx**					
Part number	**Mag.**	**Image circle**	**G**	**W**	**w x h**	**w x h**	**w x h**	**w x h**	**w x h**	**Object distance** d	**Mount**	**Length**	**Height**	**Width**
(*)	(x)	Ø (mm)			4.80 x 3.60 (mm x mm)	5.70 x 4.28 (mm x mm)	6.40 x 4.80 (mm x mm)	7.13 x 5.37 (mm x mm)	8.45 x 7.07 (mm x mm)	(mm)		(mm)	(mm)	(mm)
					Object field of view (mm x mm)									
TCCXQ 150-x	1.50	11	x	x	3.20 x 2.40	3.80 x 2.85	4.27 x 3.20	4.75 x 3.58	5.63 x 4.71	82.8	C	155.0	64	198.9
TCCXQ 100-x	1.00	11	x	x	4.80 x 3.60	5.70 x 4.28	6.40 x 4.80	7.13 x 5.37	8.45 x 7.07	82.8	C	155.0	64	182.5
TCCXQ 075-x	0.75	11	x	x	6.40 x 4.80	7.60 x 5.71	8.53 x 6.40	9.51 x 7.16	11.3 x 9.43	82.8	C	155.0	64	213.5
TCCXQ 066-x	0.66	11	x	x	7.27 x 5.45	8.64 x 6.48	9.70 x 7.27	10.8 x 8.10	12.8 x 10.7	82.8	C	155.0	64	207.8
TCCXQ 050-x	0.50	11	x	x	9.60 x 7.20	11.4 x 8.56	12.8 x 9.60	14.3 x 10.7	16.9 x 14.1	82.8	C	155.0	64	189.2
TCCXQ 024-x	0.24	11	x	x	19.8 x 14.8	23.4 x 17.6	26.3 x 19.8	29.3 x 22.1	34.8 x 29.1	20.1	C	235.9	88	252.4
TCCXQ 018-x	0.18	11	x	x	26.1 x 19.6	31.0 x 23.3	34.8 x 26.1	38.8 x 29.2	45.9 x 38.4	37.0	C	285.2	102	303.2
TCCXQ 016-x	0.16	11	x	x	30.6 x 22.9	36.3 x 27.2	40.8 x 30.6	45.4 x 34.2	53.8 x 45.0	50.7	C	319.2	108	336.7
TCCXQ 014-x	0.14	11	x	x	34.8 x 26.1	41.5 x 31.1	46.4 x 34.8	51.7 x 38.9	61.2 x 51.2	63.8	C	350.3	128	367.6
TCCXQ 011-x	0.11	11	x	x	43.6 x 32.7	51.7 x 38.8	58.2 x 43.6	64.8 x 48.8	76.8 x 64.3	90.1	C	415.6	144	433.1

Camera phase adjustment feature is available **upon request**.

(*) The last digit of the part number "-x" defines the source colour.

TCZR series

8x bi-telecentric zoom lenses with motorized control

TCZR series is a leading edge optical solution for imaging and measurement applications requiring both the flexibility of zoom lenses and the accuracy of fixed optics.
By means of a very accurate mechanism, these lenses ensure unequaled magnification, focusing and image center stability when switching from a magnification to another, thus avoiding recalibration at any given time.
Four different magnifications, featuring a total range of 8x, can be selected either by means of the onboard control keyboard or via computer through a specific remote control software.
Bi-telecentricity, high resolution and low distortion make these zooms able to perform the same measurement tasks as a fixed magnification telecentric lens.

FOR OTHER MULTI-MAGNIFICATION OPTICS SEE ALSO		
	MCZR series	p. 76
FULL RANGE OF COMPATIBLE ILLUMINATORS		
	Backlights LTBP, LTBC, LTBFC	p. 132-138
FULL RANGE OF COMPATIBLE ACCESSORIES		
	CMHO TCZR	p. 162

MANUAL AND SETUP

Please refer to our website for the updated TCZR manual and for a complete technical documentation of the setup process.
www.opto-engineering.com

KEY ADVANTAGES

Perfect magnification constancy
No need of re-calibration, after zooming.

Perfect parfocality
No need of refocusing when changing magnification.

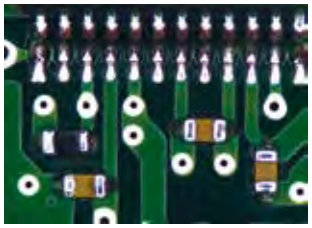
Bi-telecentricity
Very accurate measurement is possible.

Excellent image center stability
Each magnification maintains its FOV center.

Full motorization control
Zoom magnification can be set either manually or via software.

TCZR series can be coupled with LTCLHP and LTRN series illuminators and CMHO TCZR precision clamp.

Application examples



Electronic board images taken with TCZR 036 at four different magnifications.

Hard disk arm images taken with TCZR 072 at four different magnifications.

			Detector type					Optical specifications						Dimensions		
Part number	Mag. (x)	Image circle Ø (mm)	1/3" w x h 4.80 x 3.60 (mm x mm)	1/2.5" w x h 5.70 x 4.28 (mm x mm)	1/2" w x h 6.40 x 4.80 (mm x mm)	1/1.8" w x h 7.13 x 5.37 (mm x mm)	2/3" - 5 Mpx w x h 8.45 x 7.07 (mm x mm)	WD (mm)	wF/# 1	Telecentricity (deg) 2	Distortion (%)	Field depth (mm) 3	CTF @70lp/mm (%)	Mount	Length (mm)	Diam. (mm)
			Object field of view (mm x mm)													
TCZR 036	0.250	11.0	19.2 x 14.4	22.8 x 17.1	25.6 x 19.2	28.5 x 21.5	33.7 x 28.2	74.0	16	< 0.05	< 0.05	11	> 40	C	212.0	56
	0.500		9.60 x 7.20	11.4 x 8.50	12.8 x 9.60	14.2 x 10.7	16.8 x 14.1				< 0.04	2.8	> 35			
	1.000		4.80 x 3.60	5.70 x 4.20	6.40 x 4.80	7.10 x 5.30	8.40 x 7.00				< 0.04	0.7	> 40			
	2.000		2.40 x 1.80	2.80 x 2.10	3.20 x 2.40	3.50 x 2.60	4.20 x 3.50				< 0.08	0.2	> 35			
TCZR 072	0.125	11.0	38.4 x 28.8	45.6 x 34.2	51.2 x 38.4	57.0 x 49.0	67.6 x 56.5	157.8	16	< 0.05	< 0.10	45	> 35	C	279.7	99
	0.250		19.2 x 14.4	22.8 x 17.1	25.6 x 19.2	28.5 x 21.5	33.7 x 28.2				< 0.08	11	> 40			
	0.500		9.60 x 7.20	11.4 x 8.50	12.8 x 9.60	14.2 x 10.7	16.8 x 14.1				< 0.05	2.8	> 40			
	1.000		4.80 x 3.60	5.70 x 4.20	6.40 x 4.80	7.10 x 5.30	8.40 x 7.00				< 0.07	0.7	> 35			

1 Working F-number (wF/#): the real F-number of a lens when used as a macro. Lenses with smaller apertures can be supplied on request.

2 Maximum slope of principal rays inside the lens: converted in milliradians, it gives the maximum measurement error for any millimeter of object displacement.

3 At the borders of the field depth, the image can be still used for measurement, but to get a perfectly sharp image only half of the nominal field depth should be considered. Pixel size used for calculation is 3.9 µm.

TCBENCH series

TC optical bench kits for easy measurements

KEY ADVANTAGES

Pre-assembled setup
Just attach your camera, and the bench is ready for measurement.

Best optical performances
The bench is pre-set to provide unpaired measurement accuracy.

Tested system
The bench is quality tested as a whole system.

SEE ALSO
TCBENCH CORE series p. 27
FULL RANGE OF COMPATIBLE ACCESSORIES
Optical filters p. 174

TCBENCH series are complete optical systems designed for hassle-free development of demanding measurement applications.

Each kit integrates:
- 1 TC bi-telecentric lens for 2/3" detectors
- 1 LTCLHP telecentric illuminator (green)
- 2 CMHO mechanical clamps
- 1 CMPT base-plate
- 1 PTTC chrome-on-glass calibration pattern
- 1 CMPH pattern holder

The benches come ready to be used, pre-assembled and pre-aligned to assure the best accuracy that a telecentric measurement system can deliver.

The collimated light source is set in order to optimize both illumination homogeneity and relevant optical parameters: distortion, telecentricity and resolution.
Coupling a LTCLHP illuminator with a telecentric lens increases the natural field depth of the lens; this is particularly true for 2/3" detector lenses where the acceptance angle of ray bundles is much larger than the divergence of the collimating source.
For this reason these benches feature unmatched image resolution and field depth.

Opto Engineering measures the optical performances of each TCBENCH and provides an individual test report. TCBENCH also benefits from a special price policy, combining high-end performances with cost effectiveness.

			Detector type					Optical specifications					Dimensions				
Part number	Mag. (x)	Image circle Ø (mm)	1/3'' w x h 4.80 x 3.60 (mm x mm)	1/2.5'' w x h 5.70 x 4.28 (mm x mm)	1/2'' w x h 6.40 x 4.80 (mm x mm)	1/1.8'' w x h 7.13 x 5.37 (mm x mm)	2/3''- 5 Mpx w x h 8.45 x 7.07 (mm x mm)	WD (mm) 1	Optical Accuracy (µm) 2	Optical Accuracy (%) 3	Field Depth (mm)	CTF @70lp/mm (%)	Mount	Length (mm)	Width (mm)	Height (mm)	Weight (g)
			Field of view (mm x mm)														
TCBENCH 009	1.000	11.0	4.80 x 3.60	5.70 x 4.28	6.40 x 4.80	7.13 x 5.37	8.44 x 7.06	62.2	< 5	< 0.06%	1.2	> 35	C	282.0	56.0	78.5	900
TCBENCH 016	0.528	11.0	9.09 x 6.82	10.8 x 8.10	12.1 x 9.09	13.5 x 10.2	16.0 x 13.4	43.1	< 8	< 0.05%	2.9	> 40	C	297.0	65.5	81.2	1200
TCBENCH 024	0.350	11.0	13.7 x 10.3	16.3 x 12.2	18.3 x 13.7	20.4 x 15.3	24.1 x 20.2	67.2	< 13	< 0.05%	7.0	> 55	C	391.0	65.5	78.5	1340
TCBENCH 036	0.243	11.0	19.7 x 14.8	23.4 x 17.6	26.3 x 19.7	29.3 x 22.1	34.7 x 29.0	102.5	< 22	< 0.06%	14	> 50	C	529.0	103.0	140.5	4150
TCBENCH 048	0.184	11.0	26.1 x 19.6	31.0 x 23.3	34.8 x 26.1	38.8 x 29.2	46.0 x 38.4	132.9	< 31	< 0.06%	24	> 50	C	636.0	117.0	147.5	5600
TCBENCH 056	0.157	11.0	30.6 x 22.9	36.3 x 27.2	40.7 x 30.6	45.4 x 34.2	53.8 x 45.0	157.8	< 36	< 0.06%	33	> 55	C	701.0	122.0	150.0	7300
TCBENCH 064	0.138	11.0	34.9 x 26.2	41.5 x 31.1	46.6 x 34.9	51.9 x 39.1	61.4 x 51.4	181.8	< 40	< 0.06%	43	> 65	C	845.0	143.0	160.5	8700
TCBENCH 080	0.110	11.0	43.5 x 32.6	51.7 x 38.8	58.0 x 43.5	64.6 x 48.7	76.5 x 64.0	226.7	< 55	< 0.07%	67	> 55	C	915.0	158.0	168.0	11100
TCBENCH 096	0.093	11.0	51.4 x 38.5	61.0 x 45.8	68.5 x 51.4	76.3 x 57.5	90.4 x 75.6	278.6	< 70	< 0.07%	94	> 50	C	1053.0	206.5	185.0	15300

Camera phase adjustment feature is available **upon request**.

1 Working distance: distance between the front end of the lens mechanics and the object. Set this distance within +/- 3% of the nominal value for maximum resolution.

2,3 Maximum measurement error without software calibration; standard image correction libraries yield close to zero measurement error.

TCBENCH CORE series

Ultra compact TCCORE optical bench for precision measurements

VISION TOP INNOVATION 2016

NEW

INTERNATIONAL PATENT PENDING

KEY ADVANTAGES

Multi-level cost cutting
Saves money on manufacturing and transportation costs.

Downsized vision system
Allows to reduce the length of your measurement system.

Pre-assembled setup
Just add a camera and a measurement software and you're ready to go.

Best optical performances in a super tight space
A complete optical system designed for hassle free development of demanding precision measurement applications.

TCBENCH CORE series are complete optical systems offering superior performances needed for highly demanding measurement applications in a super compact assembly.

The benches come pre-mounted and pre-aligned, ensuring the best accuracy that a telecentric measurement system can deliver.

Each TCBENCH CORE integrates:
- 1 TC CORE bi-telecentric lens for 2/3" sensors
- 1 LTCLHP CORE telecentric illuminator (green)
- 1 CMPTCR base plate

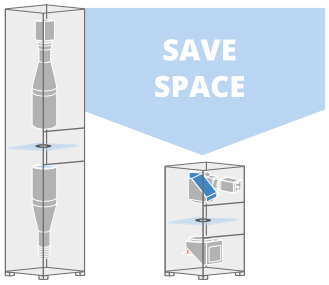
TCBENCH CORE systems deliver the same optical performances as our TCBENCH systems in a very reduced space.

FULL RANGE OF COMPATIBLE ACCESSORIES

Optical filters p. 174

Non-contact measurement machine example

Technical specs		Standard components	TCBENCH CORE	Comparison
Camera sensor	(mm)	8.45 x 7.07	8.45 x 7.07	
FOV	(mm)	90.4 x 75.6	90.4 x 75.6	High-end performances of both systems
Field depth	(mm)	94	94	
CTF 70 lp/mm	(%)	> 50	> 50	
Height	(m)	1.65	0.77	54% volume difference
Length	(m)	0.45	0.45	
Width	(m)	0.41	0.41	
Volume	(m^3)	0.30	0.14	



Example of off-line measurement systems with "classic" telecentric lens and illuminator (left) and TCBENCH CORE (right).

Part number	Mag. (x)	Image circle Ø (mm)	Detector type: 1/3" w x h 4.80 x 3.60 (mm x mm)	1/2.5" w x h 5.70 x 4.28 (mm x mm)	1/2" w x h 6.40 x 4.80 (mm x mm)	1/1.8" w x h 7.13 x 5.37 (mm x mm)	2/3" - 5 Mpx w x h 8.45 x 7.07 (mm x mm)	Optical specs: WD (mm) 1	Field Depth (mm) 2	CTF @70lp/mm (%)	Dimensions: Mount	Length (mm)	Width (mm)	Height (mm)	Weight (g)
			Field of view (mm x mm)												
TCCRBENCH 048	0.184	11.0	26.1 x 19.6	31.0 x 23.3	34.8 x 26.1	38.8 x 29.2	46.0 x 38.4	132.9	24	> 50	C	352	134	118	3849
TCCRBENCH 056	0.157	11.0	30.6 x 22.9	36.3 x 27.2	40.7 x 30.6	45.4 x 34.2	53.8 x 45.0	157.8	33	> 55	C	424	144	122	5392
TCCRBENCH 064	0.138	11.0	34.9 x 26.2	41.5 x 31.1	46.6 x 34.9	51.9 x 39.1	61.4 x 51.4	181.8	43	> 65	C	474	152	134	6260
TCCRBENCH 080	0.110	11.0	43.5 x 32.6	51.7 x 38.8	58.0 x 43.5	64.6 x 48.7	76.5 x 64.0	226.7	67	> 55	C	578	182	162	10965
TCCRBENCH 096	0.093	11.0	51.4 x 38.5	61.0 x 45.8	68.5 x 51.4	76.3 x 57.5	90.4 x 75.6	278.6	94	> 50	C	696	200	189	15207

1 Working distance: distance between the front end of the lens mechanics and the object. Set this distance within +/- 3% of the nominal value for maximum resolution and minimum distortion.

2 At the borders of the field depth the image can be still used for measurement but, to get a perfectly sharp image, only half of the nominal field depth should be considered. Pixel size used for calculation is 5.5 µm.

TCKIT case

Telecentric optics selection for machine vision labs

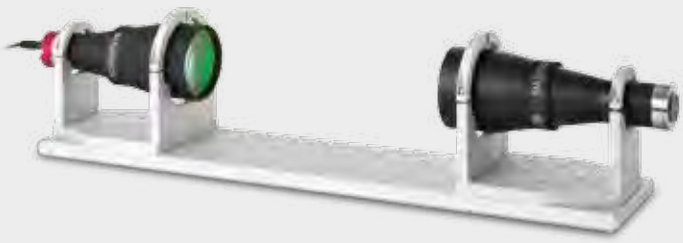
The **Opto Engineering TCKIT case** includes a selection of some of the most commonly used telecentric optics in measurement applications.
A kit of four C-mount telecentric lenses covers FOVs ranging from 9 mm to 64 mm, offering good coverage of many measurement applications. These lenses are suitable for detectors up to 2/3", so that most cameras can be used in combination with this set of optics. In addition, a LTCLHP 036-G collimated light source (green color) is included in the box; this illuminator can be coupled with the three smaller telecentric lenses in order to demonstrate the several benefits of collimated illumination.
The telecentric kit case is a very helpful tool for system integrators and research centers that are frequently dealing with new machine vision applications.
The TCKIT case also benefits from our special educational price: you should seriously consider to buy this kit for your laboratory and discover the advantages of bi-telecentric optics!

Part number	Products included	Description
TCKIT	TC 23 064	Bi-telecentric lens for 2/3", 64 x 48 mm FOV
	TC 23 036	Bi-telecentric lens for 2/3", 36 x 27 mm FOV
	TC 23 016	Bi-telecentric lens for 2/3", 16 x 12 mm FOV
	TC 23 009	Bi-telecentric lens for 2/3", 8.8 x 6.6 mm FOV
	LTCLHP 036-G	Telecentric HP illuminator, beam diameter 45 mm, green

TCEDGEVIS

Telecentric system for defect detection on flat transparent materials

NEW

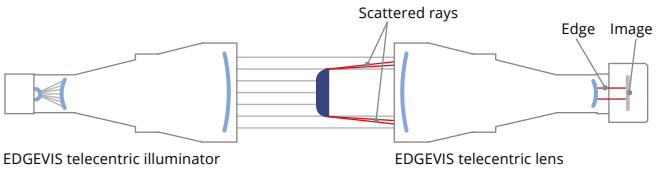


KEY ADVANTAGES

Revolutionary method for inspecting flat transparent surfaces (clear glass, plastic films) and for OCR/OCV applications:

- **Extreme contrast**
- **Even the smallest defects can be seen**
- **Supplied as a ready-to-use optical bench**

TCEDGEVIS telecentric optical systems provide a truly revolutionary approach to the inspection of flat transparent materials.
The special optical design ensures that only the light rays deflected by an object's edge are imaged on the sensor: edges are automatically extracted without the need of software algorithms. This technique allows the detection of extremely tiny defects, particles and surface discontinuities that would be impossible to see with traditional lens systems. This approach is also suitable for OCR/OCV applications on clear glass, plastic films etc.
TCEDGEVIS optical systems include an EDGE telecentric lens, EDGE telecentric illuminator and mounting mechanics and are supplied as fully tested and pre-aligned optical benches.

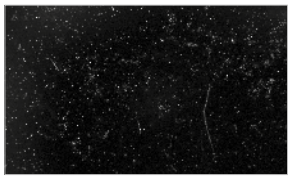


Working principle: when light rays encounter an object they get scattered from its edges. The TCEDGEVIS optical system filters these rays to form an image of the object's profile with much higher contrast than traditional optical methods.

Display inspection:

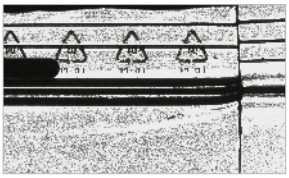
Detection of tiny scratches, bubbles and inclusions on smartphone glass screen.

Particle analysis:



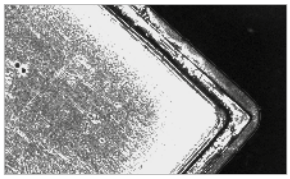
Checking dust deposits on a glass surface.

Packaging:



Seal integrity inspection at the highest contrast.

Packaging:



Seal quality inspection on transparent plastics and soldering joint.

OCR and OCV:

Transparent text on clear plastic surface.

Part number	Mag.	Image circle	Detector type: 1/3'' w x h 4.80 x 3.60	1/2.5'' w x h 5.70 x 4.28	1/2'' w x h 6.40 x 4.80	1/1.8'' w x h 7.13 x 5.37	2/3'' - 5 Mpx w x h 8.45 x 7.07	Optical specifications: WD	Light color, peak wavelength	Dimensions: Mount	Length	Width	Height
	(x)	Ø (mm)	Object field of view (mm x mm)					(mm) [1]	(nm)		(mm)	(mm)	(mm)
TCEV 23 036-G	0.243	11.0	19.7 x 14.8	23.4 x 17.6	26.3 x 19.7	29.3 x 22.1	34.7 x 29.0	102.5	green, 520	C	549	103.0	140.5
TCEV 23 048-G	0.184	11.0	26.1 x 19.6	31.0 x 23.3	34.8 x 26.1	38.8 x 29.2	46.0 x 38.4	132.9	green, 520	C	657	117.0	147.5
TCEV 23 056-G	0.157	11.0	30.6 x 22.9	36.3 x 27.2	40.7 x 30.6	45.4 x 34.2	53.8 x 45.0	157.8	green, 520	C	715	122.0	150.0
TCEV 23 064-G	0.138	11.0	34.9 x 26.2	41.5 x 31.1	46.6 x 34.9	51.9 x 39.1	61.4 x 51.4	181.8	green, 520	C	848	143.0	160.5
TCEV 23 080-G	0.110	11.0	43.5 x 32.6	51.7 x 38.8	58.0 x 43.5	64.6 x 48.7	76.5 x 64.0	226.7	green, 520	C	936	158.0	168.0
TCEV 23 096-G	0.093	11.0	51.4 x 38.5	61.0 x 45.8	68.5 x 51.4	76.3 x 57.5	90.4 x 75.6	278.6	green, 520	C	1087	206.5	185.0

1 Working distance: distance between the front end of the lens mechanics and the object.
Set this distance within +/- 3% of the nominal value for maximum resolution and minimum distortion.

TCHM series

High magnification telecentric lenses for detectors up to 2/3"

Part number	Mag.	Image circle	Max detector size	Detector type: 1/3" w x h 4.80 x 3.60 (mm x mm)	1/2.5" w x h 5.70 x 4.28 (mm x mm)	1/2" w x h 6.4 x 4.8 (mm x mm)	1/1.8" w x h 7.13 x 5.37 (mm x mm)	2/3" - 5 MP w x h 8.45 x 7.07 (mm)	Optical specifications: WD	wF/# [1]	Distortion	Field depth	Nominal resolving power	Mechanical specs: Mount	Length	Diam.
	(x)	Ø (mm)		Object field of view (mm x mm)					(mm)		(%)	(mm)	(µm)		(mm)	(mm)
Working distance (WD) 71 mm																
RT-HR-6M-71	6.00	11	2/3"	0.8 x 0.6	1.0 x 0.7	1.1 x 0.8	1.2 x 0.9	1.4 x 1.2	71.00	41.1	0.27	0.10	4.60	C	108	18
RT-HR-4M-71	4.00	11	2/3"	1.2 x 0.9	1.4 x 1.1	1.6 x 1.2	1.8 x 1.3	2.1 x 1.8	71.00	29	0.24	0.10	4.90	C	100	18
RT-HR-2M-71	2.00	11	2/3"	2.4 x 1.8	2.9 x 2.1	3.2 x 2.4	3.6 x 2.7	4.2 x 3.5	71.00	18.5	0.21	0.30	6.20	C	97	18
RT-HR-1M-71	1.00	11	2/3"	4.8 x 3.6	5.7 x 4.3	6.4 x 4.8	7.1 x 5.4	8.5 x 7.1	71.00	15.6	0	0.90	10.50	C	116	18
Working distance (WD) 110 mm																
RT-HR-6M-110	6.00	11	2/3"	0.8 x 0.6	1.0 x 0.7	1.1 x 0.8	1.2 x 0.9	1.4 x 1.2	110.00	55.6	0.25	0.20	6.20	C	114	18
RT-HR-4M-110	4.00	11	2/3"	1.2 x 0.9	1.4 x 1.1	1.6 x 1.2	1.8 x 1.3	2.1 x 1.8	110.00	39.2	0.54	0.20	6.60	C	95	18
RT-HR-2M-110	2.00	11	2/3"	2.4 x 1.8	2.9 x 2.1	3.2 x 2.4	3.6 x 2.7	4.2 x 3.5	110.00	23.8	0.78	0.40	8.00	C	87	18
RT-HR-1M-110	1.00	11	2/3"	4.8 x 3.6	5.7 x 4.3	6.4 x 4.8	7.1 x 5.4	8.5 x 7.1	110.00	6.7	0.04	1.00	11.20	C	125	18

1 Working F-number (wF/#): the real F-number of a lens when used as a macro.

TELECENTRIC LENSES | 1/3" TO 2/3" SENSORS

TCVLWD series

Very long working distance (WD) telecentric lenses for detectors up to 1/1.8"

Part number	Mag.	Image circle	Max detector size	Detector type: 1/3" w x h 4.80 x 3.60 (mm x mm)	1/2.5" w x h 5.70 x 4.28 (mm x mm)	1/2" w x h 6.4 x 4.8 (mm x mm)	1/1.8" w x h 7.13 x 5.37 (mm x mm)	Optical specifications: WD	wF/# [1]	Distortion	Field depth	Nominal resolving power	Mechanical specs: Mount	Length	Diam.
	(x)	Ø (mm)		Object field of view (mm x mm)				(mm)		(%)	(mm)	(µm)		(mm)	(mm)
RT-TV-1M-150	1.00	8.0	1/2"	4.8 x 3.6	5.7 x 4.3	6.4 x 4.8	-	156.00	16.7	0.15	1.00	12.00	C	159.0	24
RT-TV-2M-150	2.00	8.0	1/2"	2.4 x 1.8	2.9 x 2.1	3.2 x 2.4	-	156.00	25.0	0.07	0.44	9.00	C	168.0	24
RT-TV-3M-150	3.00	8.0	1/2"	1.6 x 1.2	1.9 x 1.4	2.1 x 1.6	-	156.00	37.5	0.05	0.34	9.00	C	171.8	24
RT-TV-1M-220	1.00	8.0	1/2"	4.8 x 3.6	5.7 x 4.3	6.4 x 4.8	-	218.20	20.0	0.10	1.24	14.00	C	218.0	27
RT-TV-2M-220	2.00	8.0	1/2"	2.4 x 1.8	2.9 x 2.1	3.2 x 2.4	-	218.20	33.0	0.10	0.67	11.00	C	227.0	27
RT-TV-3M-220	3.00	8.0	1/2"	1.6 x 1.2	1.9 x 1.4	2.1 x 1.6	-	218.20	43.0	0.10	0.41	9.60	C	230.8	27
RT-TV-1M-290	1.00	8.0	1/2"	4.8 x 3.6	5.7 x 4.3	6.4 x 4.8	-	290.70	20.0	0.10	1.24	13.00	C	203.7	27
RT-TV-2M-290	2.00	8.0	1/2"	2.4 x 1.8	2.9 x 2.1	3.2 x 2.4	-	290.70	33.0	0.10	0.67	11.00	C	212.7	27
RT-TV-3M-290	3.00	8.0	1/2"	1.6 x 1.2	1.9 x 1.4	2.1 x 1.6	-	290.70	43.0	0.10	0.41	9.60	C	216.5	27
RT-TV-05M-400	0.50	8.0	1/2"	9.6 x 7.2	11.4 x 8.6	12.8 x 9.6	-	400.00	13.9	0.35	3.07	18.60	C	149.6	34
RT-TV-1M-400	1.00	8.9	1/1.8"	4.8 x 3.6	5.7 x 4.3	6.4 x 4.8	7.1 x 5.4	400.00	25.0	0.30	1.69	16.80	C	166.2	34
RT-TV-2M-400	2.00	8.9	1/1.8"	2.4 x 1.8	2.9 x 2.1	3.2 x 2.4	3.6 x 2.7	400.00	33.3	0.07	0.64	11.20	C	176.5	34
RT-TV-05M-800	0.50	8.9	1/1.8"	9.6 x 7.2	11.4 x 8.6	12.8 x 9.6	14.3 x 10.7	800.00	16.7	0.04	3.89	22.40	C	279.6	58
RT-TV-1M-800	1.00	8.9	1/1.8"	4.8 x 3.6	5.7 x 4.3	6.4 x 4.8	7.1 x 5.4	800.00	20.0	0.09	1.24	13.40	C	296.7	58

1 Working F-number (wF/#): the real F-number of a lens when used as a macro.

TCCXHM series

High magnification telecentric lenses with built-in coaxial illumination for detectors up to 2/3"

Part number	Mag.	Image circle	Max detector size	Detector type: 1/3” w x h 4.80 x 3.60 (mm x mm)	1/2.5” w x h 5.70 x 4.28 (mm x mm)	1/2” w x h 6.4 x 4.8 (mm x mm)	1/1.8” w x h 7.13 x 5.37 (mm x mm)	2/3” - 5 MP w x h 8.45 x 7.07 (mm)	Optical specifications: WD (mm)	wF/# [1]	Distortion (%)	Field depth (mm)	Nominal resolving power (µm)	Mechanical specs: Mount	Length (mm)	Diam. (mm)
	(x)	Ø (mm)		Object field of view (mm x mm)												
Working distance (WD) 71 mm																
RT-HR-6F-71	6.00	11	2/3”	0.8 x 0.6	1.0 x 0.7	1.1 x 0.8	1.2 x 0.9	1.4 x 1.2	71.00	41.1	0.27	0.10	4.60	C	107.9	18
RT-HR-4F-71	4.00	11	2/3”	1.2 x 0.9	1.4 x 1.1	1.6 x 1.2	1.8 x 1.3	2.1 x 1.8	71.00	29.0	0.24	0.13	4.90	C	100.0	18
RT-HR-2F-71	2.00	11	2/3”	2.4 x 1.8	2.9 x 2.1	3.2 x 2.4	3.6 x 2.7	4.2 x 3.5	71.00	18.5	0.21	0.30	6.20	C	97.0	18
RT-HR-1F-71	1.00	11	2/3”	4.8 x 3.6	5.7 x 4.3	6.4 x 4.8	7.1 x 5.4	8.5 x 7.1	71.00	15.6	0	0.90	10.50	C	116.1	18
Working distance (WD) 110 mm																
RT-HR-6F-110	6.00	11	2/3”	0.8 x 0.6	1.0 x 0.7	1.1 x 0.8	1.2 x 0.9	1.4 x 1.2	110.00	55.6	0.25	0.16	6.20	C	114.2	18
RT-HR-4F-110	4.00	11	2/3”	1.2 x 0.9	1.4 x 1.1	1.6 x 1.2	1.8 x 1.3	2.1 x 1.8	110.00	39.2	0.54	0.20	6.60	C	94.6	18
RT-HR-2F-110	2.00	11	2/3”	2.4 x 1.8	2.9 x 2.1	3.2 x 2.4	3.6 x 2.7	4.2 x 3.5	110.00	23.8	0.78	0.40	8.00	C	87.4	18
RT-HR-1F-110	1.00	11	2/3”	4.8 x 3.6	5.7 x 4.3	6.4 x 4.8	7.1 x 5.4	8.5 x 7.1	110.00	6.7	0.04	1.00	11.20	C	125.2	18

1 Working F-number (wF/#): the real F-number of a lens when used as a macro.

FULL RANGE OF COMPATIBLE LED SOURCES

LDSC series p. 187

TCCXLM series

Telecentric lenses with built-in coaxial illumination for detectors up to 2/3”

Part number	Mag.	Image circle	Max detector size	Detector type: 1/3” w x h 4.80 x 3.60 (mm x mm)	1/2.5” w x h 5.70 x 4.28 (mm x mm)	1/2” w x h 6.4 x 4.8 (mm x mm)	1/1.8” w x h 7.13 x 5.37 (mm x mm)	2/3” - 5 MP w x h 8.45 x 7.07 (mm)	Optical specifications: WD (mm)	wF/#	Distortion (%)	Field depth (mm)	Nominal resolving power (µm)	Mechanical specs: Mount	Length (mm)	Diam. (mm)
	(x)	Ø (mm)		Object field of view (mm x mm)												
RT-TCL0400-F	0.40	11	2/3"	12.0 x 9.0	14.3 x 10.7	16.0 x 12.0	17.8 x 13.4	21.1 x 17.7	78.50	8 - 40	-0.02	2.10	15.00	C	187.5	44
RT-TCL0300-F	0.30	11	2/3"	16.0 x 12.0	19.0 x 14.3	21.3 x 16.0	23.8 x 17.9	28.2 x 23.6	108.20	8 - 40	0.01	3.70	20.00	C	224.4	49
RT-TCL0200-F	0.20	11	2/3"	24.0 x 18.0	28.5 x 21.4	32.0 x 24.0	35.7 x 26.9	42.3 x 35.4	167.00	8 40	0.01	8.40	31.00	C	297.2	68

FULL RANGE OF COMPATIBLE LED SOURCES

LDSC series p. 187

TC2MHR-TC4MHR series

High-resolution telecentric lenses for large detectors up to 4/3"

TC2MHR and TC4MHR series are high resolution telecentric lenses designed for detectors larger than 2/3": TC2MHR lenses cover up to 1" detectors (16 mm diagonal) while TC4MHR lenses cover up to 21.5 mm detector diagonal (e.g. suitable for 4/3" detectors), making them the perfect choice for advanced metrology applications.

The re-designed TC2MHR-4MHR series outperforms the previous version featuring unmatched resolution, low distortion and homogeneous image quality while offering the best performance to price ratio.

TC2MHR-4MHR feature a compact and robust design that allows easy integration in industrial environments and additionally feature phase adjustment by simply loosening the set screws positioned in the eyepiece part.

In order to help the selection, some of the most commonly used large matrix detectors are listed: select the product that best suits your application by choosing the column where the your detector is listed and scrolling down the table until you find the field of view best matching your needs.

KEY ADVANTAGES

Wide image circle for detectors larger than 2/3".

Excellent resolution and low distortion.

Simple and robust design for industrial environments.

Detailed **test report** with **measured** optical parameters.

C, F and M42X1 (-E) **mount options** with easy phase adjustment.

FOR COAXIAL TELECENTRIC LENSES UP TO 1" DETECTORS SEE ALSO		
	TCCX2M	p. 42
FULL RANGE OF COMPATIBLE ILLUMINATORS		
	Backlights LTBP, LTBC, LTBFC	p. 132-138
FULL RANGE OF COMPATIBLE ACCESSORIES		
	CMMR series	p. 168

Mount C

Mount E = M42x1

Mount F

			Detector type				Optical specifications						Dimensions					
				1"	1.2"	4/3"												
Part number	Mag.	Image circle	KAI 2020 14.8 mm diag. w x h	KAI-04050 16 mm diag. w x h	KAI-4022/4021 21.5 mm diag. w x h	KAI-08050 22.6 mm diag. w x h	WD	wF/#	Telecentricity typical (max)	Distortion typical (max)	Field depth	CTF @50lp/mm	Length			Diam.		
	(x)	Ø (mm)	11.84 x 8.88 (mm x mm)	12.8 x 9.64 (mm x mm)	15.2 x 15.2 (mm x mm)	18.1 x 13.6 (mm x mm) 7	(mm) 1	2	(deg) 3	(%) 4	(mm) 5	(%)	(mm) 6			(mm)		
TC2MHR lenses			Object field of view (mm x mm) 8										C	E	F	C	E	F
TC2MHR 016-x	0.767	16.6	15.4 x 11.6	16.7 x 12.5	Ø = 19.8	Ø = 17.7	43.8	16	< 0.08 (0.10)	< 0.04 (0.10)	2.0	> 30	145.5	147.0	116.5	45	52	64
TC2MHR 024-x	0.508	16.9	23.3 x 17.5	25.2 x 18.9	Ø = 29.9	Ø = 26.8	67.2	16	< 0.08 (0.10)	< 0.04 (0.10)	4.6	> 40	170.4	171.9	141.4	45	52	64
TC2MHR 036-x	0.353	16.7	33.5 x 25.2	36.3 x 27.2	Ø = 43.1	Ø = 38.5	102.6	16	< 0.08 (0.10)	< 0.08 (0.10)	10	> 30	197.7	199.2	168.7	61	61	64
TC2MHR 048-x	0.268	16.9	44.2 x 33.1	47.8 x 35.8	Ø = 56.7	Ø = 50.7	133.4	16	< 0.08 (0.10)	< 0.08 (0.10)	17	> 30	232.8	234.3	203.8	75	75	75
TC2MHR 056-x	0.228	16.8	51.9 x 38.9	56.1 x 42.1	Ø = 66.7	Ø = 59.6	157.8	16	< 0.04 (0.08)	< 0.05(0.10)	23	> 40	257.1	258.7	228.1	80	80	80
TC2MHR 064-x	0.200	16.8	59.3 x 44.5	64.1 x 48.1	Ø = 76.1	Ø = 68.1	181.9	16	< 0.04 (0.08)	< 0.05 (0.10)	30	> 40	278.3	279.8	249.3	100	100	100
TC2MHR 080-x	0.160	16.9	74.0 x 55.5	80.0 x 60.0	Ø = 95.0	Ø = 85.0	226.8	16	< 0.04 (0.08)	< 0.05 (0.10)	46	> 40	324.0	325.5	295.0	116	116	116
TC2MHR 096-x	0.137	16.9	86.6 x 65.0	93.6 x 70.2	Ø = 111.2	Ø = 99.5	278.6	16	< 0.05 (0.10)	< 0.07 (0.10)	64	> 40	396.4	397.9	367.4	143	143	143
TC2MHR 120-x	0.104	16.5	113.8 x 85.4	123.1 x 92.3	Ø = 146.2	Ø = 130.8	334.6	16	< 0.07 (0.10)	< 0.07 (0.10)	110	> 40	451.4	452.9	422.4	180	180	180
TC2MHR 144-x	0.089	16.8	133.5 x 100.1	144.3 x 108.2	Ø = 171.4	Ø = 153.3	396.0	16	< 0.05 (0.10)	< 0.05 (0.10)	151	> 40	510.8	512.4	481.8	200	200	200
TC2MHR 192-x	0.067	16.8	178.0 x 133.5	192.5 x 144.4	Ø = 228.6	Ø = 204.5	527.5	16	< 0.05 (0.10)	< 0.04 (0.10)	268	> 40	649.2	650.8	620.2	260	260	260
TC2MHR 240-x	0.053	16.2	223.8 x 167.9	242.0 x 181.5	Ø = 287.3	Ø = 257.1	492.9	16	< 0.05 (0.10)	< 0.04 (0.10)	424	> 40	812.2	813.7	783.2	322	322	322
TC4MHR lenses																		
TC4M 004-x	4.000	22.0	2.96 x 2.22	3.21 x 2.41	3.79 x 3.79	4.53 x 3.40	57.1	22	< 0.08 (0.10)	< 0.08 (0.10)	0.1	> 30	206.4	n.a.	178.4	45	n.a.	45
TC4M 007-x	2.667	22.0	4.44 x 3.33	4.82 x 3.61	5.69 x 5.69	6.80 x 5.10	61.2	22	< 0.08 (0.10)	< 0.06 (0.10)	0.2	> 30	183.5	n.a.	155.4	45	n.a.	45
TC4M 009-x	2.000	22.0	5.92 x 4.44	6.42 x 4.82	7.57 x 7.57	9.06 x 6.80	63.3	22	< 0.08 (0.10)	< 0.05 (0.10)	0.3	> 30	170.0	n.a.	142.0	45	n.a.	45
TC4MHR 016-x	1.055	21.2	11.2 x 8.4	12.1 x 9.1	14.4 x 14.4	17.2 x 12.9	43.8	16	< 0.08 (0.10)	< 0.04 (0.10)	1.1	> 30	169.6	171.1	140.6	45	52	64
TC4MHR 024-x	0.700	21.6	16.9 x 12.7	18.3 x 13.7	21.7 x 21.7	25.9 x 19.4	67.2	16	< 0.08 (0.10)	< 0.04 (0.10)	2.4	> 30	194.8	196.3	165.8	45	52	64
TC4MHR 036-x	0.486	21.4	24.4 x 18.3	26.3 x 19.7	31.3 x 31.3	37.2 x 28.0	102.6	16	< 0.05 (0.10)	< 0.08 (0.10)	5.0	> 30	222.0	223.6	193.0	61	61	64
TC4MHR 048-x	0.369	21.7	32.1 x 24.1	34.7 x 26.0	41.2 x 41.2	49.1 x 36.9	133.4	16	< 0.08 (0.10)	< 0.08 (0.10)	8.7	> 40	257.1	258.6	228.1	75	75	75
TC4MHR 056-x	0.314	21.6	37.7 x 28.3	40.8 x 30.6	48.4 x 48.4	57.6 x 43.3	157.8	16	< 0.05 (0.10)	< 0.04 (0.10)	12.0	> 40	280.7	282.2	251.7	80	80	80
TC4MHR 064-x	0.275	21.6	43.1 x 32.3	46.6 x 34.9	55.3 x 55.3	65.8 x 49.5	181.9	16	< 0.05 (0.10)	< 0.04 (0.10)	15.7	> 40	301.8	303.4	272.8	100	100	100
TC4MHR 080-x	0.221	21.7	53.7 x 40.3	58.0 x 43.5	68.9 x 68.9	82.0 x 61.7	226.8	16	< 0.05 (0.10)	< 0.04 (0.10)	24.4	> 40	347.6	349.1	318.6	116	116	116
TC4MHR 096-x	0.186	21.6	63.5 x 47.6	68.7 x 51.5	81.6 x 81.6	97.1 x 73.0	278.6	16	< 0.05 (0.10)	< 0.04 (0.10)	34.2	> 35	392.8	394.3	363.8	143	143	143
TC4MHR 120-x	0.143	21.2	82.6 x 62.0	89.3 x 67.0	106.1 x 106.1	126.3 x 94.9	334.6	16	< 0.05 (0.10)	< 0.04 (0.10)	57.8	> 30	475.2	476.7	446.2	180	180	180
TC4MHR 144-x	0.122	21.6	96.9 x 72.7	104.7 x 78.6	124.4 x 124.4	148.1 x 111.3	396.0	16	< 0.05 (0.10)	< 0.04 (0.10)	79.5	> 30	537.7	539.2	508.7	200	200	200
TC4MHR 192-x	0.092	21.6	129.4 x 97.0	139.9 x 104.9	166.1 x 166.1	197.8 x 148.6	527.6	16	< 0.05 (0.10)	< 0.04 (0.10)	141.8	> 30	679.1	680.7	650.1	260	260	260
TC4MHR 240-x	0.073	21.1	161.7 x 121.3	174.9 x 131.1	207.7 x 207.7	247.3 x 185.8	492.9	16	< 0.05 (0.10)	< 0.05 (0.10)	221.5	> 30	827.3	828.8	798.3	322	322	322

1 Working distance: distance between the front end of the mechanics and the object. Set this distance within +/- 3% of the nominal value for maximum resolution and minimum distortion.
2 Working F-number (wF/#): the real F-number of a lens when used as a macro. Lenses with smaller apertures can be supplied on request.
3 Maximum slope of chief rays inside the lens: when converted to milliradians, it gives the maximum measurement error for any millimeter of object displacement. Typical (average production) values and maximum (guaranteed) values are listed.
4 Percent deviation of the real image compared to an ideal, undistorted image: typical (average production) values and maximum (guaranteed) values are listed.
5 At the borders of the field depth the image can be still used for measurement but, to get a perfectly sharp image, only half of the nominal field depth should be considered. Pixel size used for calculation is 5 µm.
6 Measured from the front end of the mechanics to the camera flange.
7 With KAI-08050 (22,6 mm diagonal) detectors, the FOV of TC4MHR yyy lenses may show some vignetting at the image corners.
8 For the fields with the indication "Ø =", the image of a circular object of such diameter is fully inscribed into the detector.

Ordering information

It's easy to select the right lens for your application: our part numbers are coded as **TC2MHR yyy-x** or **TC4MHR yyy-x** where **yyy** refers to the width dimension of the object field of view (FOV) in millimeters and **-x** refers to the mount option:
- **C** for C-mount
- **F** for F-mount
- **E** for M42X1 mount (flange distance FD 16 mm).

E.g. TC4MHR064-F for an F-mount TC 4MHR 064 lens. Customized mounts are also available upon request.

TC2MHR - TC4MHR CORE series

Ultra compact high-resolution telecentric lenses up to 4/3"

NEW

INTERNATIONAL PATENT PENDING

KEY ADVANTAGES

Excellent optical performances
TC2MHR - TC4MHR CORE telecentric lenses deliver excellent optical performances as other comparable Opto Engineering telecentric lenses.

Extremely compact
TC2MHR - TC4MHR CORE lenses are up to 70% smaller than other telecentric lenses on the market.

Designed for flexibility and smart integration
TC2MHR CORE - TC4MHR CORE lenses integrate a camera phase adjustment and can be mounted on multiple sides with or without clamps, allowing to cut the costs.

Save you money
Systems integrating TC2MHR - TC4MHR CORE lenses take much less space, resulting in lower manufacturing, shipping and storage costs.

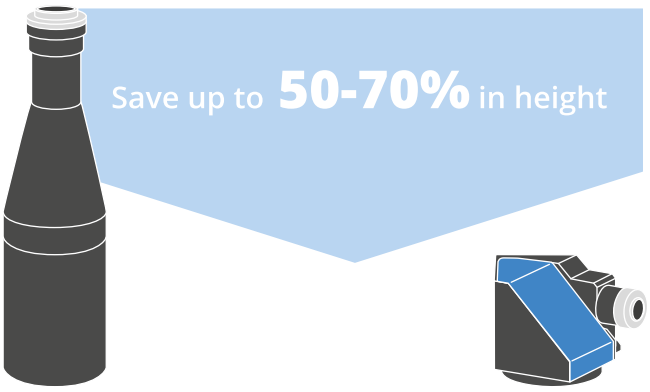
Boost your sales
A smaller vision system or measurement machine is the solution preferred by the industry.

TC2MHR CORE and TC4MHR CORE series are ultra compact telecentric lenses tailored for high-resolution sensors up to 4/3".

TC2MHR CORE and TC4MHR CORE lenses deliver excellent optical performances in a super compact shape. Thanks to the unique opto-mechanical design, these lenses offer very high resolution, nearly zero distortion and high field depth while saving up to 70% in length compared to similar FOV lenses on the market.

TC2MHR CORE and TC4MHR CORE lenses ensure hassle-free integration in a measurement system. The rear phase adjustment allows the user to easily align the camera sensor to the sample.

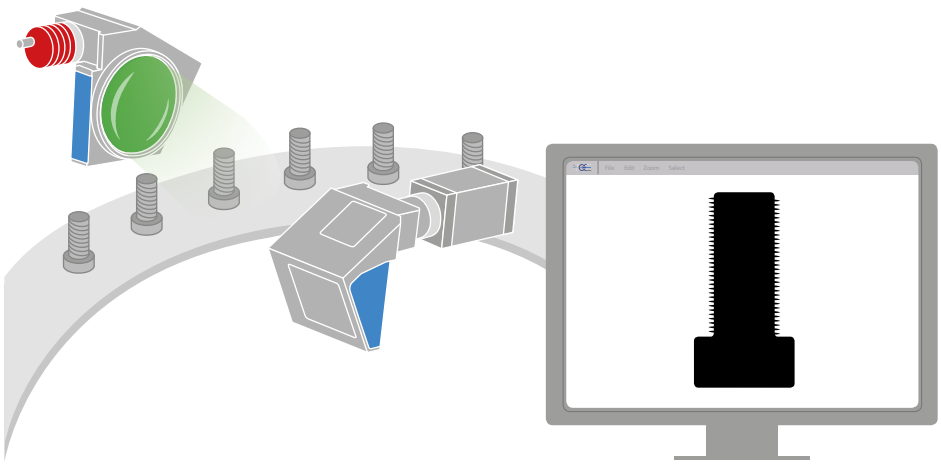
These lenses can be mounted in several orientations thanks to the M6 threads located on multiple sides, even without clamps.
For maximum flexibility, a special front mounting clamp is also available.



Comparison of a "classic" telecentric lens and a TC CORE telecentric lens:
TC CORE lens delivers best optical performances and is extremely compact.

FULL RANGE OF COMPATIBLE ILLUMINATORS		
	LTCLHP CORE series	p. 108
FULL RANGE OF COMPATIBLE ACCESSORIES		
	CMHOCR series	p. 165

Application example



Standard solution
with a 4/3” camera,
TC4MHR CORE lens
and a LTCLHP CORE illuminator.

TC2MHR - TC4MHR CORE series

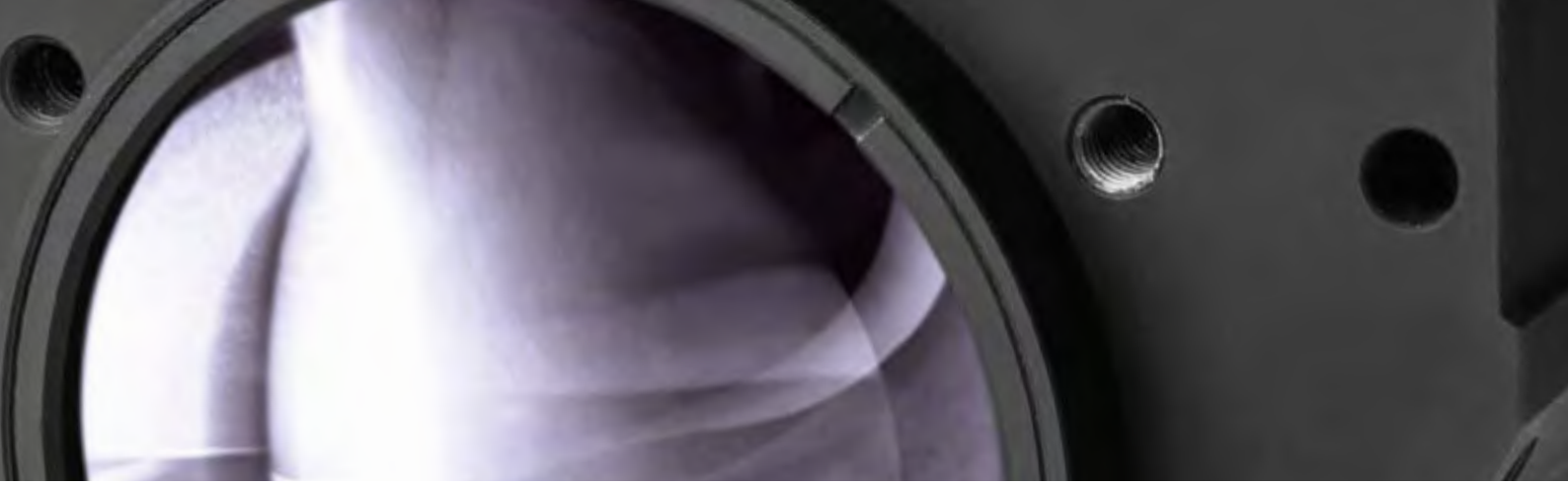
Ultra compact high-resolution telecentric lenses up to 4/3"

TCCR2M080-C
with Mount C

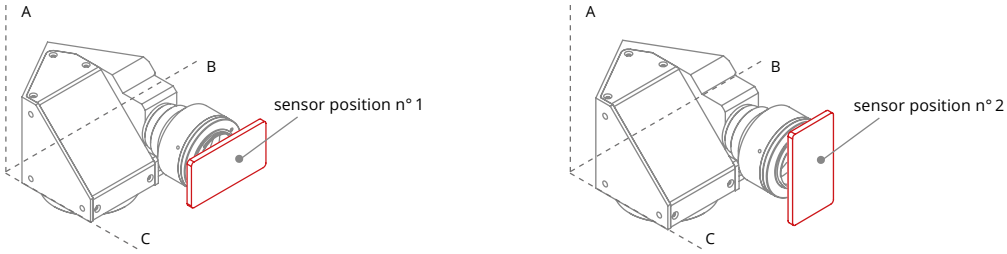
TCCR4M096-E
with Mount E (M42x1)

TCCR4M056-F
with Mount F

Built-in phase adjustment allows to easily align the camera sensor.



TC2MHR - TC4MHR CORE lens dimensions (A, B, C) and correct position of the sensor in relation to the lens:



The long side of sensor has to be aligned along axis B (position n°1) or axis A (pisition n°2).

			Detector type				Optical specifications						Dimensions			
Part number	**Mag.** (x)	**Image circle** Ø (mm)	**KAI 2020 14.8 mm diag. w x h** 11.84 x 8.88 (mm x mm)	**1" KAI-04050 16 mm diag. w x h** 12.8 x 9.64 (mm x mm)	**1.2" KAI-4022/4021 21.5 mm diag. w x h** 15.2 x 15.2 (mm x mm)	**4/3" KAI-08050 22.6 mm diag. w x h** 18.1 x 13.6 (mm x mm)	**WD** (mm) 1	**wF/#** 2	**Telecentricity** typical (max) (deg) 3	**Distortion** typical (max) (%) 4	**Field depth** (mm) 5	**CTF** @50lp/mm (%)	**Mount** 6	**A** (mm)	**B** (mm)	**C** (mm)
TCCR2MHR			Object field of view (mm x mm) 7													
TCCR2M 048-C	0.268	16.9	44.2 x 33.1	47.8 x 35.8	Ø = 56.7	Ø = 50.7	133.41	16	< 0.08 (0.10)	< 0.08 (0.10)	17	> 30	C	77	109	168
TCCR2M 048-E	0.268	16.9	44.2 x 33.1	47.8 x 35.8	Ø = 56.7	Ø = 50.7	133.41	16	< 0.08 (0.10)	< 0.08 (0.10)	17	> 30	M42x1 FD 16	77	112	170
TCCR2M 056-C	0.228	16.8	51.9 x 38.9	56.1 x 42.1	Ø = 66.7	Ø = 59.6	157.79	16	< 0.04 (0.08)	< 0.05(0.10)	23	> 40	C	94	112	178
TCCR2M 056-E	0.228	16.8	51.9 x 38.9	56.1 x 42.1	Ø = 66.7	Ø = 59.6	157.79	16	< 0.04 (0.08)	< 0.05(0.10)	23	> 40	M42x1 FD 16	94	114	178
TCCR2M 064-C	0.200	16.8	59.3 x 44.5	64.1 x 48.1	Ø = 76.1	Ø = 68.1	181.86	16	< 0.04 (0.08)	< 0.05 (0.10)	30	> 40	C	101	125	185
TCCR2M 064-E	0.200	16.8	59.3 x 44.5	64.1 x 48.1	Ø = 76.1	Ø = 68.1	181.86	16	< 0.04 (0.08)	< 0.05 (0.10)	30	> 40	M42x1 FD 16	101	127	187
TCCR2M 080-C	0.160	16.9	74.0 x 55.5	80.0 x 60.0	Ø = 95.0	Ø = 85.0	226.76	16	< 0.04 (0.08)	< 0.05 (0.10)	46	> 40	C	119	145	205
TCCR2M 080-E	0.160	16.9	74.0 x 55.5	80.0 x 60.0	Ø = 95.0	Ø = 85.0	226.76	16	< 0.04 (0.08)	< 0.05 (0.10)	46	> 40	M42x1 FD 16	119	149	207
TCCR2M 096-C	0.137	16.9	86.6 x 65.0	93.6 x 70.2	Ø = 111.2	Ø = 99.5	278.62	16	< 0.05 (0.10)	< 0.07 (0.10)	64	> 40	C	139	172	230
TCCR2M 096-E	0.137	16.9	86.6 x 65.0	93.6 x 70.2	Ø = 111.2	Ø = 99.5	278.62	16	< 0.05 (0.10)	< 0.07 (0.10)	64	> 40	M42x1 FD 16	139	172	232
TCCR4MHR																
TCCR4M 048-C	0.369	21.7	32.1 x 24.1	34.7 x 26.0	41.2 x 41.2	49.1 x 36.9	133.41	16	< 0.08 (0.10)	< 0.08 (0.10)	8.7	> 40	C	77	109	193
TCCR4M 048-F	0.369	21.7	32.1 x 24.1	34.7 x 26.0	41.2 x 41.2	49.1 x 36.9	133.41	16	< 0.08 (0.10)	< 0.08 (0.10)	8.7	> 40	F	77	118	163
TCCR4M 048-E	0.369	21.7	32.1 x 24.1	34.7 x 26.0	41.2 x 41.2	49.1 x 36.9	133.41	16	< 0.08 (0.10)	< 0.08 (0.10)	8.7	> 40	M42x1 FD 16	77	112	195
TCCR4M 056-C	0.314	21.6	37.7 x 28.3	40.8 x 30.6	48.4 x 48.4	57.6 x 43.3	157.80	16	< 0.05 (0.10)	< 0.04 (0.10)	12.0	> 40	C	94	112	202
TCCR4M0 56-F	0.314	21.6	37.7 x 28.3	40.8 x 30.6	48.4 x 48.4	57.6 x 43.3	157.80	16	< 0.05 (0.10)	< 0.04 (0.10)	12.0	> 40	F	94	119	173
TCCR4M 056-E	0.314	21.6	37.7 x 28.3	40.8 x 30.6	48.4 x 48.4	57.6 x 43.3	157.80	16	< 0.05 (0.10)	< 0.04 (0.10)	12.0	> 40	M42x1 FD 16	94	115	204
TCCR4M 064-C	0.275	21.6	43.1 x 32.3	46.6 x 34.9	55.3 x 55.3	65.8 x 49.5	181.86	16	< 0.05 (0.10)	< 0.04 (0.10)	15.7	> 40	C	101	124	208
TCCR4M 064-F	0.275	21.6	43.1 x 32.3	46.6 x 34.9	55.3 x 55.3	65.8 x 49.5	181.86	16	< 0.05 (0.10)	< 0.04 (0.10)	15.7	> 40	F	101	129	180
TCCR4M 064-E	0.275	21.6	43.1 x 32.3	46.6 x 34.9	55.3 x 55.3	65.8 x 49.5	181.86	16	< 0.05 (0.10)	< 0.04 (0.10)	15.7	> 40	M42x1 FD 16	101	127	211
TCCR4M 080-C	0.221	21.7	53.7 x 40.3	58.0 x 43.5	68.9 x 68.9	82.0 x 61.7	226.76	16	< 0.05 (0.10)	< 0.04 (0.10)	24.4	> 40	C	119	146	228
TCCR4M 080-F	0.221	21.7	53.7 x 40.3	58.0 x 43.5	68.9 x 68.9	82.0 x 61.7	226.76	16	< 0.05 (0.10)	< 0.04 (0.10)	24.4	> 40	F	119	152	199
TCCR4M 080-E	0.221	21.7	53.7 x 40.3	58.0 x 43.5	68.9 x 68.9	82.0 x 61.7	226.76	16	< 0.05 (0.10)	< 0.04 (0.10)	24.4	> 40	M42x1 FD 16	119	148	231
TCCR4M 096-C	0.186	21.6	63.5 x 47.6	68.7 x 51.5	81.6 x 81.6	97.1 x 73.0	278.62	16	< 0.05 (0.10)	< 0.04 (0.10)	34.2	> 35	C	139	172	254
TCCR4M 096-F	0.186	21.6	63.5 x 47.6	68.7 x 51.5	81.6 x 81.6	97.1 x 73.0	278.62	16	< 0.05 (0.10)	< 0.04 (0.10)	34.2	> 35	F	139	175	225
TCCR4M 096-E	0.186	21.6	63.5 x 47.6	68.7 x 51.5	81.6 x 81.6	97.1 x 73.0	278.62	16	< 0.05 (0.10)	< 0.04 (0.10)	34.2	> 35	M42x1 FD 16	139	173	256

1 Working distance: distance between the front end of the mechanics and the object. Set this distance within +/- 3% of the nominal value for maximum resolution and minimum distortion.
2 Working F-number (wF/#): the real F-number of a lens when used as a macro. Lenses with smaller apertures can be supplied on request.
3 Maximum slope of chief rays inside the lens: when converted to milliradians, it gives the maximum measurement error for any millimeter of object displacement. Typical (average production) values and maximum (guaranteed) values are listed.
4 Percent deviation of the real image compared to an ideal, undistorted image: typical (average production) values and maximum (guaranteed) values are listed.
5 At the borders of the field depth the image can be still used for measurement but, to get a perfectly sharp image, only half of the nominal field depth should be considered. Pixel size used for calculation is 5 µm.
6 M42x1 mount has a flange distance of 16 mm.
7 For the fields with the indication "Ø =", the image of a circular object of such diameter is fully inscribed into the detector.

TCDP PLUS series

Dual magnification telecentric lens

NEW

KEY ADVANTAGES

Perfect measurement accuracy
TCDP PLUS telecentric lenses produce two images at different magnifications to cover an extended range of your product dimensions with the same accuracy.

Revolutionary flexibility
281 possible combinations allow to personalize and order the TCDP PLUS lens fitting YOUR needs.

Smart cost reduction
Solving two vision tasks with one lens involves less components and lowers the vision system cost.

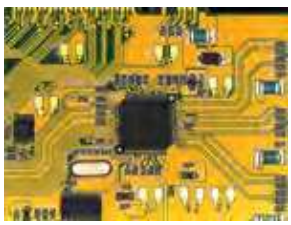
Off-the-shelf lenses tailored for your needs
Get a standard product customized for your application with no price or lead time increase.

TCDP PLUS series are double magnification telecentric lenses supporting two different cameras to measure objects with different magnification factors. It is a perfect choice both for precise measurement of components with different dimensions and for applications where same measurement accuracy for imaging both a complete part and its small detail is required.
No moving mechanism is needed so the lens ensures full magnification repeatability with no need of post-zoom recalibration.

TCDP PLUS lens helps to cut your vision system's costs: you integrate one lens instead of two thus require a single kit of illumination and mounting.
TCDP PLUS can be mounted on CMHO clamping mechanics and paired with LTCLHP collimated illuminators as well as LTRN ring illuminators designed for standard TC series.

Application examples

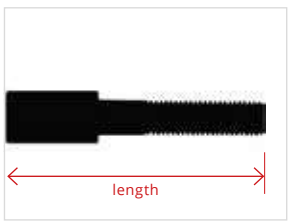
TCDP23C4MC096 imaging an electronic board with two different cameras.



Full FOV image with lens lower magnification.

2x magnified image of the object central area.

TCDP23C4XC144 imaging a screw with two different cameras.



Full FOV image with lens lower magnification.

4x magnified image of the object central area.

Part number	Mount	Mag. (x)	Image circle Ø (mm)	Detector type: 1/3" w x h (mm x mm) 4.80 x 3.60	1/2.5" w x h 5.70 x 4.28	1/2" w x h 6.40 x 4.80	1/1.8" w x h 7.13 x 5.37	2/3" - 5 Mpx w x h 8.45 x 7.07	KAI-2020 14.8 mm diag w x h 11.84 x 8.88	1" KAI-04050 16 mm diag w x h 12.8 x 9.60	1.2" KAI-4022/4021 21.5 mm diag w x h 15.20 x 15.20	4/3" KAI-08050 22.6 mm diag w x h 18.1 x 13.6
1				Object field of view (mm x mm)								
TCDP 2MF 4MF 096	F	0.137	16.9	35.1 x 26.3	41.7 x 31.3	46.8 x 35.1	52.2 x 39.3	61.8 x 51.7	86.3 x 65.0	93.6 x 70.2	111.2 x 111.2	Ø = 99.5
		0.186	21.6	25.8 x 19.3	30.6 x 23.0	34.3 x 25.8	38.3 x 28.8	45.3 x 37.9	63.3 x 47.6	68.7 x 51.5	81.6 x 81.6	97.1 x 73.0
TCDP 23C 4XC 096	C	0.093	11.0	51.4 x 38.5	61.0 x 45.8	68.5 x 51.4	76.3 x 57.5	90.5 x 75.7	Ø = 95.1	Ø = 102.8	n.a.	n.a.
		0.374	11.0	12.8 x 9.6	15.3 x 11.5	17.1 x 12.8	19.1 x 14.4	22.6 x 18.9	Ø = 23.8	Ø = 25.7	n.a.	n.a.
TCDP 23C 4MC096	C	0.093	11.0	51.4 x 38.5	61.0 x 45.8	68.5 x 51.4	76.3 x 57.5	90.5 x 75.7	Ø = 95.1	Ø = 102.8	n.a.	n.a.
		0.186	21.6	25.8 x 19.3	30.6 x 23.0	34.3 x 25.8	38.3 x 28.8	45.3 x 37.9	63.3 x 47.6	68.7 x 51.5	81.6 x 81.6	97.1 x 73.0
TCDP 12C 23C 096	C	0.068	8.0	70.6 x 52.9	83.8 x 62.9	94.1 x 70.6	104.9 x 79.0	Ø = 104.0	n.a.	n.a.	n.a.	n.a.
		0.093	11.0	51.4 x 38.5	61.0 x 45.8	68.5 x 51.4	76.3 x 57.5	90.5 x 75.7	Ø = 95.1	Ø = 102.8	n.a.	n.a.
TCDP 2MF 4MF 120	F	0.104	16.5	46.2 x 34.6	54.8 x 41.2	61.5 x 46.2	68.6 x 51.6	81.3 x 68.0	113.5 x 85.4	123.1 x 92.3	146.2 x 146.2	Ø = 130.8
		0.143	21.2	33.5 x 25.1	39.8 x 29.9	44.7 x 33.5	49.8 x 37.5	59.0 x 49.3	82.3 x 62.0	89.3 x 67.0	106.1 x 106.1	126.3 x 94.9
TCDP 23C 4XC 120	C	0.072	11.0	67.0 x 50.3	79.6 x 59.8	89.4 x 67.0	99.6 x 75.0	118.0 x 98.7	Ø = 124.0	Ø = 134.0	n.a.	n.a.
		0.286	11.0	16.8 x 12.6	19.9 x 14.9	22.3 x 16.8	24.9 x 18.7	29.5 x 24.7	Ø = 31.0	Ø = 33.5	n.a.	n.a.
TCDP 23C 4MC 120	C	0.072	11.0	67.0 x 50.3	79.6 x 59.8	89.4 x 67.0	99.6 x 75.0	118.0 x 98.7	Ø = 124.0	Ø = 134.0	n.a.	n.a.
		0.143	21.2	33.5 x 25.1	39.8 x 29.9	44.7 x 33.5	49.8 x 37.5	59.0 x 49.3	82.3 x 62.0	89.3 x 67.0	106.1 x 106.1	126.3 x 94.9
TCDP 12C 23C 120	C	0.052	8.0	92.1 x 69.1	109.3 x 82.1	122.8 x 92.1	136.8 x 103.0	Ø = 135.6	n.a.	n.a.	n.a.	n.a.
		0.072	11.0	67.0 x 50.3	79.6 x 59.8	89.4 x 67.0	99.6 x 75.0	118.0 x 98.7	Ø = 124.0	Ø = 134.0	n.a.	n.a.
TCDP 2MF 4MF 144	F	0.089	16.8	54.1 x 40.6	64.3 x 48.3	72.2 x 54.1	80.4 x 60.5	95.3 x 79.7	133.0 x 100.1	144.3 x 108.2	171.4 x 171.4	Ø = 153.3
		0.122	21.6	39.3 x 29.5	46.6 x 35.0	52.4 x 39.3	58.3 x 43.9	69.1 x 57.9	96.6 x 72.7	104.7 x 78.6	124.4 x 124.4	148.1 x 111.3
TCDP 23C 4XC 144	C	0.046	11.0	104.9 x 78.7	124.5 x 93.5	139.8 x 104.9	155.8 x 117.3	184.6 x 154.5	Ø = 194.0	Ø = 209.7	n.a.	n.a.
		0.183	11.0	26.2 x 19.7	31.1 x 23.4	35.0 x 26.2	39.0 x 29.3	46.2 x 38.6	Ø = 48.5	Ø = 52.5	n.a.	n.a.
TCDP 23C 4MC 144	C	0.061	11.0	78.6 x 58.9	93.3 x 70.1	104.8 x 78.6	116.7 x 87.9	138.3 x 115.7	Ø = 145.4	Ø = 157.1	n.a.	n.a.
		0.122	21.6	39.3 x 29.5	46.6 x 35.0	52.4 x 39.3	58.3 x 43.9	69.1 x 57.9	96.6 x 72.7	104.7 x 78.6	124.4 x 124.4	148.1 x 111.3
TCDP 12C 23C 144	C	0.044	8.0	107.9 x 81.0	128.2 x 96.2	143.9 x 107.9	160.3 x 120.8	Ø = 159.0	n.a.	n.a.	n.a.	n.a.
		0.061	11.0	78.6 x 58.9	93.3 x 70.1	104.8 x 78.6	116.7 x 87.9	138.3 x 115.7	Ø = 145.4	Ø = 157.1	n.a.	n.a.
TCDP 2MF 4MF 192	F	0.067	16.8	72.2 x 54.1	85.7 x 64.4	96.2 x 72.2	107.2 x 80.8	127.1 x 106.3	177.4 x 133.5	192.5 x 144.4	228.6 x 228.6	Ø = 204.5
		0.092	21.6	52.5 x 39.3	62.3 x 46.8	69.9 x 52.5	77.9 x 58.7	92.3 x 77.3	129.0 x 97.0	139.9 x 104.9	166.1 x 166.1	197.8 x 148.6
TCDP 23C 4XC 192	C	0.046	11.0	104.9 x 78.7	124.5 x 93.5	139.8 x 104.9	155.8 x 117.3	184.6 x 154.5	Ø = 194.0	Ø = 209.7	n.a.	n.a.
		0.183	11.0	26.2 x 19.7	31.1 x 23.4	35.0 x 26.2	39.0 x 29.3	46.2 x 38.6	Ø = 48.5	Ø = 52.5	n.a.	n.a.
TCDP 23C 4MC 192	C	0.046	11.0	104.9 x 78.7	124.5 x 93.5	139.8 x 104.9	155.8 x 117.3	184.6 x 154.5	Ø = 194.0	Ø = 209.7	n.a.	n.a.
		0.092	21.6	52.5 x 39.3	62.3 x 46.8	69.9 x 52.5	77.9 x 58.7	92.3 x 77.3	129.0 x 97.0	139.9 x 104.9	166.1 x 166.1	197.8 x 148.6
TCDP 12C 23C 192	C	0.033	8.0	144.1 x 108.0	171.1 x 128.5	192.1 x 144.1	214.0 x 161.2	Ø = 212.2	n.a.	n.a.	n.a.	n.a.
		0.046	11.0	104.9 x 78.7	124.5 x 93.5	139.8 x 104.9	155.8 x 117.3	184.6 x 154.5	Ø = 194.0	Ø = 209.7	n.a.	n.a.
TCDP 2MF 4MF 240	F	0.053	16.2	90.7 x 68.1	107.8 x 80.9	121.0 x 90.7	134.8 x 101.5	159.7 x 133.6	223.1 x 167.9	242.0 x 181.5	287.3 x 287.3	Ø = 257.1
		0.073	21.1	65.6 x 49.2	77.9 x 58.5	87.4 x 65.6	97.4 x 73.4	115.4 x 96.6	161.2 x 121.3	174.9 x 131.1	207.7 x 207.7	247.3 x 185.8
TCDP 23C 4XC 240	C	0.037	11.0	130.8 x 98.1	155.4 x 116.7	174.4 x 130.8	194.3 x 146.4	230.3 x 192.7	Ø = 242.0	Ø = 261.7	n.a.	n.a.
		0.147	11.0	32.7 x 24.5	38.8 x 29.1	43.5 x 32.7	48.5 x 36.5	57.5 x 48.1	Ø = 60.4	Ø = 65.3	n.a.	n.a.
TCDP 23C 4MC 240	C	0.037	11.0	130.8 x 98.1	155.4 x 116.7	174.4 x 130.8	194.3 x 146.4	230.3 x 192.7	Ø = 242.0	Ø = 261.7	n.a.	n.a.
		0.073	21.1	65.6 x 49.2	77.9 x 58.5	87.4 x 65.6	97.4 x 73.4	115.4 x 96.6	161.2 x 121.3	174.9 x 131.1	207.7 x 207.7	247.3 x 185.8
TCDP 23C 2MC 240	C	0.037	11.0	130.8 x 98.1	155.4 x 116.7	174.4 x 130.8	194.3 x 146.4	230.3 x 192.7	Ø = 242.0	Ø = 261.7	n.a.	n.a.
		0.053	16.2	90.7 x 68.1	107.8 x 80.9	121.0 x 90.7	134.8 x 101.5	159.7 x 133.6	223.1 x 167.9	242.0 x 181.5	287.3 x 287.3	Ø = 257.1

1 TCDP Series has been replaced by TCDP PLUS series.
Please check our website for the list of replaced products.

TCDP PLUS series

Dual magnification telecentric lens

TCDP 4X 096 coupled with LTCLHP 096 telecentric illuminator and LTRN 096 ring light.

TCDP PLUS revolutionary design can easily match any of your application needs: 281 possible combinations allow to create and order a lens perfect for you, and at the same time benefit from a price and lead time of an off-the-shelf component.

TCDP PLUS lens comes in 5 different sizes integrating two of 7 different oculars, allowing to work with more than 9 different camera sensors (from 1/3" to 4/3") and C-, F- or M42x1 (FD 16mm) camera mounts.

On the tables below you'll find a wide range of TCDP PLUS lenses. On our website you'll find a simple tool that allows you to create and order your own TCDP PLUS lens basing on your camera sensor and desired fields of view.

Built-in phase adjustment allows to easily align the camera sensor.

FOR OTHER MULTI-MAGNIFICATION OPTICS SEE ALSO		
	MCZR series	p. 76
FULL RANGE OF COMPATIBLE ILLUMINATORS		
	Compact collimated illuminatos LTCLHP CORE series	p. 108
FULL RANGE OF COMPATIBLE ACCESSORIES		
	CMHO series	p. 162

SETUP

Please check our website for other 281 possible combinations.

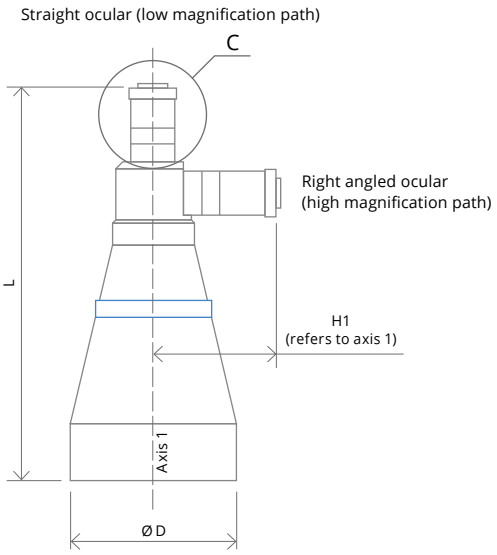
www.opto-engineering.com

TCDP PLUS lens dimensions:

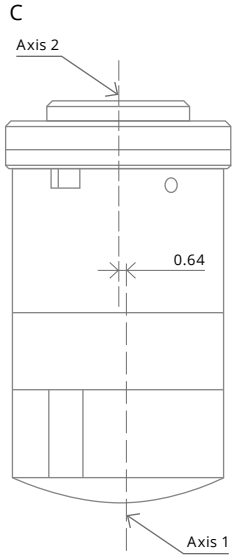
L = length of the lens from the front end to its straight ocular (low magnification path)

H1 = distance from the end of the right angled ocular (high magnification path) to the middle of the lens (axis 1)

D = lens diameter



Dimensions of a TCDP PLUS lens.



Position of axis 1 and axis 2.

		Optical specifications						Dimensions		
Part number [1]	**Mag.** (x)	**WD** (mm)	**F/N** [2]	**Telecentricity** (deg) [3]	**Distortion** typical (max) (%)	**Field depth** (mm) [4]	**CTF** @70lp/mm (%)	**Length** L (mm)	H1 (mm)	**Diam.** D (mm)
TCDP 2MF 4MF 096	0.137	278.6	16.0	< 0.05 (0.10)	< 0.07 (0.10)	64.0	> 40	341.6	117.1	143.0
	0.186	278.6	16.0	< 0.05 (0.10)	< 0.04 (0.10)	34.2	> 35			
TCDP 23C 4XC 096	0.093	278.6	8.0	< 0.06 (0.08)	< 0.04 (0.08)	77.0	> 40	337.7	192.1	143.0
	0.374	278.6	12.0	< 0.06 (0.10)	< 0.07 (0.10)	7.0	> 40			
TCDP 23C 4MC 096	0.093	278.6	8.0	< 0.06 (0.08)	< 0.04 (0.08)	77.0	> 40	337.7	146.0	143.0
	0.186	278.6	16.0	< 0.05 (0.10)	< 0.04 (0.10)	34.2	> 35			
TCDP 12C 23C 096	0.068	278.6	8.0	< 0.06 (0.08)	< 0.03 (0.08)	145.0	> 45	318.0	89.2	143.0
	0.093	278.6	8.0	< 0.06 (0.08)	< 0.04 (0.08)	77.0	> 40			
TCDP 2MF 4MF 120	0.104	334.5	16.0	< 0.07 (0.10)	< 0.07 (0.10)	110.0	> 40	427.3	118.9	180.0
	0.143	334.5	16.0	< 0.05 (0.10)	< 0.04 (0.10)	57.8	> 30			
TCDP 23C 4XC 120	0.072	334.5	8.0	< 0.07 (0.08)	< 0.04 (0.10)	131.0	> 35	423.4	192.1	180.0
	0.286	334.5	12.0	< 0.08 (0.10)	< 0.05 (0.08)	12.0	> 35			
TCDP 23C 4MC 120	0.072	334.5	8.0	< 0.07 (0.08)	< 0.04 (0.10)	131.0	> 35	423.4	147.8	180.0
	0.143	334.5	16.0	< 0.05 (0.10)	< 0.04 (0.10)	57.8	> 30			
TCDP 12C 23C 120	0.052	334.5	8.0	< 0.06 (0.08)	< 0.04 (0.10)	247.0	> 45	403.7	91.1	180.0
	0.072	334.5	8.0	< 0.07 (0.08)	< 0.04 (0.10)	131.0	> 35			
TCDP 2MF 4MF 144	0.089	396.0	16.0	< 0.05 (0.10)	< 0.05 (0.10)	151.0	> 40	486.7	118.9	200.0
	0.122	396.0	16.0	< 0.05 (0.10)	< 0.04 (0.10)	79.5	> 30			
TCDP 23C 4XC 144	0.061	396.0	8.0	< 0.05 (0.08)	< 0.04 (0.08)	180.0	> 40	482.8	192.1	200.0
	0.244	396.0	12.0	< 0.08 (0.10)	< 0.05 (0.08)	17.0	> 35			
TCDP 23C 4MC 144	0.061	396.0	8.0	< 0.05 (0.08)	< 0.04 (0.08)	180.0	> 40	482.8	147.8	200.0
	0.122	396.0	16.0	< 0.05 (0.10)	< 0.04 (0.10)	79.5	> 30			
TCDP 12C 23C 144	0.044	396.0	8.0	< 0.05 (0.08)	< 0.05 (0.08)	339.0	> 35	463.1	91.1	200.0
	0.061	396.0	8.0	< 0.05 (0.08)	< 0.04 (0.08)	180.0	> 40			
TCDP 2MF 4MF 192	0.067	527.0	16.0	< 0.05 (0.10)	< 0.04 (0.10)	268.0	> 40	627.2	118.9	260.0
	0.092	527.0	16.0	< 0.05 (0.10)	< 0.04 (0.10)	141.8	> 30			
TCDP 23C 4XC 192	0.046	527.0	8.0	< 0.06 (0.08)	< 0.05 (0.08)	320.0	> 35	623.2	192.1	260.0
	0.183	527.0	12.0	< 0.08 (0.10)	< 0.05 (0.08)	30.0	> 35			
TCDP 23C 4MC 192	0.046	527.0	8.0	< 0.06 (0.08)	< 0.05 (0.08)	320.0	> 35	623.2	147.8	260.0
	0.092	527.0	16.0	< 0.05 (0.10)	< 0.04 (0.10)	141.8	> 30			
TCDP 12C 23C 192	0.033	527.0	8.0	< 0.06 (0.08)	< 0.04 (0.08)	603.0	> 45	603.5	91.1	260.0
	0.046	527.0	8.0	< 0.06 (0.08)	< 0.05 (0.08)	320.0	> 35			
TCDP 2MF 4MF 240	0.053	492.8	16.0	< 0.05 (0.10)	< 0.04 (0.10)	424.0	> 40	788.8	95.0	322.0
	0.073	492.8	16.0	< 0.05 (0.10)	< 0.04 (0.10)	424.0	> 40			
TCDP 23C 4XC 240	0.037	492.8	8.0	< 0.03 (0.08)	< 0.04 (0.08)	498.0	> 45	784.9	192.1	322.0
	0.147	492.8	12.0	< 0.06 (0.10)	< 0.08 (0.10)	47.0	> 45			
TCDP 23C 4MC 240	0.037	492.8	8.0	< 0.03 (0.08)	< 0.04 (0.08)	498.0	> 45	784.9	147.8	322.0
	0.073	492.8	16.0	< 0.05 (0.10)	< 0.05 (0.10)	221.5	> 30			
TCDP 23C 2MC 240	0.037	492.8	8.0	< 0.03 (0.08)	< 0.04 (0.08)	498.0	> 45	784.9	124.0	322.0
	0.053	492.8	16.0	< 0.05 (0.10)	< 0.04 (0.10)	424.0	> 40			

1 TCDP Series has been replaced by TCDP PLUS series. Please check our website for the list of replaced products.
2 Working F-number (wF/#): the real F/# of a lens when used as a macro.
3 Maximum slope of principal rays inside the lens: when converted to milliradians, it gives the maximum measurement error for any millimiter of object displacement.
4 At the borders of the field depth the image can be still used for measurement but, to get a very sharp image, only half of the nominal field depth should be considered. Pixel size used for calculation is 5.5 µm.

TCCX2M series

Telecentric lenses with built-in coaxial illumination for detectors up to 1"

Part number	Mag.	Image circle	Max detector size	Detector type: 1/3'' w x h 4.80 x 3.60 (mm x mm)	1/2.5'' w x h 5.70 x 4.28 (mm x mm)	1/2" w x h 6.4 x 4.8 (mm x mm)	1/1.8" w x h 7.13 x 5.37 (mm x mm)	2/3" - 5 MP w x h 8.45 x 7.07 (mm x mm)	KAI-04050 16 mm diag w x h 12.8 x 9.6 (mm x mm)	Optical specifications: WD (mm)	wF/# [1]	Distortion (%)	Field depth (mm)	Nominal resolving power (µm)	Mechanical specs: Mount	Length (mm)	Diam. (mm)
	(x)	Ø (mm)		Object field of view (mm x mm)													
RT-MP-4F-65	4.00	16	1"	1.2 x 0.9	1.4 x 1.1	1.6 x 1.2	1.8 x 1.3	2.1 x 1.8	3.2 x 2.4	65.00	16.7	0.23	0.04	2.80	C	165.5	29
RT-MP-2F-65	2.00	16	1"	2.4 x 1.8	2.9 x 2.1	3.2 x 2.4	3.6 x 2.7	4.2 x 3.5	6.4 x 4.8	65.00	10	0.40	0.10	3.40	C	127.0	29
RT-MP-1.5F-65	1.50	16	1"	3.2 x 2.4	3.8 x 2.9	4.3 x 3.2	4.8 x 3.6	5.6 x 4.7	8.5 x 6.4	65.00	7.5	0.50	0.11	3.40	C	114.6	29
RT-MP-1F-65	1.00	16	1"	4.8 x 3.6	5.7 x 4.3	6.4 x 4.8	7.1 x 5.4	8.5 x 7.1	12.8 x 9.6	65.50	8	-0.10	0.28	5.40	C	133.1	32
RT-TCL0750-FU	0.75	16	1"	6.4 x 4.8	7.6 x 5.7	8.5 x 6.4	9.5 x 7.2	11.3 x 9.4	17.1 x 12.8	60.70	12 - 60	-0.03	0.80	11.00	C	206.4	38
RT-TCL0600-FU	0.60	16	1"	8.0 x 6.0	9.5 x 7.1	10.7 x 8.0	11.9 x 9.0	14.1 x 11.8	21.3 x 16.0	78.50	12 - 60	-0.02	1.30	13.50	C	228.5	44
RT-TCL0450-FU	0.45	16	1"	10.7 x 8.0	12.7 x 9.5	14.2 x 10.7	15.8 x 11.9	18.8 x 15.7	28.4 x 21.3	108.20	12 - 60	0.01	2.20	18.00	C	265.4	49
RT-TCL0300-FU	0.30	16	1"	16.0 x 12.0	19.0 x 14.3	21.3 x 16.0	23.8 x 17.9	28.2 x 23.6	42.7 x 32.0	167.00	12 - 60	0.01	5.00	27.00	C	338.2	68

1 Working F-number (wF/#): the real F-number of a lens when used as a macro.

FULL RANGE OF COMPATIBLE LED SOURCES

LDSC series p. 187


Opto Engineering
OPTO ENGINEERING
THE TELECENTRIC COMPANY

TC16M series

Telecentric lenses for 35 mm and 4 k / 8 k pixel line detectors

TC16M series telecentric lenses have been specifically designed to fit 35 mm format (36 x 24 mm) detectors with very high resolution, such as 11, 16 or 29 Mpx.
This combination is the typical choice for extremely accurate measurement of large items such as engine parts, glass or metal sheets, PCBs and electronic components, LCDs, etc.

TC16M lenses are also perfectly suitable for 4 kpx and 8 kpx linescan cameras and can be successfully used to determine the diameter of cylindrical objects: for example shafts, turned metal parts, machine tools, etc.
Besides the standard F and M58x0.75 mount options, any other mechanical interface can be supplied upon request.

KEY ADVANTAGES

Wide image circle for large detectors up to 43.3 mm.

Excellent resolution and low distortion.

Simple and robust design for industrial environments.

Detailed **test report** with **measured** optical parameters.

Mount F

Mount Q = M58x0.75

FULL RANGE OF COMPATIBLE ILLUMINATORS		
	LTCLHP CORE series	p. 108
FULL RANGE OF COMPATIBLE CLAMPING MECHANICS		
	CMHO series	p. 162

DO YOU KNOW?

Why Opto Engineering telecentric lenses don't integrate an iris?
Check the answer to this and other FAQ directly on our web page at:
www.opto-engineering.com/faqs

			Detector type					Optical specifications						Mechanical specifications		
			Line 2 kpx	Line 4 kpx	Full frame APS-C	Line 8 kpx	Full frame 35 mm									
Part number	Mag.	Image circle	2 k x 10 µm	4 k x 7 µm	w x h	8 k x 5 µm	w x h	WD	wF/#	Telecentricity	Distortion	Field Depth	CTF	Mount	Length	Diam.
			20.5	28.7	23.6 x 15.7	41.0	36.0 x 24.0			typical (max)	typical (max)		@50lp/mm			
	(x)	Ø (mm)	(mm)	(mm)	(mm)	(mm)	(mm x mm)	(mm)		(deg)	(%)	(mm)	(%)		(mm)	(mm)
			Object field of view (mm)					1	2	3	4	5		6	7	
TC16M 009	4.000	43.3	5.12	7.17	5.90 x 3.93	10.2	9.00 x 6.00	57.8	22	< 0.03 (0.05)	< 0.03 (0.05)	0.15	> 20	F	487.9	64
TC16M 009-Q	4.000	43.3	5.12	7.17	5.90 x 3.93	10.2	9.00 x 6.00	57.8	22	< 0.03 (0.05)	< 0.03 (0.05)	0.15	> 20	M58X0.75 FD 6.56	527.9	64
TC16M 012	3.000	43.3	6.83	9.56	7.87 x 5.23	13.7	12.0 x 8.00	57.8	18	< 0.03 (0.05)	< 0.03 (0.05)	0.2	> 30	F	378.7	64
TC16M 012-Q	3.000	43.3	6.83	9.56	7.87 x 5.23	13.7	12.0 x 8.00	57.8	18	< 0.03 (0.05)	< 0.03 (0.05)	0.2	> 30	M58X0.75 FD 6.56	418.7	64
TC16M 018	2.000	43.3	10.2	14.3	11.8 x 7.85	20.5	18.0 x 12.0	57.8	16	< 0.03 (0.05)	< 0.03 (0.05)	0.3	> 40	F	259.6	64
TC16M 018-Q	2.000	43.3	10.2	14.3	11.8 x 7.85	20.5	18.0 x 12.0	57.8	16	< 0.03 (0.05)	< 0.03 (0.05)	0.3	> 40	M58X0.75 FD 6.56	299.5	64
TC16M 036	1.000	42.0	20.5	28.7	23.6 x 15.7	41.0	36.0 x 24.0	102.6	16	< 0.03 (0.05)	< 0.02 (0.03)	1.0	> 30	F	309.0	64
TC16M 036-Q	1.000	43.3	20.5	28.7	23.6 x 15.7	41.0	36.0 x 24.0	102.6	16	< 0.03 (0.05)	< 0.02 (0.03)	1.0	> 30	M58X0.75 FD 6.56	348.9	64
TC16M 048	0.751	43.3	27.3	38.2	31.1 x 20.7	54.6	47.9 x 32.0	125.6	16	< 0.06 (0.10)	< 0.05 (0.10)	2.0	> 30	F	315.2	75
TC16M 048-Q	0.750	43.3	27.3	38.2	31.1 x 20.7	54.6	47.9 x 32.0	125.6	16	< 0.06 (0.10)	< 0.05 (0.10)	2.0	> 30	M58X0.75 FD 6.56	355.2	75
TC16M 056	0.641	43.3	31.9	44.7	36.8 x 24.5	63.9	56.1 x 37.4	148.6	16	< 0.04 (0.08)	< 0.04 (0.10)	2.5	> 40	F	338.5	80
TC16M 056-Q	0.640	43.3	31.9	44.7	36.8 x 24.5	63.9	56.1 x 37.4	148.6	16	< 0.04 (0.08)	< 0.04 (0.10)	2.5	> 40	M58X0.75 FD 6.56	378.5	80
TC16M 064	0.561	43.3	36.5	51.1	42.1 x 28.0	73.1	64.2 x 42.8	170.6	16	< 0.04 (0.08)	< 0.06 (0.15)	4.0	> 30	F	359.6	100
TC16M 064-Q	0.560	43.3	36.5	51.1	42.1 x 28.0	73.1	64.2 x 42.8	170.6	16	< 0.04 (0.08)	< 0.06 (0.15)	4.0	> 30	M58X0.75 FD 6.56	399.6	100
TC16M 080	0.463	43.3	44.2	61.9	50.9 x 33.9	88.4	77.7 x 51.8	197.3	16	< 0.03 (0.08)	< 0.09 (0.20)	5.0	> 30	F	406.4	116
TC16M 080-Q	0.460	43.3	44.2	61.9	50.9 x 33.9	88.4	77.7 x 51.8	197.3	16	< 0.03 (0.08)	< 0.09 (0.20)	5.0	> 30	M58X0.75 FD 6.56	446.4	116
TC16M 096	0.380	43.3	53.9	75.4	61.2 x 41.3	107.7	94.7 x 63.1	262.3	16	< 0.06 (0.08)	< 0.07 (0.15)	9.0	> 40	F	449.2	143
TC16M 096-Q	0.380	43.3	53.9	75.4	61.2 x 41.3	107.7	94.7 x 63.1	262.3	16	< 0.06 (0.08)	< 0.07 (0.15)	9.0	> 40	M58X0.75 FD 6.56	489.1	143
TC16M 120	0.289	43.3	70.9	99.3	81.8 x 54.4	141.9	124.7 x 83.1	331.6	16	< 0.05 (0.08)	< 0.05 (0.10)	15.0	> 40	F	538.1	180
TC16M 120-Q	0.290	43.3	70.9	99.3	81.8 x 54.4	141.9	124.7 x 83.1	331.6	16	< 0.05 (0.08)	< 0.05 (0.10)	15.0	> 40	M58X0.75 FD 6.56	578.1	180
TC16M 144	0.245	43.3	83.6	117.0	96.3 x 64.1	167.1	146.9 x 97.9	397.4	16	< 0.05 (0.08)	< 0.08 (0.20)	19.0	> 40	F	597.8	200
TC16M 144-Q	0.250	43.3	83.6	117.0	96.3 x 64.1	167.1	146.9 x 97.9	397.4	16	< 0.05 (0.08)	< 0.08 (0.20)	19.0	> 40	M58X0.75 FD 6.56	637.7	200
TC16M 192	0.187	43.3	109.5	153.3	126.0 x 83.8	219.0	192.0 x 128.0	457.5	16	< 0.06 (0.08)	< 0.05 (0.10)	33.0	> 40	F	742.0	260
TC16M 192-Q	0.190	43.3	109.5	153.3	126.0 x 83.8	219.0	192.0 x 128.0	457.5	16	< 0.06 (0.08)	< 0.05 (0.10)	33.0	> 40	M58X0.75 FD 6.56	781.5	260
TC16M 240	0.150	43.3	136.5	191.1	157.8 x 105	273.1	240.0 x 160.0	542.8	16	< 0.06 (0.08)	< 0.08 (0.15)	52.0	> 40	F	899.0	322
TC16M 240-Q	0.150	43.3	136.5	191.1	157.8 x 105	273.1	240.0 x 160.0	542.8	16	< 0.06 (0.08)	< 0.08 (0.15)	52.0	> 40	M58X0.75 FD 6.56	938.7	322

1 Working distance: distance between the front end of the mechanics and the object. Set this distance within +/- 3% of the nominal value for maximum resolution and minimum distortion.
2 Working F/#: the real F/# of a lens when used as a macro. Lenses with smaller apertures can be supplied on request.
3 Maximum slope of chief rays inside the lens: when converted to milliradians, it gives the maximum measurement error for any millimeter of object displacement. Typical (average production) values and maximum (guaranteed) values are listed.
4 Percent deviation of the real image compared to an ideal, undistorted image: typical (average production) values and maximum (guaranteed) values are listed.
5 At the borders of the field depth the image can be still used for measurement but, to get a very sharp image, only half of the nominal field depth should be considered. Pixel size used for calculation is 4.8 µm.
6 FD stands for Flange Distance (in mm), defined as the distance from the mounting flange (the "metal ring" in rear part of the lens) to the camera detector plane.
7 Measured from the front end of the mechanics to the camera flange.

TC4K series

Flat telecentric lenses for 4 k pixel linescan cameras

KEY ADVANTAGES

Compact design
"Flat" shape for easy integration.

Easy rotational phase and focus adjustment
Robust and precise tuning of FOV phase angle and best focus position.

Compatible LTCL4K telecentric illuminators
with matching flat design.

Dedicated CMMR4K mirrors
90° deflection of the light path for usage in tight spaces and easy integration.

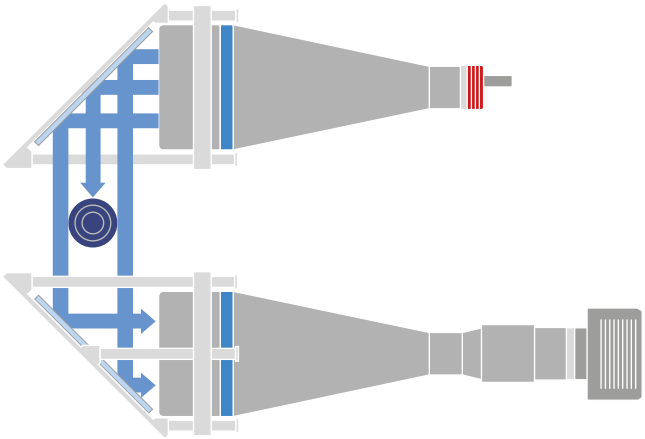
TC4K series telecentric lenses have been designed for measurement applications using linescan cameras with a detector size up to 28.7 mm (e.g. 4096 pixels with pixel size 7 µm).
Dimensional constraints are often a major issue when designing image scanning systems where the sample or the camera itself must be moved: TC4K series is the Opto Engineering solution for applications and machines with tight dimensional constrains. Compatible LTCL4K illuminators with matching flat design and dedicated accessories allow for optical combinations that fit most geometrical measurement configurations.
TC4K series feature standard F or M42 mount to fit common linescan camera interfaces; additional mounts are available upon request. Moreover, the lens-camera interface provides both fine detector phase adjustment and a precise focusing mechanism. Detector phase adjustment allows to precisely position the linear FOV at 90° from the object movement direction.

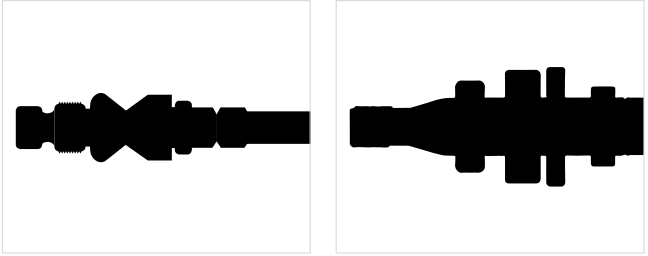
Mount F

Mount N = M42x1

FULL RANGE OF COMPATIBLE ILLUMINATORS		
	LTCL4K series	p. 112
	LTBRDC series	p. 139
FULL RANGE OF COMPATIBLE MIRRORS		
	CMMR4K series	p. 168

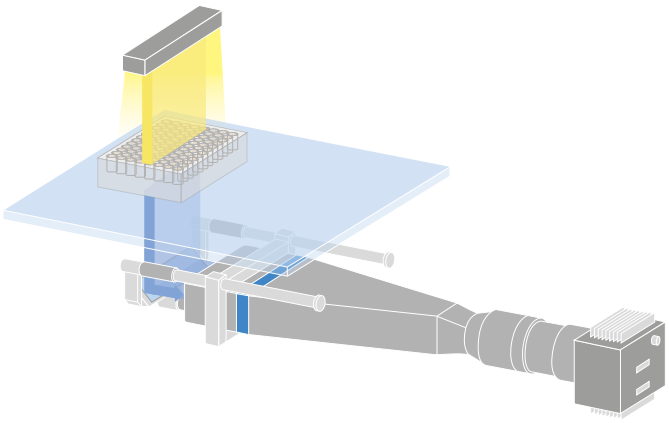
Application examples

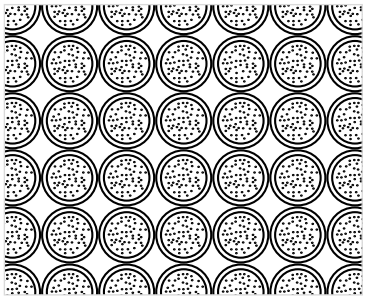




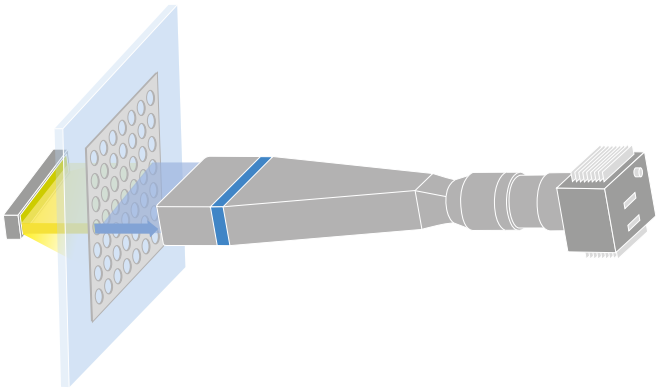
Engine shaft measurement performed with TC4K lens coupled to LTCL4K telecentric illuminator by means of two CMMR4K deflecting mirrors.

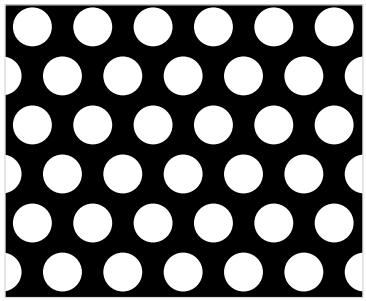
Cell count in a Petri dish performed with TC4K lens used in combination with CMMR4K deflecting mirror and a back light.





Metal sheet measurement performed by TC4K lens and diffused backlight illumination.





			Detector type		Optical specifications						Mechanical specifications							
Part number	**Mag.** (x)	**Image width** (mm)	**Line - 2 kpx 2k x 10 µm** 20.5 (mm)	**Line - 4 kpx 4k x 7 µm** 28.7 (mm)	**WD** (mm) 1	**wF/#** 2	**Telecentricity** typical (max) (deg) 3	**Distortion** typical (max) (%) 4	**Field depth** (mm) 5	**CTF** @50lp/mm (%)	**Flange distance**		**Length** (mm) 6		**Width** (mm)		**Height** (mm)	
			Object field of view (mm)								F	N	F	N	F	N	F	N
TC4K 060-x	0.48	28.7	42.8	60.0	174.0	16	0.06 (0.10)	0.05 (0.08)	7.3	> 30	46.5	10.6	319.2	355.2	83	83	64	52
TC4K 090-x	0.32	28.7	64.3	90.0	174.0	16	0.05 (0.10)	0.05 (0.08)	16.4	> 30	46.5	10.6	360.7	396.6	114	114	64	52
TC4K 120-x	0.24	28.7	85.4	119.6	174.0	16	0.10 (0.12)	0.08 (0.10)	29.2	> 25	46.5	10.6	337.3	373.2	114	114	64	52
TC4K 180-x	0.16	28.7	128.6	180.0	254.0	16	0.08 (0.10)	0.08 (0.10)	65.6	> 30	46.5	10.6	522.4	558.4	208	208	64	52

1 Working distance: distance between the front end of the mechanics and the object. Set this distance within +/- 3% of the nominal value for maximum resolution and minimum distortion.
2 Working F-number (wF/#): the real F-number of a lens when used as a macro. Lenses with smaller apertures can be supplied on request.
3 Maximum slope of chief rays inside the lens: when converted to milliradians, it gives the maximum measurement error for any millimeter of object displacement. Typical (average production) values and maximum (guaranteed) values are listed.
4 Percent deviation of the real image compared to an ideal, undistorted image: typical (average production) values and maximum (guaranteed) values are listed.
5 At the borders of the field depth the image can be still used for measurement but, to get a perfectly sharp image, only half of the nominal field depth should be considered. Pixel size used for calculation is 7 µm.
6 Measured from the front end of the mechanics to the camera flange.

Ordering information

It's easy to select the right lens for your application: our part numbers are coded as **TC4K yyy -x** where **yyy** refers to the field of view (FOV) in millimeters and **-x** refers to the mount option:
- F for F-mount
- N for M42x1 mount (flange distance FD 10.56 mm).
E.g. TC4K060-N for a TC4K060 with M42x1 mount.

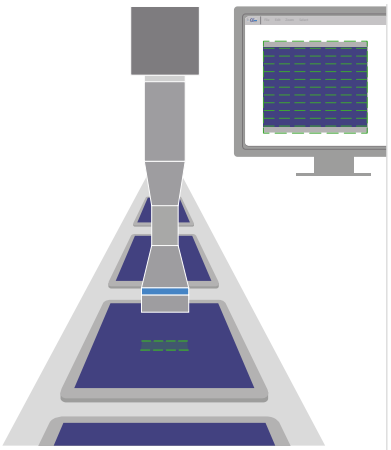
TC12K series

Telecentric lenses for 12 k and 16 k pixel linescan cameras

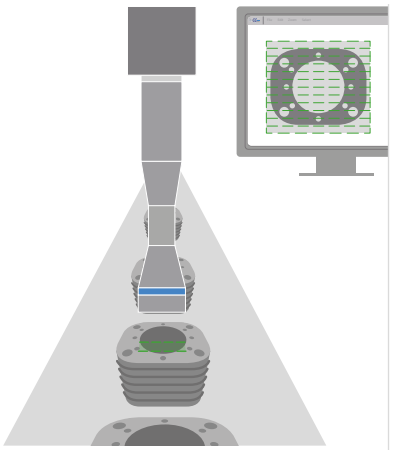
TC12K series telecentric lenses are designed to fit very large line detector cameras. An image circle diameter larger than 62 mm combined with the very high resolution featured by this lens family makes TC12K series the solution of choice for 12 k and 16 k pixel cameras. Flat panel display, solar cell and electronic board inspection are among the most common applications of these optics in the electronics industry; at the same time the optical specifications make them perfectly suitable for large mechanical parts accurate measurement.
In addition to the standard M72x0.75 mount, TC12K lenses can be equipped with other camera mounts at no additional cost ensuring wide compatibility with most common linescan cameras.

FULL RANGE OF COMPATIBLE ILLUMINATORS		
	bar lights LTBRDC series	p. 139
	backlights LTBP, LTBC, LTBFC series	p. 132-138
FULL RANGE OF CLAMPING MECHANICS		
	CMHOTC12K series	p. 162

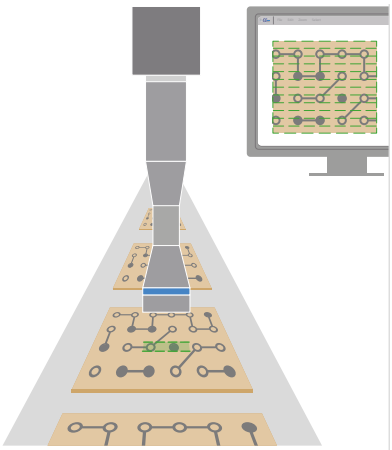
Application examples



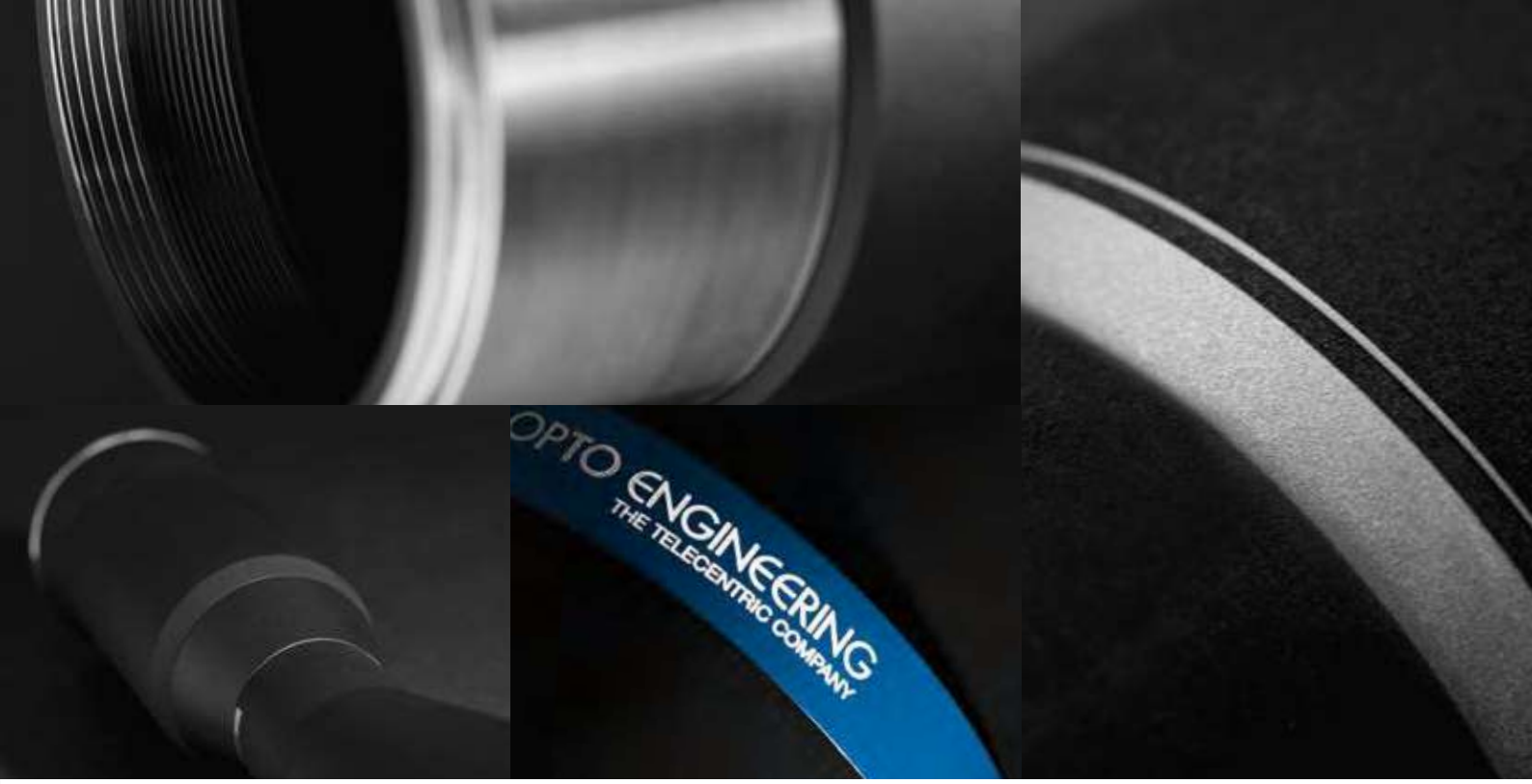
Flat panel inspection



Large mechanical parts

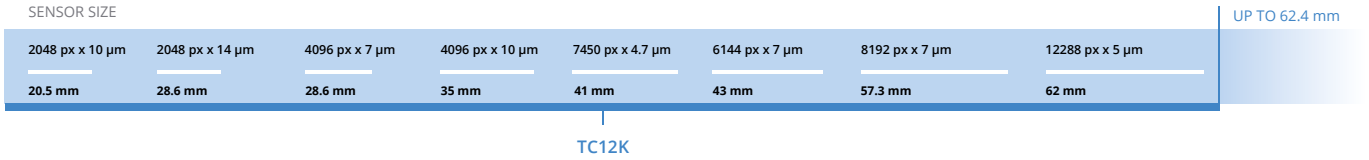


Electronic board inspection



Wide image circle

TC12K is optimized to cover line scan sensor sizes up to 62.4 mm.



Phase adjustment

Adjusting the phase of the camera mounted on TC12K telecentric lenses is easy: simply loosen the three set screws and rotate the camera mount until you achieve the desired angular alignment.

			Detector type				Optical specifications						Dimensions		
Part number	Mag. (x)	Image circle Ø (mm)	Line - 8 kpx 8 k x 7 µm 57.3 (mm)	Line - 16 kpx 16 k x 3.5 µm 57.3 (mm)	Line - 12 kpx 12 k x 5 µm 61.4 (mm)	Line - 12 kpx 12 k x 5.2 µm 62.4 (mm)	WD	wF/#	Telecentricity typical (max) (deg)	Distortion typical (max) (%)	Field depth (mm)	CTF @50lp/mm (%)	Mount	Length (mm)	Diam. (mm)
			Object field of view (mm)				1	2	3	4	5		7	6	
TC12K 064	0.960	62.4	59.7	59.7	64.0	65.0	162.8	16	< 0.06 (0.08)	< 0.08 (0.10)	1.3	> 35	M72 x 0.75 - FD 6.56	566.7	100
TC12K 080	0.698	62.4	82.2	82.2	88.1	89.5	157.4	16	< 0.06 (0.08)	< 0.08 (0.10)	2.5	> 35	M72 x 0.75 - FD 6.56	541.9	116
TC12K 120	0.529	62.4	108.4	108.4	116.1	117.9	254.0	16	< 0.06 (0.08)	< 0.06 (0.08)	4.3	> 40	M72 x 0.75 - FD 6.56	722.1	180
TC12K 144	0.439	62.4	130.6	130.6	140.0	142.2	237.9	16	< 0.06 (0.08)	< 0.07 (0.10)	6.2	> 40	M72 x 0.75 - FD 6.56	743.3	200
TC12K 192	0.320	62.4	179.4	179.4	192.3	195.3	265.5	16	< 0.06 (0.08)	< 0.08 (0.10)	11.7	> 35	M72 x 0.75 - FD 6.56	857.5	260
TC12K 240	0.260	62.4	220.5	220.5	236.3	240.0	492.8	16	< 0.06 (0.08)	< 0.08 (0.10)	17.8	> 35	M72 x 0.75 - FD 6.56	1072.8	322

1 Working distance: distance between the front end of the mechanics and the object. Set this distance within +/- 3% of the nominal value for maximum resolution and minimum distortion.
2 Working F-number (wF/#): the real F-number of a lens when used as a macro. Lenses with smaller apertures can be supplied on request.
3 Maximum slope of chief rays inside the lens: when converted to milliradians, it gives the maximum measurement error for any millimeter of object displacement.
4 Percent deviation of the real image compared to an ideal, undistorted image: typical (average production) values and maximum (guaranteed) values are listed.
5 At the borders of the field depth the image can be still used for measurement but, to get a perfectly sharp image, only half of the nominal field depth should be considered. Pixel size used for calculation is 5 µm.
6 Measured from the front end of the mechanics to the camera flange.
7 FD stands for Flange Distance (in mm), defined as the distance from the mounting flange (the "metal ring" in rear part of the lens) to the camera detector plane.

360° VIEW OPTICS

The perfect solution for machine-vision inspection challenges.

One of the most recurring demands of the machine vision market is to be able to view every surface of an object with as few cameras as possible. This request is becoming more and more common in a variety of market areas, like the beverage, pharmaceutical and automotive industries.

Opto Engineering designed these incredible optical solutions: just one camera shot is enough to capture the top and side views of an object or the bottom and inside views of an holed object.

Most of these special optics are unique and patented by Opto Engineering: their names are registered trademarks and you will not find similar products on the market featuring the same build quality and the same optical performances.

CE REACH COMPLIANT RoHS

Refer to specific datasheets available at **www.opto-engineering.com** for product compliancy with regulations, certifications and safety labels.

PC series

Pericentric lenses for 360° top and lateral view with just one camera

KEY ADVANTAGES

Just one camera
No need for multiple cameras placed around and over the object.

Fast image analysis
No image matching software is needed as the picture is not segmented.

Single point of view
No perspective effects typical of multi-image systems.

Smooth on-line integration
Inspected parts pass unobstructed in the free space below the lens.

PC pericentric lenses are unique optical systems designed to perform a complete inspection of an object up to 60 mm quickly and reliably: just one camera acquisition is enough to capture **the top and lateral faces** of an object.

Thanks to this innovative design there is no need to over-complicate the inspection setup with the use of additional mirrors, while delivering the magnification and field depth required to acquire the entire object volume.

The term pericentric comes from the specific path of the light rays: the resulting image shows the lateral views wrapped around the top face, which makes PC series ideal for cylindrical objects, very common in the beverage and pharmaceutical industry.

Classic application examples include bottleneck threads inspection and data matrix reading - the code will always be properly imaged, no matter the facing direction.

Sample images taken with PC optics

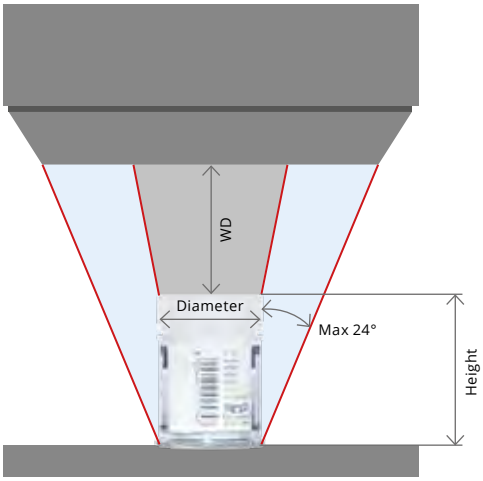


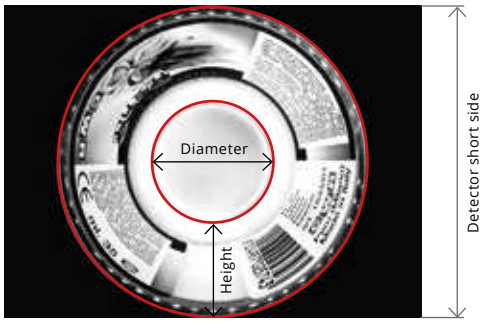



DEDICATED COMPATIBLE RING LIGHTS		
	LTRN 210x20 for PC xx030XS LTRN 245x25 for PC xx030HP	p. 120-122
DEDICATED CLAMPING MECHANICS FOR PCxx030XS		
	CMHO080	p. 162

SETUP

Please refer to our website for setup instructions.
www.opto-engineering.com





$$\mathbf{r}\ (\%) = \frac{\text{Side view height (px)}}{\text{Detector short side (px)}} * 100$$

Unwrapped image

PC optics are designed to work with 1/3", 1/2" and 2/3" detectors. The choice of such detectors ensures the most appropriate optical magnification factor to achieve the field depth required by high resolution 3D pericentric imaging.

The image of the top of the object and its sides are inscribed into the short side of the camera detector.

The smaller the object diameter, the larger the object height which can be inspected, while thin objects can be inspected over a larger diameter.

The tables below show possible combinations of object diameters and heights along with the appropriate working distance and recommended F-number; the "r" parameter for each configuration is also listed.

The "r" parameter is the ratio between the side view height (the circular crown thickness) and the detector short side.
It provides information about side view resolution. The higher "r", the higher the resolution that can be achieved in the side view.

PC series

Pericentric lenses for 360° top and lateral view with just one camera

EXTENDED RANGE

Compact PC xx030XS lenses for inspection of objects with diameter down to 7.5 mm.

Part number		PC 13030HP	PC 12030HP	PC 13030XS	PC 12030XS	PC 23030XS
Detector type		**1/3”**	**1/2”**	**1/3”**	**1/2”**	**2/3”**
Field of view	**(diam x height)**					
Min	(mm x mm)	20 x 60	20 x 60	7.5 x 5	10 x 5	15 x 5
Typical	(mm x mm)	30 x 30	30 x 30	30 x 30	30 x 30	30 x 30
Max	(mm x mm)	60 x 20	60 x 20	55 x 20	55 x 15	55 x 12
Optical specifications						
Wavelength range	(nm)	450 .. 650	450 .. 650	450 .. 650	450 .. 650	450 .. 650
Working distance	(mm)	20 .. 80	20 .. 80	20 .. 85	20 .. 80	20 .. 80
CTF @ 50 lp/mm	(%)	> 30	> 25	> 40	> 30	> 25
F/#		4-16	4-16	4-16	4-16	4-16
Mechanical specifications						
Diameter (max)	(mm)	197	197	116	116	116
Length	(mm)	448	448	378	378	378
Weight	(g)	6800	6800	2950	2950	2950
Mount		C	C	C	C	C

Field of view selection chart

PC 13030HP field of view

Diam. (mm)	Height (mm)	WD (mm)	F/#	r (%)	Height (mm)	WD (mm)	F/#	r (%)	Height (mm)	WD (mm)	F/#	r (%)	Height (mm)	WD (mm)	F/#	r (%)	Height (mm)	WD (mm)	F/#	r (%)	Height (mm)	WD (mm)	F/#	r (%)
20	7	79	16	10	13	79	8	20	20	65	16	26	30	61	12	30	40	55	14	34	60	25	16	37
25	8	71	4	17	17	63	12	21	25	55	16	26	38	40	14	30	50	30	16	30				
30	10	65	4	13	20	55	8	19	30	42	12	25	45	35	12	29								
40	13	52	6	12	27	43	12	20	40	27	12	25												
50	17	36	6	13	33	20	8	15																
60	20	23	4	11																				

PC 12030HP field of view

Diam. mm	Height (mm)	WD (mm)	F/#	r (%)	Height (mm)	WD (mm)	F/#	r (%)	Height (mm)	WD (mm)	F/#	r (%)	Height (mm)	WD (mm)	F/#	r (%)	Height (mm)	WD (mm)	F/#	r (%)	Height (mm)	WD (mm)	F/#	r (%)
20	7	76	16	10	13	70	24	15	20	65	24	28	30	55	16	32	40	45	24	32	60	27	24	35
25	8	72	12	11	17	63	12	18	25	54	16	28	38	40	16	32	50	29	16	32				
30	10	66	12	11	20	56	12	19	30	45	16	25	45	30	16	35								
40	13	54	6	11	27	36	16	20	40	27	24	23												
50	17	32	12	13	33	20	16	18																
60	20	22	12	11																				

PC 13030XS field of view

Diam. (mm)	Height (mm)	WD (mm)	F/#	r (%)	Height (mm)	WD (mm)	F/#	r (%)	Height (mm)	WD (mm)	F/#	r (%)	Height (mm)	WD (mm)	F/#	r (%)	Height (mm)	WD (mm)	F/#	r (%)	Height (mm)	WD (mm)	F/#	r (%)
7.5	5	85	16	19																				
10	5	84	16	14	10	77	16	20																
15	5	75	6	10	10	70	8	15	15	65	16	20	20	60	16	22	25	54	16	24	32	45	16	28
20	10	62	8	12	20	52	14	18	30	42	14	22	40	32	16	26								
25	5	62	6	6	15	52	12	15	25	42	12	19	35	32	12	24	45	22	12	27				
30	10	52	4	9	20	42	8	17	30	32	8	20	40	22	16	23	50	12	16	27				
35	5	48	4	7	15	38	4	12	25	28	8	16	35	18	8	20	42	10	12	22				
40	10	38	4	9	20	28	4	13	30	20	8	16	37	10	16	19								
45	5	34	6	7	15	30	6	9	25	20	8	12	35	10	16	15								
50	5	25	4	8	15	20	6	9	25	10	8	13												
55	10	20	6	6	20	10	8	10																

PC 12030XS field of view

Diam. mm	Height (mm)	WD (mm)	F/#	r (%)	Height (mm)	WD (mm)	F/#	r (%)	Height (mm)	WD (mm)	F/#	r (%)	Height (mm)	WD (mm)	F/#	r (%)
10	5	82	18	18												
15	5	73	16	14	15	63	16	23								
20	5	66	16	9	10	61	16	14	20	51	16	22				
25	10	56	12	10	20	46	16	18	30	36	16	23				
30	10	48	8	10	20	38	16	15	30	28	16	20	40	18	16	24
35	5	48	12	5	15	38	12	12	25	28	12	17	35	18	16	21
40	10	37	14	8	20	27	16	13	30	17	16	17				
45	10	32	8	7	20	22	8	12	30	12	16	16				
50	10	25	10	7	20	15	16	12								
55	5	23	16	5	15	13	16	10								

PC 23030XS field of view

Diam. mm	Height (mm)	WD (mm)	F/#	r (%)	Height (mm)	WD (mm)	F/#	r (%)	Height (mm)	WD (mm)	F/#	r (%)	Height (mm)	WD (mm)	F/#	r (%)
15	5	78	8	12	15	68	16	19								
20	10	62	16	12	20	52	16	18								
25	10	57	8	10	20	47	12	16	30	37	16	21				
30	15	45	8	12	25	35	12	17	35	25	16	20	45	13	16	23
35	10	45	16	8	15	40	16	11	25	30	16	15				
40	10	38	12	8	20	30	12	13	30	20	16	17				
45	10	33	16	7	20	23	16	11								
50	10	25	16	5	20	15	16	11								
55	12	12	16	6												

PCCD series

Catadioptric lenses for 360° top and lateral view with just one camera

KEY ADVANTAGES

360° imaging of small objects
Parts down to 7.5 mm in diameter can be imaged.

Extra wide lateral viewing angle
Object sides viewing angle approaches 45°.

Compactness
The lens can be easily integrated in any system.

Perfect chromatic correction
For RGB camera applications and color inspection.

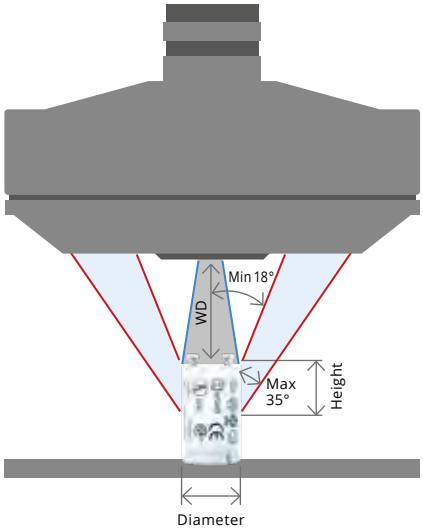
ACCESSORY

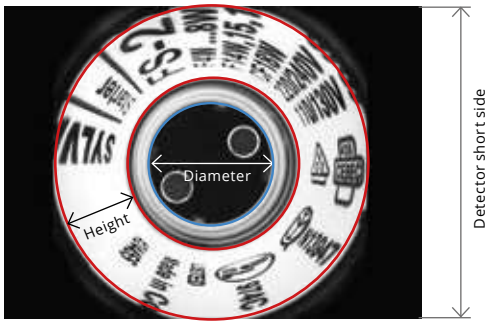
PCCDLFAT Field of view extender for inspection of objects with diameter > 25 mm.

PCCD series are catadioptric lenses exclusively developed and produced by Opto Engineering to enable the 360° side view imaging of small objects. Their innovative optical design, based on a catadioptric system, makes it possible to image objects with diameters as small as 7 mm.
The sides of the object are imaged through the catadioptric system, while the top surface is directly imaged onto the center of the detector. The compactness and high resolution performances of these lenses make them the perfect choice for the inspection of components like pharmaceutical containers, plastic caps, pre-forms, bottle necks, screws and other threaded objects.
PCCD series can work either with 1/2", 1/3" and 2/3" detectors. The sides of the object being inspected are observed over a wide view angle, approaching 45° at its maximum; this feature makes it possible to inspect complex object geometries under a convenient perspective.

Part number		PCCD 013	PCCD 012	PCCD 023
Detector type		**1/3"**	**1/2"**	**2/3"**
Field of view	**(diam x height)**			
Min	(mm x mm)	7.5 x 5	7.5 x 5	7.5 x 5
Typical	(mm x mm)	15 x 10	15 x 10	15 x 10
Max	(mm x mm)	25 x 17	25 x 17	25 x 17
Extended with PCCDLFAT	(mm x mm)	35 x 26	35 x 26	35 x 25
Optical specifications				
Wavelength range	(nm)	450 .. 650	450 .. 650	450 .. 650
Working distance	(mm)	28 .. 53	28 .. 53	24 .. 47
Working distance with PCCDLFAT	(mm)	5 .. 11	5 .. 11	5 .. 11
CTF @ 50 lp/mm	(%)	> 35	> 30	> 30
F/#		6 - 24	8 - 32	8 - 24
Mechanical specifications				
Diameter	(mm)	143	143	143
Length	(mm)	110.5	110.5	110.5
Weight	(g)	980	990	990
Mount		C	C	C

Sample images taken with PCCD optics





$$\mathbf{c}\ (\%) = \frac{\text{Top view diameter (px)}}{\text{Detector short side (px)}} * 100$$

Unwrapped image

DEDICATED COMPATIBLE RING LIGHTS		
	LTRN165x45, LTRN245x35	p. 120-122
DEDICATED CLAMPING MECHANICS		
	CMHO PCCD	p. 162
FIELD OF VIEW EXTENDER ACCESSORY		
	PCCDLFAT	p. 175

The image of the external walls of the object, captured through the catadioptric system, is inscribed into the short side of the camera detector within a circular crown. On the other hand, the top of the object is directly imaged onto the central part of the detector area: both the lateral and top view of the object are in perfect focus at the same time.

The tables show possible combinations of object diameters and heights along with the appropriate working distance and recommended F-number; the "c" parameter for each configuration is also listed.

The "c" parameter describes the dimension of the top view image: it is calculated as the ratio between the central top view diameter and the short side of the detector. The typical ratio between the object height and its diameter is 2/3 which means that, for a given object diameter (i.e. 15 mm), the recommended inspection height will be around 67% of the diameter (10 mm). However, this parameter can be modified to accommodate for different aspect ratios (up to 100%) by adjusting the lens working distance, focus and F-number.

Field of view selection chart

PCCD 013 field of view

Diameter (mm)	Height (mm)	WD (mm)	F/#	c (%)
7.5	5.0	53	24	11
10	6.7	49	16	15
15	10.0	42	12	22
20	13.3	35	8	30
25	16.7	28	6	37
Extended FOV with PCCDLFAT				
30	22	11	8	36
35	26	5	8	37

PCCD 012 field of view

Diameter (mm)	Height (mm)	WD (mm)	F/#	c (%)
7.5	5.0	53	32	13
10	6.7	49	24	17
15	10.0	42	16	25
20	13.3	34	12	33
25	16.7	28	8	42
Extended FOV with PCCDLFAT				
30	22	11	8	37
35	26	5	8	37

PCCD 023 field of view

Diameter (mm)	Height (mm)	WD (mm)	F/#	c (%)
7.5	5.0	47	24	12
10	6.7	45	24	16
15	10.0	38	16	24
20	13.3	30	12	32
25	16.7	24	8	40
Extended FOV with PCCDLFAT				
30	22	14	8	37
35	25	10	8	45

PCCD accessories

PCCDLFAT is an accessory designed to extend the FOV of PCCD optics and inspect objects with even larger diameters (beyond 25 mm). This accessory can be easily mounted on PCCD optics by the user: simply remove the pre-assembled protective window and replace it with PCCDLFAT.

PCCD optics are complemented by a full set of accessories, including **CMHO PCCD**: dedicated clamping mechanics designed to securely hold catadioptric lenses.
LTRN series: specific LED ring illuminators.

PCHI series

Hole inspection optics for 360° inside view in perfect focus

KEY ADVANTAGES

Perfect focusing of holed objects
Both the walls and the bottom of a cavity are imaged in high resolution.

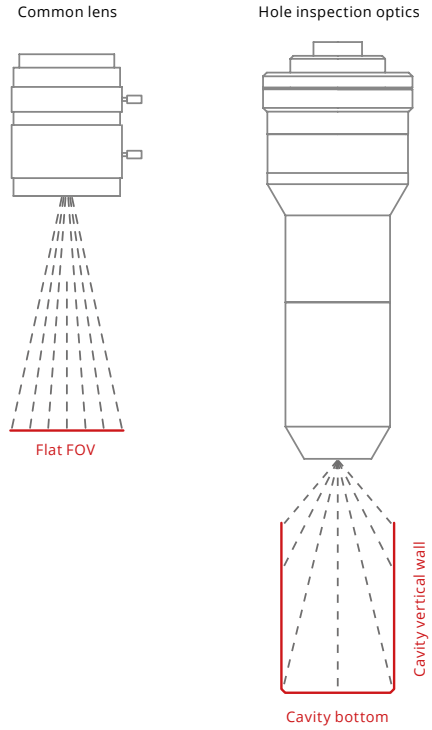
Cavity inspection from the outside
No need to put an optical probe into the hole.

Very high field depth
Objects featuring different shapes and dimensions can be imaged by the same lens.

Wide viewing angle
Sample surfaces are acquired by the lens under a convenient perspective to clearly display their features.

PCHI optics have been developed by Opto Engineering to enable the perfect viewing of holed objects, cavities and containers. Unlike common optics or so called "pinhole lenses" which can only image flat fields of view, hole inspection optics are specifically designed to image both the bottom of a hole and its vertical walls.
Thanks to the large view angle (>82°) and innovative optical design, these lenses are compatible with a wide range of object diameters and thicknesses. Hole inspection optics are the perfect solution to inspect a variety of different object shapes such as cylinders, cones, holes, bottles or threaded objects.

FULL RANGE OF COMPATIBLE ILLUMINATORS		
	LTLAB2-x	p. 118
	LTRN 050 W45	p. 122

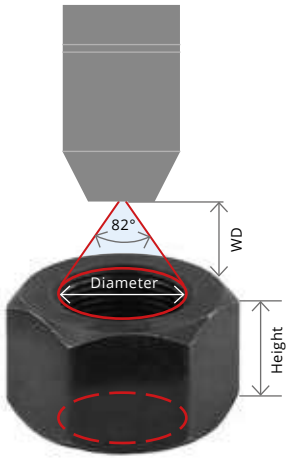


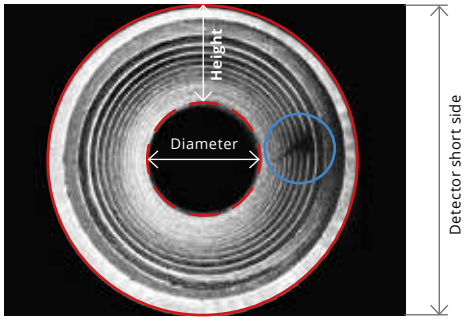
Sample images taken with PCHI optics

Perfect focusing is maintained throughout the entire depth of a hole.

Conical cavity inspection is possible from both sides.

Square, polygonal or irregular cross section objects can be inspected.





$$\mathbf{r}\,(\%) = \frac{\text{Side view height (px)}}{\text{Detector short side (px)}} * 100$$

Unwrapped image

Part number		PCHI 013	PCHI 012	PCHI 023
Detector type		**1/3”**	**1/2”**	**2/3"**
Field of view 1	**(diam x height)**			
Min	(mm x mm)	10 x 10	10 x 10	10 x 10
Max	(mm x mm)	120 x 190	120 x 190	120 x 190
Optical specifications				
Wavelength range	(nm)	450 .. 650	450 .. 650	450 .. 650
Working distance	(mm)	5 .. 62	5 .. 62	5 .. 35
CTF @ 50 lp/mm	(%)	> 40	> 40	> 30
wF/# 2		4.7	5.8	8.3
Mechanical specifications				
Diameter	(mm)	28.0	28.0	28.0
Length	(mm)	102.0	104.0	108.5
Weight	(g)	250	250	250
Mount		C	C	C

1 Certain cameras may affect PCHI 0xx range of focusing when viewing large diameters objects. Contact us to check compatibility with your specific camera.
2 Working F-number (wF/#): the real F-number of a lens when used as a macro.

EXTENDED RANGE

PCHI 023 now available for high resolution 2/3” detectors.

Field of view selection chart

PCHI 013, PCHI 012 and PCHI 023 field of view

Hole diameter	High res. imaging Cavity height	r	Normal res. imaging Cavity height	r	WD
(mm)	(mm)	(%)	(mm)	(%)	(mm)
10	6	23.5	10	28	5
15	8.5	22.5	14.5	29	6.5
20	13	26.5	22	32.5	9
25	18	26	31	33	11
30	22	26	37	32	14
40	31	26.5	53	32	18
50	40	27	68	32	23
60	50	28.5	85	32.5	29
70	60	28	102	33	35
80	75	29.5	120	34	41
100	97	30	155	34.5	52
120	120	31	190	35	62

PCHI optics can image cavities whose diameters and thicknesses span over a wide range of values.

For a given hole diameter, the table on the left lists the maximum cavity height allowed for both high resolution imaging (small pixel sizes) and normal resolution imaging (>5 micron pixels) applications; the “r” ratio indicates how much of the detector area gets covered by the image of the hole inner walls.

The listed working distance values ensure that the object image is exactly inscribed into the short side of the detector, thus maximizing “r” ratio and image resolution.

PCBP series

Boroscopic probes for panoramic cavity imaging and measurement from inside

KEY ADVANTAGES

Inspection of cavities from inside
Hidden internal features and defects are clearly viewed.

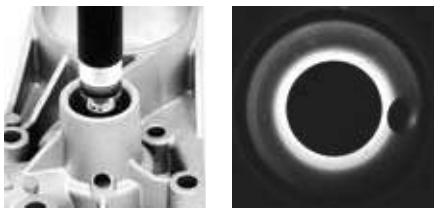
High resolution
The catadioptric design enables the detection of tiny defects over a very wide view angle.

Flaw detection
Coarse deformations revealed using direct illumination.

Surface defect enhancement
Mixing direct and indirect illumination makes it possible to emphasize tiny and scarcely visible defects.

PCBP probes are used to inspect holed objects such as engine parts, containers and tubes whose hidden features can only be controlled by introducing a probe into the cavity.
The catadioptric (refracting + reflecting) optical design ensures much higher resolution than fiber-based probes and enables a complete 360° inner View-throughout the entire cavity length. B Boroscopic probes are intended to be handled by a robot arm or S.C.A.R.A. in order to scan even the deepest cavities. Built-in illumination keeps the device very compact and makes it suitable for simple 3D applications by means of panoramic triangulation techniques.

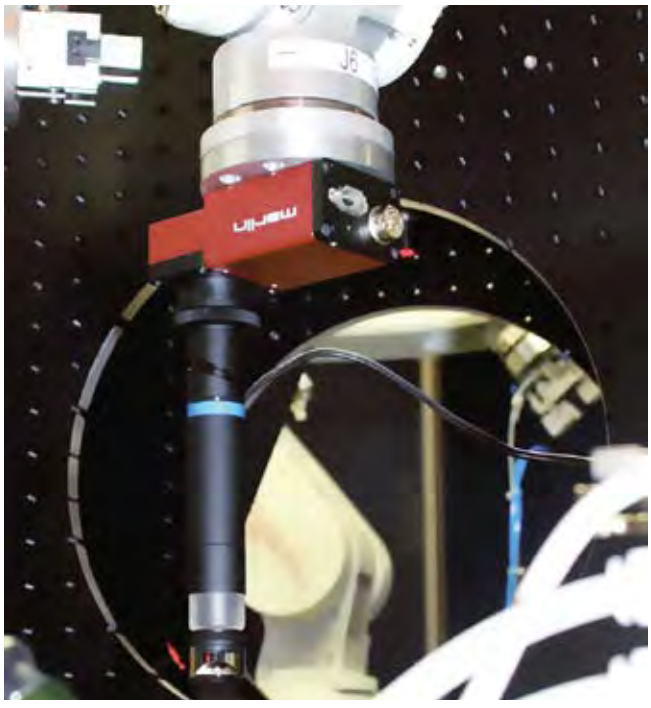
Sample images taken with a PCBP optics

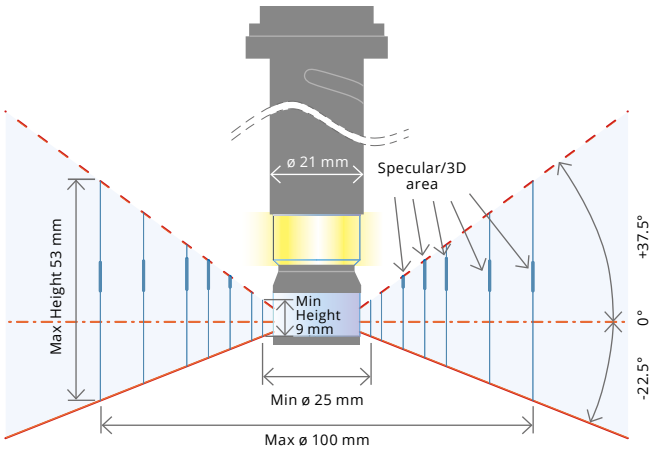


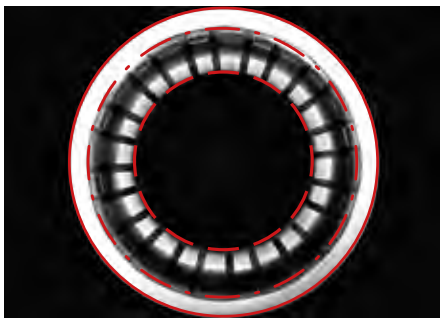
Inspection of holed parts of an engine.

Tube scanning for integrity inspection.

Defect and impurities detection inside containers.







Unwrapped image

PCBP probes can image cavities whose diameter ranges from 25 mm to 100 mm and over: the table below shows the inspection range allowed.

Inspection area

Diameter (mm)	Height (mm)
25	9
30	12
40	18
50	23
60	29
80	41
100	53

An integrated LED source illuminates the cavity both diffusely and directly (specular illumination). The diagram on the left shows the different illumination areas. The diffused illumination is used for defect detection and component inspection.

The direct/specular illumination can be efficiently used to check for surface deformation on metal and highly reflective objects as well as to measure the hole diameter.

The image of the cavity covers around 50% of the detector height; the continuous red line indicates the bottom view of the cavity (-22.5°), the dashed line shows the upper view (+37.5°) while the dashdotted line refers to the lateral view (0°).

Part number		PCBP 013	PCBP 012
Detector type		**1/3”**	**1/2”**
Field of view	**(diam x height)**		
Min	(mm x mm)	25 x 9	25 x 9
Max	(mm x mm)	100 x 53	100 x 53
Optical specifications			
Wavelength range	(nm)	450 .. 650	450 .. 650
Viewing angle	(deg)	60	60
CTF @ 50 lp/mm	(%)	> 25	> 20
F/#		14	16
Mechanical specifications			
Diameter	(mm)	21	21
Length	(mm)	167	137
Weight	(g)	113	92
Mount		C	C
Electrical specifications			
LED Voltage	(V)	16 .. 24	16 .. 24
LED Power	(W)	< 2.0	< 2.0

The LED illumination device is integrated into the unit. The optical tip of the probe **PCBPTIP** can be easily replaced in case of damage.

The best focus is achieved by means of a lockable focusing mechanism. Power supply cables exit the device nearby the C-mount.

PCPW series

Polyview optics for multiple side views with one shot

KEY ADVANTAGES

Just one camera
No need for multiple cameras placed around and over the object.

Wide viewing angles
45° side view makes otherwise hidden features visible.

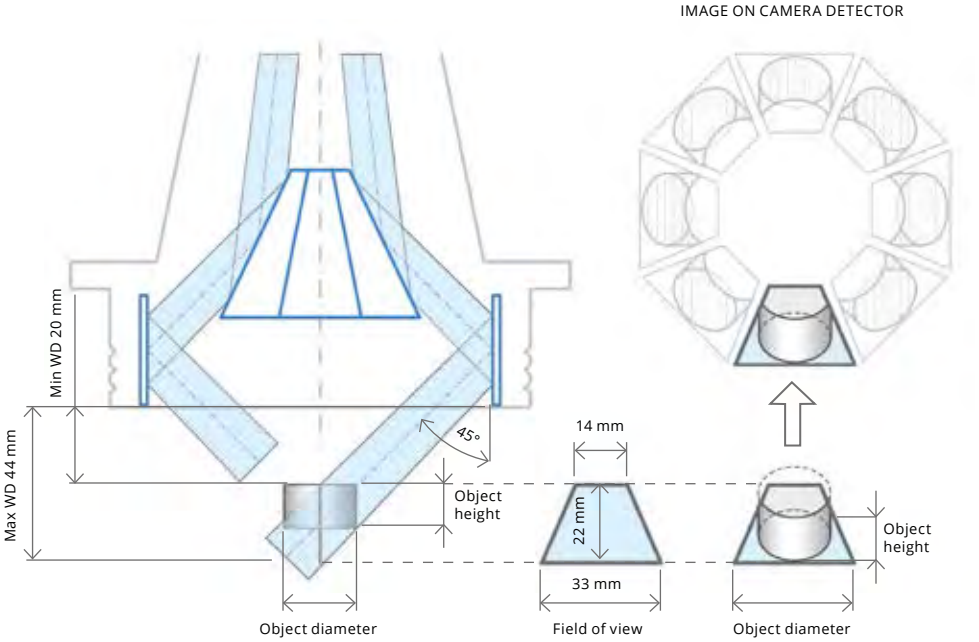
Complete surface inspection
Both inner and outer object surfaces can be imaged in one shot.

Very high resolution
Even the tiniest defects can be detected.

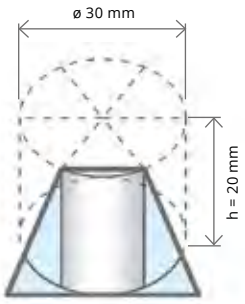
PCPW optics provide eight different views of the side and top surfaces of an object.
The wide perspective angle (45°) enables the inspection of the side features of an object (for example the threads of a screw or a nut) otherwise impossible to acquire with a single camera.
Both the external walls of an object and its top can be imaged at the same time, while internal surfaces of holed objects can be completely inspected from the outside. A combined view of the internal and external surfaces is possible and an image displaying both the inner walls and the bottom of a cavity can be obtained.
In addition to these unique features, PCPW optics also ensures excellent image resolution and image brightness.

Sample images taken with PCPW optics

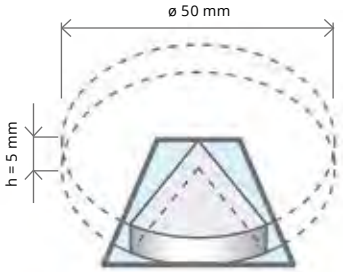
Part number		PCPW 013	PCPW 012	PCPW 023
Detector type		**1/3”**	**1/2”**	**2/3”**
Max object diameter for SIDE inspection				
Height 20 mm	(mm)	30	30	30
Height 5 mm	(mm)	50	50	50
Max object diameter for SIDE + TOP inspection				
Height 10 mm	(mm)	30	30	30
Optical specifications				
Wavelength range	(nm)	450 .. 650	450 .. 650	450 .. 650
Working distance	(mm)	20 .. 40	20 .. 40	20 .. 40
CTF @ 50 lp/mm	(%)	> 60	> 50	> 40
F/#		4-12	6-16	8-16
Mechanical specifications				
Diameter	(mm)	140	140	140
Length	(mm)	224	224	224
Weight	(g)	990	990	990
Mount		C	C	C



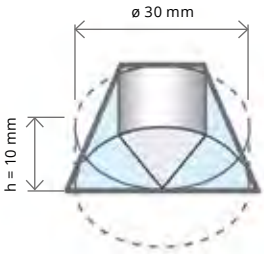
The diagram shows how PCPW optics image a cylindrical object. The object is observed at a 45° viewing angle, from eight different points of view. Eight different trapezoidal fields of view are obtained: all the object features included in such a trapezoid will be imaged on the corresponding image portion. 45° viewing angle allows for imaging both the sides of a cylindrical object and its top; if the object is a hollow cylinder (hole or cavity), the inner wall of the cavity will be imaged instead of the top, thus enabling both outer and inner sides inspection.



When the object height is maximum (20 mm) up to 30 mm diameter objects can be inspected.



Up to 50 mm diameter objects can be inspected, provided their thickness doesn't exceed 5 mm.



Combined view of both the inner sides and the bottom of a cavity is possible when objects are up to 30 mm diameter and 10 mm height.

Maximum field of view

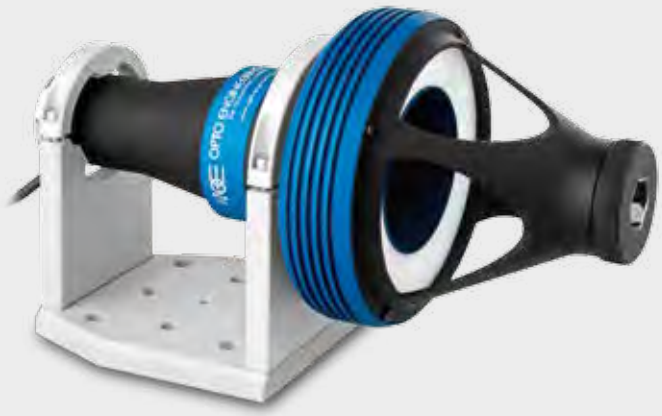
In order to perform a complete 360° inspection, each of the eight image portions should image at least 1/6 of the cylindrical surface; this condition ensures a good overlapping between two different lateral views, since part of the object features will be shared by two neighboring image portions.

Part number		LTRN 050 W 45
Light color		**white, 6300 K**
Dimensions		
Outer diameter	(mm)	54.0
Inner diameter	(mm)	15.2
Height	(mm)	18.0
Weight	(g)	30.0
Mount		threaded retaining ring
Voltage	(V, DC)	24
Power	(W)	3
Compatible PC lenses		PCPW 0xx, PCHI 0xx
Other compatible lenses		TC 23 00x, MC3-03X

LTRN 050 W 45 is a small LED ring illuminator compatible with different products and suitable for a variety of inspections. This illuminator is also perfectly suitable for illuminating the inner sides of a cavity imaged by a Polyview lens; the illuminator flange is threaded to fit PCPW series inner mounting interface.

PCMP series

Micro-polyview optics for 3D measurement and imaging of small parts



KEY ADVANTAGES

Small parts lateral imaging
Inspection of objects whose size ranges from 1 to 10 mm.

Measurement capability
The top and the lateral views show the same magnification.

High field depth
The top and the lateral views are imaged without significant defocusing.

PCMP optics are 3D, multi-image lenses designed to completely measure and inspect objects whose dimensions range from 1 to 10 mm, such as electronic components, solder paste and micro-mechanics. Six different lateral views are provided by an array of mirrors interfaced to a bi-telecentric lens; the top of the object is directly imaged at the center of the field of view.
The lateral views feature exactly the same magnification and the images remain in perfect focus even when the object is displaced from its nominal position. All the views can be used to precisely measure the dimension of components from different angles.
PCMP series integrates LED illumination with the optimal lighting geometry for this optical configuration.

CUSTOM FEATURES

- different number of views
- different view angles
- asymmetric or special mirror arrays
can be supplied upon request.

Part number		PCMP 012	PCMP 023
Detector type		**1/2"**	**2/3"**
Max object inspection height			
With diameter 2.5 mm		6	6
With diameter 5 mm		4.5	4.5
With diameter 7.5 mm		3	3
With diameter 10 mm		1	1
Optical specifications			
Wavelength range	(nm)	450 .. 650	450 .. 650
Working distance	(mm)	1.5 .. 5	1.5 .. 5
CTF @ 50 lp/mm	(%)	> 40	> 40
wF/# 1		8	8
Mechanical specifications			
Diameter	(mm)	119	119
Length	(mm)	262	262
Weight	(g)	980	980
Mount		C	C
Electrical specifications			
Illuminator voltage	(V, DC)	24	24
Illuminator power	(W)	18	18

Camera phase adjustment feature is available **upon request**.

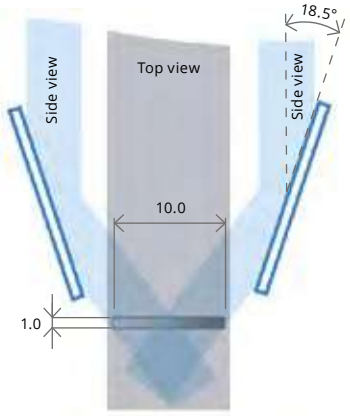
1 Working F-number (wF/#): the real F-number of a lens when used as a macro.

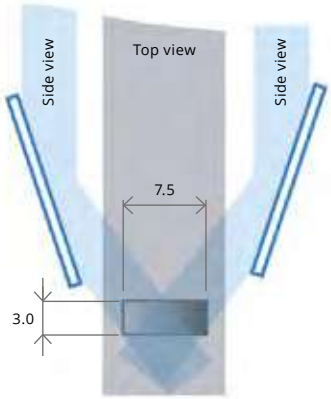
The suggested working distance ranges from 1.5 to 5 mm. The best focusing can be achieved by adjusting the number of spacers in the C-mount interface or by vertically positioning the illuminator+mirror assembly.
The image orientation phase can be adjusted by simply rotating the mirror cage or the whole assembly.

The top and side views show exactly the same magnification; however the side views appear to be compressed because of the perspective angle. Thanks to telecentric imaging such compression is purely linear and therefore very easy to compensate.

DEDICATED COMPATIBLE RING LIGHTS

LTRN 245x45
LTRN 050x45
p. 122





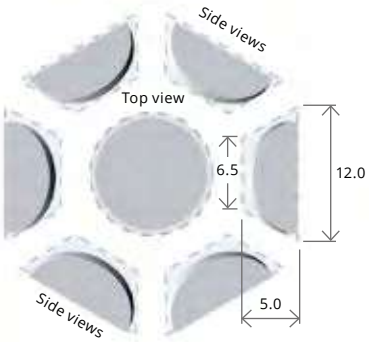


IMAGE ON CAMERA DETECTOR

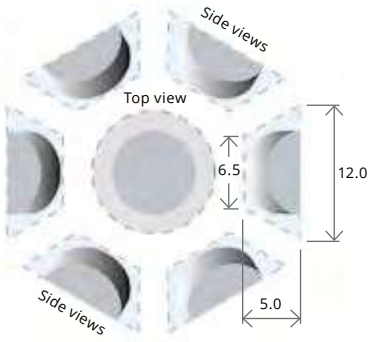
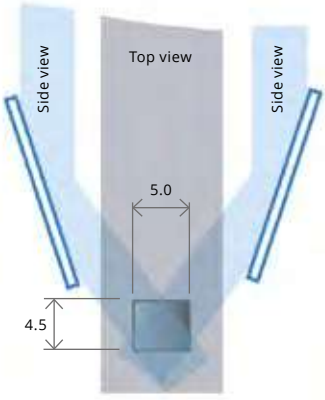
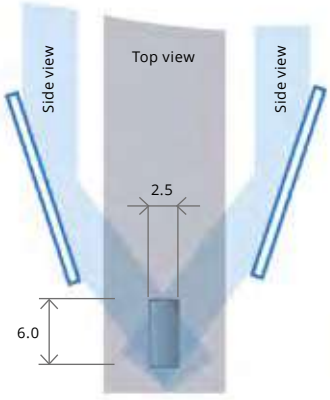


IMAGE ON CAMERA DETECTOR





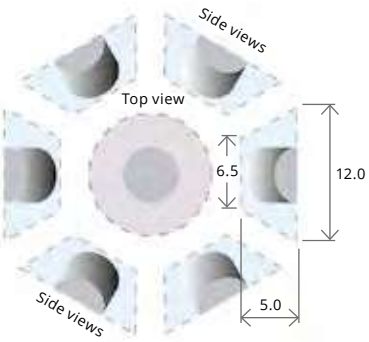


IMAGE ON CAMERA DETECTOR

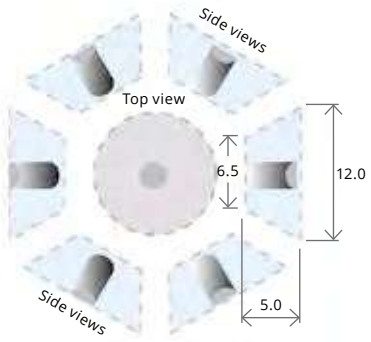


IMAGE ON CAMERA DETECTOR

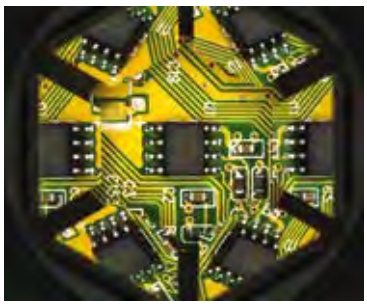
Application examples

Mechanical components inspection

Thread integrity, pitch and diameter can be verified and measured.

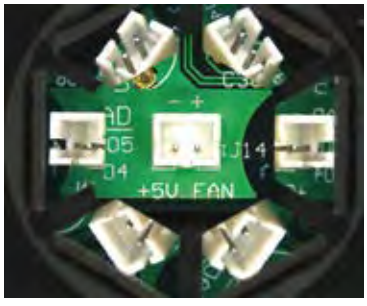
SMD components inspection

Integrated circuit position, rotation, pin integrity and bonding can be checked.



Electronic connector check

Presence/absence, alignment and length of pins can be precisely measured.



TCCAGE series

Bi-telecentric system for multiple side imaging and measurement at 90°

KEY ADVANTAGES

90° lateral imaging
The four orthonormal views allow visualization of object features that are hidden when looked at from the top.

Long and thin object inspection
The characteristic aspects ratio of the four image segments perfectly fits long and thin objects.

Built-in illumination
The device also incorporates two different light sources, for back and direct illumination.

Suitable for measurement
The telecentric optics makes this module perfect for any multiple-measurement application.

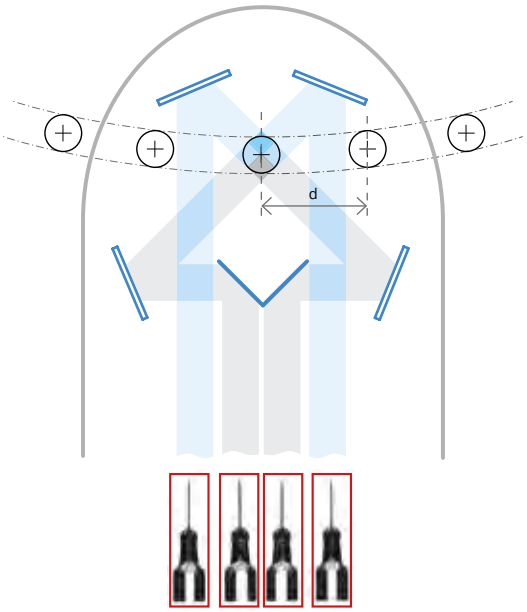
TCCAGE is an integrated optomechanical system designed to fully inspect and measure parts from their side without any need of rotation. Four orthonormal views of an object are provided by a bi-telecentric lens through an array of mirrors.
The optical path is designed to set the displacement angle between the views is exactly 90°; this optical layout ensures complete coverage of the object lateral surface.
Furthermore, telecentric imaging makes the system insensitive to off-centered parts and therefore suitable for measurement applications.

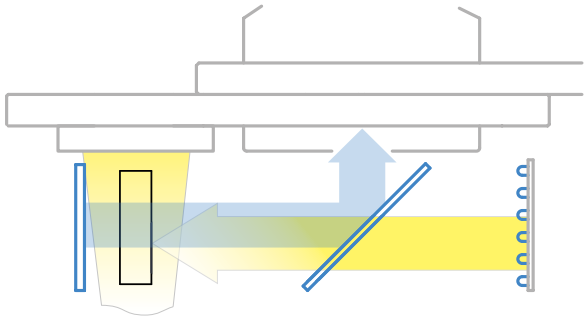
TCCAGE is the perfect solution for inspecting parts whose features would be hidden when looked at from the top and for all those applications where an object must be inspected or measured from different sides.
Two different illumination devices are built into the system to provide either backlight or direct part illumination.

Part number		TCCAGE 12048	TCCAGE 23048	TCCAGE 12096	TCCAGE 23096
Detector type		**1/2”**	**2/3”**	**1/2”**	**2/3”**
Max object diameter	(mm)	8	8	16	16
Max object height	(mm)	32	32	68	68
Optical specifications					
Wavelength range	(mm)	450 .. 650	450 .. 650	450 .. 650	450 .. 650
CTF @ 50 lp/mm	(%)	> 40	> 40	> 40	> 40
wF/# 1		8	8	8	8
Mechanical specifications					
Width	(mm)	111	111	179	179
Length	(mm)	192.8	192.8	347	347
Height	(mm)	248	248	405	424
Weight	(g)	2700	2700	9111	9154
Mount		C	C	C	C
Electrical specifications					
Ring illumination voltage	(V, DC)	24	24	24	24
Ring illumination power	(W)	3	3	3	3
Back illumination voltage	(V, DC)	24	24	24	24
Back illumination power	(W)	9	9	15	15

Camera phase adjustment feature is available **upon request**.

1 Working F-number (wF/#): the real F-number of a lens when used as a macro.





Sample images taken with TCCAGE

Working principle

A bi-telecentric lens observes the object from four different positions through a mirror assembly, ensuring that the optical path is the same for all four view points.
The four views are equally spaced every 90° and partially overlapped, obtaining complete coverage of the object lateral surfaces.
The system can thus tolerate off-centered components without any significant decay of the image quality thanks to the telecentric optics, which ensures that magnification is maintained in each image segment. The system is designed so as to allow components to pass unobstructed through the mirror cage, for in-line applications.

When TCCAGE system is used for in-line inspection, consider the following minimum distance "d" between two consecutive objects in order to avoid image overlapping

TCCAGE xx048	d (mm) ≅ 25 + $\varnothing_{object}$/2
TCCAGE xx096	d (mm) ≅ 50 + $\varnothing_{object}$/2

Illumination geometry

TCCAGE series integrate both direct and backlight illumination devices. Direct illumination (yellow cone in the drawing) is provided by a ring illuminator placed on the top of the part that can be used to enhance surface defects.
Back lighting (indicated by the yellow arrow) is obtained by means of a diffusive source which illuminates the object through the mirror system; this type of illumination is suggested for measurement purposes or to inspect transparent objects.

Additional port

TCCAGE is provided with an extra port placed right above the object. This port can be used to inspect the top of the part using an additional lens and camera system (for example a PCHI hole inspection lens, a macro or TC lens). The port can also accomodate other types of illuminators.

MACRO LENSES

70 - 78	1/3” TO 2/3” SENSORS
80	UP TO 4/3” SENSORS
82 - 86	VERY LARGE & LINESCAN SENSORS

A complete array of products dedicated to close-range inspection.

Macro lenses are Opto Engineering answer to the need for macro-based accurate imaging. While not suited to measurement applications - due to their non-telecentric nature which allows perspective bias - **they can perform close-range inspections very effectively with impressive optical performance in terms of resolution and lack of distortion**.

Like all our products, these optics are built to be deployed in a real-world environment: their compact form factor, flexible design, optical capabilities and excellent value make the Opto Engineering macro lenses an optimal component of a wide range of machine vision systems.

Refer to specific datasheets available at **www.opto-engineering.com** for product compliancy with regulations, certifications and safety labels.


ENGINEERING
THE TELECENTRIC COMPANY
www.opto-engineering.com

MC series

Zero distortion macro lenses

KEY ADVANTAGES

Zero distortion
MC series are suitable for any measurement application where telecentricity is not required.

High resolution
MC series has been specifically designed to work in macro configuration.

Compactness
Small outer diameter (15 mm), fitting applications with limited space for optical components.

MC series macro lenses are designed to capture images of small objects when both very good resolution and nearly zero distortion are needed. Small object fields of view are often observed by means of long focal length lenses equipped with an additional spacer, used to adjust the working distance.

Unfortunately, this approach leads to several problems like high image distortion, resolution loss (especially at the corners), poor depth of field and chromatic effects, thus making this method not suitable for good imaging neither compatible with accurate measurement requirements.

All of these problems can be overcome by using MC series, specifically designed for macro imaging. MC series lenses are compact and cost-effective optics providing very high image resolution. A very low optical distortion makes these lenses perfectly suitable for precise dimensional measurement applications.

FOR HIGHER MAGNIFICATION TELECENTRIC LENSES SEE ALSO		
	TCHM series	p. 30
FULL RANGE OF COMPATIBLE ILLUMINATORS		
	Ring lights LTRN, LTLA series	p. 118-122
	Backlights LTBP, LTBC, LTBFC series	p. 132-138

Application examples

			Detector type					Optical specifications				Mechanical specifications			
Part number	Mag. (x)	Image circle Ø (mm)	1/3" w x h 4.80 x 3.60 (mm x mm)	1/2.5" w x h 5.70 x 4.28 (mm x mm)	1/2" w x h 6.40 x 4.80 (mm x mm)	1/1.8" w x h 7.13 x 5.37 (mm x mm)	2/3" - 5 Mpx w x h 8.45 x 7.07 (mm x mm)	WD (mm)	Distortion (%)	F/# (wF/#) 1	Field depth (mm) 2	Mount	Length (mm) 3	Height (mm)	Diam. (mm)
			Object field of view (mm x mm)												
MC 300X	3.00	11.0	1.60 x 1.20	1.90 x 1.43	2.13 x 1.60	2.38 x 1.79	2.82 x 2.36	29	< 0.01	5.0 (20)	0.09	C	106.5	30.0	15
MC 200X	2.00	11.0	2.40 x 1.80	2.85 x 2.14	3.20 x 2.40	3.56 x 2.68	4.22 x 3.53	33	< 0.01	5.3 (16)	0.16	C	78.1	30.0	15
MC 150X	1.50	11.0	3.20 x 2.40	3.80 x 2.85	4.27 x 3.20	4.75 x 3.58	5.63 x 4.71	38	< 0.01	5.2 (13)	0.23	C	63.9	30.0	15
MC 100X	1.00	11.0	4.80 x 3.60	5.70 x 4.28	6.40 x 4.80	7.13 x 5.37	8.45 x 7.07	47	< 0.01	5.0 (10)	0.40	C	49.9	30.0	15
MC 075X	0.75	11.0	6.40 x 4.80	7.60 x 5.70	8.53 x 6.40	9.50 x 7.16	11.3 x 9.42	58	< 0.02	5.1 (9)	0.63	C	42.8	30.0	15
MC 050X	0.50	11.0	9.60 x 7.20	11.4 x 8.55	12.8 x 9.60	14.3 x 10.7	16.9 x 14.1	75	< 0.02	5.3 (8)	1.27	C	35.7	30.0	15
MC 033X	0.33	11.0	14.4 x 10.8	17.1 x 12.8	19.2 x 14.4	21.4 x 16.1	25.4 x 21.2	102	< 0.05	5.3 (7)	2.50	C	31.0	30.0	15

1 F/# = F-number, wF/# = Working F-number, the real F-number of a lens when used as a macro.
2 Measured from the front end of the mechanics to the camera flange.
3 At the borders of the field depth the image can be still used fo r measurement but, to get a very sharp image, only half of the nominal field depth should be considered. Pixel size used for calculation is 3.45 µm.

MC3-03X macro

Zero distortion multi-configuration macro lens

KEY ADVANTAGES

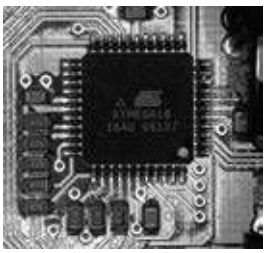
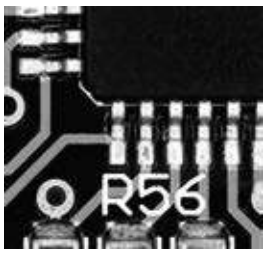
Wide range of magnifications
MC3-03X is suitable for the inspection of many different object sizes with different detector options.

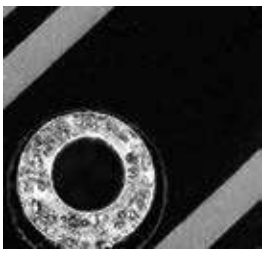
Nearly zero distortion
Less than 0.05% distortion, at any magnification, makes this lens a perfect choice for measurement applications.

Perfect optical parameters mix
Changing the magnification also changes the lens working F-number in such a way that resolution and distortion remain properly combined.

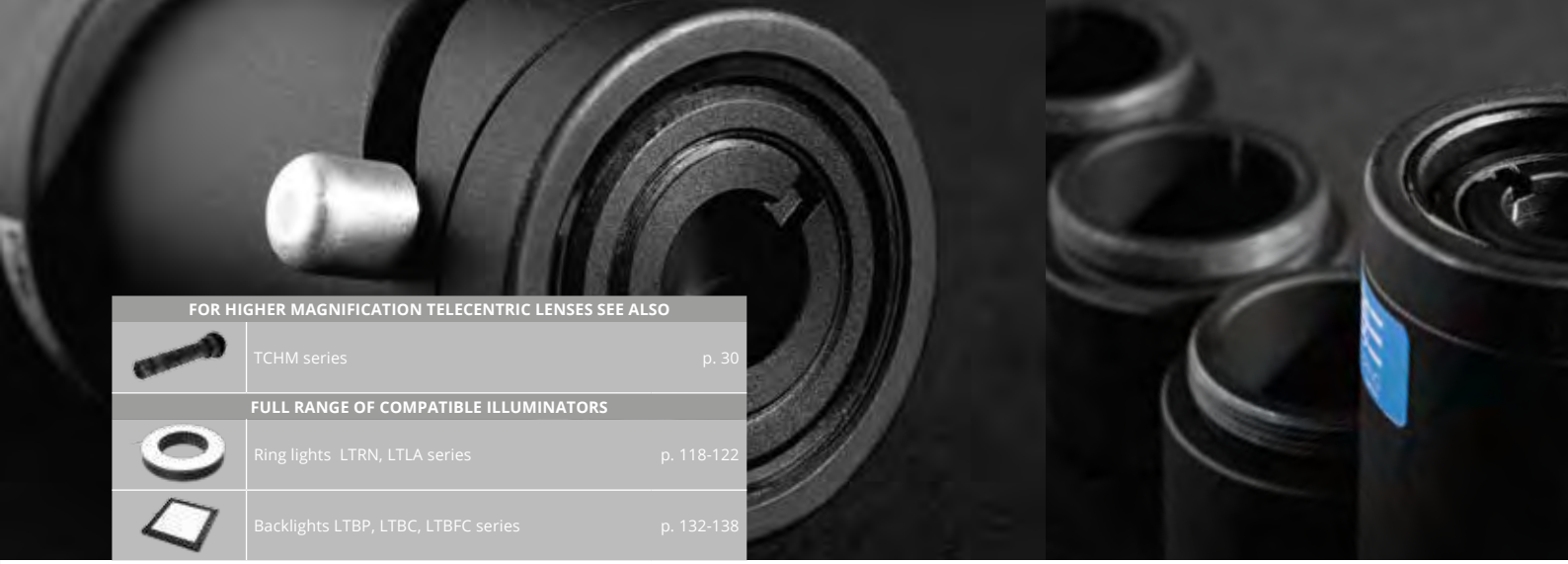
MC3-03X is a multi-configuration macro lens suitable for the inspection of objects whose size varies from a few millimeters to some centimeters. Magnification and focus can be tuned by adjusting a lockable rotating knob.
The lens magnification range can be selected by means of a set of extension tubes, included in the product package; this feature makes this component ideal for prototyping purposes and for machine vision applications requiring flexibility. Since the working F-number increases with magnification, the optimum combination of field depth, image resolution and brightness is maintained in any lens configuration.
Moreover, the optical distortion approaches zero at any magnification, making this lens perfectly suitable for measurement applications.

Application examples





FOR HIGHER MAGNIFICATION TELECENTRIC LENSES SEE ALSO

TCHM series p. 30

FULL RANGE OF COMPATIBLE ILLUMINATORS

Ring lights LTRN, LTLA series p. 118-122

Backlights LTBP, LTBC, LTBFC series p. 132-138

MC3-03X macro FOV and WD selection chart

Number of spacers	Mag. (x)	Image circle Ø (mm)	WD (mm)	F/# (wF/#) 1	Field depth (mm) 2	Detector type 1/3" w x h 4.80 x 3.60 (mm x mm)	1/2.5" w x h 5.70 x 4.28 (mm x mm)	1/2" w x h 6.40 x 4.80 (mm x mm)	1/1.8" w x h 7.13 x 5.37 (mm x mm)	2/3" - 5 Mpx w x h 8.45 x 7.07 (mm x mm)	Dimensions Mount	Length (mm)	Diam. (mm)
						Object field of view (mm x mm)							
0	0.1	11.0	275	5.5 (6)	23.8	48.0 x 36.0	57.0 x 42.8	64.0 x 48.0	71.3 x 53.7	84.5 x 70.7	C	50.5	28
	0.2	11.0	136	5.0 (6)	5.95	24.0 x 18.0	28.5 x 21.4	32.0 x 24.0	35.6 x 26.8	42.2 x 35.3			
	0.3	11.0	92	5.4 (7)	3.09	16.0 x 12.0	19.0 x 14.3	21.3 x 16.0	23.8 x 17.9	28.2 x 23.6			
	0.4	11.0	71	5.0 (7)	1.74	12.0 x 9.00	14.3 x 10.7	16.0 x 12.0	17.8 x 13.4	21.1 x 17.7			
	0.5	11.0	60	5.3 (8)	1.27	9.60 x 7.20	11.4 x 8.56	12.8 x 9.60	14.3 x 10.7	16.9 x 14.1			
	0.6	11.0	54	5.6 (9)	0.99	8.00 x 6.00	9.50 x 7.13	10.7 x 8.00	11.9 x 8.95	14.1 x 11.8			
	0.7	11.0	50	5.3 (9)	0.73	6.86 x 5.14	8.14 x 6.11	9.14 x 6.86	10.2 x 7.67	12.1 x 10.1			
	0.8	11.0	47	5.6 (10)	0.62	6.00 x 4.50	7.13 x 5.35	8.00 x 6.00	8.91 x 6.71	10.6 x 8.83			
	0.9	11.0	46	5.3 (10)	0.49	5.33 x 4.00	6.33 x 4.76	7.11 x 5.33	7.92 x 5.96	9.38 x 7.85			
	1.0	11.0	46	5.5 (11)	0.44	4.80 x 3.60	5.70 x 4.28	6.40 x 4.80	7.13 x 5.37	8.45 x 7.07			
1	0.7	11.0	31	5.3 (9)	0.73	6.86 x 5.14	8.14 x 6.11	9.14 x 6.86	10.2 x 7.67	12.1 x 10.1	C	69.0	28
	0.8	11.0	29	5.6 (10)	0.62	6.00 x 4.50	7.13 x 5.35	8.00 x 6.00	8.91 x 6.71	10.6 x 8.83			
	0.9	11.0	28	5.3 (10)	0.49	5.33 x 4.00	6.33 x 4.76	7.11 x 5.33	7.92 x 5.96	9.38 x 7.85			
	1.0	11.0	27	5.5 (11)	0.44	4.80 x 3.60	5.70 x 4.28	6.40 x 4.80	7.13 x 5.37	8.45 x 7.07			
	1.1	11.0	28	5.2 (11)	0.36	4.36 x 3.27	5.18 x 3.89	5.82 x 4.36	6.48 x 4.88	7.68 x 6.42			
	1.2	11.0	28	5.5 (12)	0.33	4.00 x 3.00	4.75 x 3.57	5.33 x 4.00	5.94 x 4.47	7.04 x 5.89			
	1.3	11.0	29	5.2 (12)	0.28	3.69 x 2.77	4.38 x 3.29	4.92 x 3.69	5.48 x 4.13	6.50 x 5.44			
	1.4	11.0	31	5.4 (13)	0.26	3.43 x 2.57	4.07 x 3.06	4.57 x 3.43	5.09 x 3.83	6.03 x 5.05			
	1.5	11.0	32	5.2 (13)	0.23	3.20 x 2.40	3.80 x 2.85	4.27 x 3.20	4.75 x 3.58	5.63 x 4.71			
	1.6	11.0	34	5.4 (14)	0.22	3.00 x 2.25	3.56 x 2.68	4.00 x 3.00	4.46 x 3.36	5.28 x 4.42			
2	1.4	11.0	12	5.4 (13)	0.26	3.43 x 2.57	4.07 x 3.06	4.57 x 3.43	5.09 x 3.83	6.03 x 5.05	C	87.5	28
	1.5	11.0	14	5.2 (13)	0.23	3.20 x 2.40	3.80 x 2.85	4.27 x 3.20	4.75 x 3.58	5.63 x 4.71			
	1.6	11.0	15	5.4 (14)	0.22	3.00 x 2.25	3.56 x 2.68	4.00 x 3.00	4.46 x 3.36	5.28 x 4.42			
	1.7	11.0	17	5.2 (14)	0.19	2.82 x 2.12	3.35 x 2.52	3.76 x 2.82	4.19 x 3.16	4.97 x 4.16			
	1.8	11.0	19	5.4 (15)	0.18	2.67 x 2.00	3.17 x 2.38	3.56 x 2.67	3.96 x 2.98	4.69 x 3.93			
	1.9	11.0	21	5.2 (15)	0.16	2.53 x 1.89	3.00 x 2.25	3.37 x 2.53	3.75 x 2.83	4.45 x 3.72			
	2.0	11.0	23	5.3 (16)	0.16	2.40 x 1.80	2.85 x 2.14	3.20 x 2.40	3.56 x 2.68	4.22 x 3.53			
	2.1	11.0	25	5.2 (16)	0.14	2.29 x 1.71	2.71 x 2.04	3.05 x 2.29	3.39 x 2.56	4.02 x 3.36			
	2.2	11.0	27	5.3 (17)	0.14	2.18 x 1.64	2.59 x 1.95	2.91 x 2.18	3.24 x 2.44	3.84 x 3.21			
	2.3	11.0	30	5.5 (18)	0.14	2.09 x 1.57	2.48 x 1.86	2.78 x 2.09	3.10 x 2.33	3.67 x 3.07			
3	2.1	11.0	7	5.2 (16)	0.14	2.29 x 1.71	2.71 x 2.04	3.05 x 2.29	3.39 x 2.56	4.02 x 3.36	C	106.0	28
	2.2	11.0	9	5.3 (17)	0.14	2.18 x 1.64	2.59 x 1.95	2.91 x 2.18	3.24 x 2.44	3.84 x 3.21			
	2.3	11.0	11	5.5 (18)	0.14	2.09 x 1.57	2.48 x 1.86	2.78 x 2.09	3.10 x 2.33	3.67 x 3.07			
	2.4	11.0	14	5.3 (18)	0.12	2.00 x 1.50	2.38 x 1.78	2.67 x 2.00	2.97 x 2.24	3.52 x 2.94			
	2.5	11.0	16	5.4 (19)	0.12	1.92 x 1.44	2.28 x 1.71	2.56 x 1.92	2.85 x 2.15	3.38 x 2.83			
	2.6	11.0	18	5.3 (19)	0.11	1.85 x 1.38	2.19 x 1.65	2.46 x 1.85	2.74 x 2.06	3.25 x 2.72			
	2.7	11.0	21	5.4 (20)	0.11	1.78 x 1.33	2.11 x 1.59	2.37 x 1.78	2.64 x 1.99	3.13 x 2.62			
	2.8	11.0	23	5.3 (20)	0.10	1.71 x 1.29	2.04 x 1.53	2.29 x 1.71	2.55 x 1.92	3.02 x 2.52			
	2.9	11.0	26	5.4 (21)	0.10	1.66 x 1.24	1.97 x 1.48	2.21 x 1.66	2.46 x 1.85	2.91 x 2.44			
	3.0	11.0	28	5.3 (21)	0.09	1.60 x 1.20	1.90 x 1.43	2.13 x 1.60	2.38 x 1.79	2.82 x 2.36			

1 F/# = F-number, wF/# = Working F-number, the real F-number of a lens when used as a macro.
2 At the borders of the field depth the image can be still used for measurement but, to get a very sharp image, only half of the nominal field depth should be considered. Pixel size used for calculation is 3.45 µm

MCSM1-01X

Macro lens with Scheimpflug adjustment

KEY ADVANTAGES

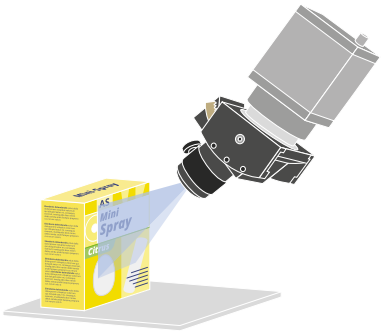
Precision Scheimpflug mount
Image focus is maintained across any tilted plane.

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.

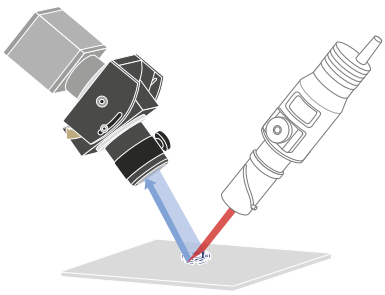
Examples of 3D imaging configuration



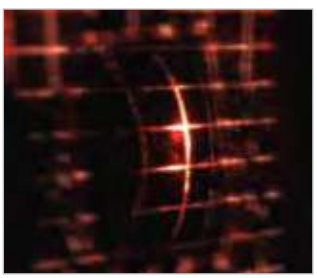
MCSM1-01X imaging a sample from an angled point of view.

Without tilt adjustment, the object is not homogeneously focused.

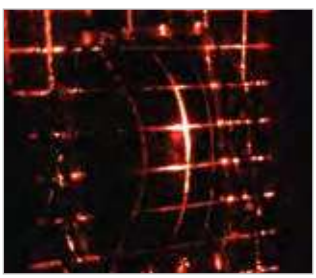
At the Scheimpflug angle, the image becomes sharp.



MCSM1-01X combined with a LTPRSMHP3W-R Scheimplfug pattern projector at 90°.

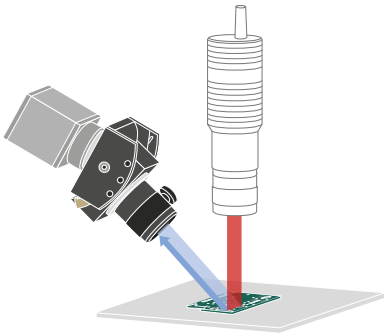


Without tilt adjustment, the image of the surface is not homogeneously focused.

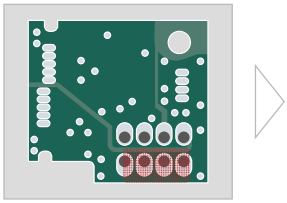


At the Scheimplflug angle, the image is sharp over the entire surface where the paste has been deposited.

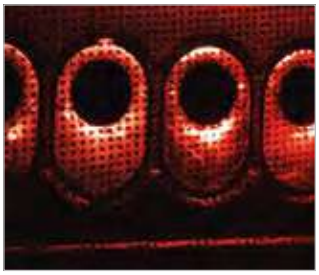
FOR TELECENTRIC LENSES WITH SCHEIMPFLUG ADJUSTMENT SEE ALSO
TCSM series p. 16
FULL RANGE OF COMPATIBLE PRODUCTS FOR 3D APPLICATIONS
LED pattern projectors p. 142



MCSM1-01X combined with LTPRHP3W-R.

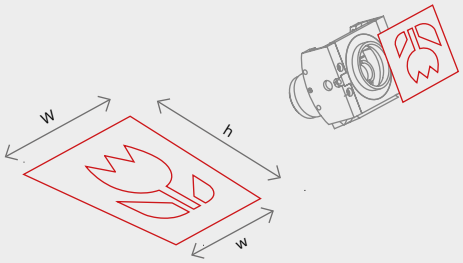
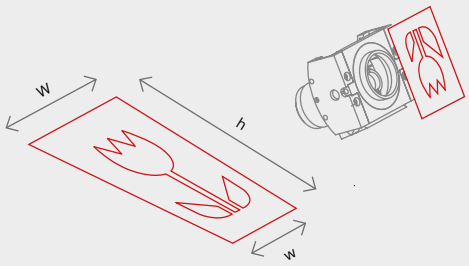


Without tilt adjustment, the image is out of focus.



At the Scheimplflug angle, the entire surface becomes focused.

FOV and WD selection chart

Mag.	F/# (wF/#)	Object tilt	Mount tilt	WD	Long detector side horizontal 1/3" w x h 4.80 x 3.60 (mm x mm)	Long detector side horizontal 1/2" w x h 6.40 x 4.80 (mm x mm)	Long detector side horizontal 2/3" w x h 8.80 x 6.60 (mm x mm)	Long detector side vertical 1/3" w x h 3.60 x 4.80 (mm x mm)	Long detector side vertical 1/2" w x h 4.80 x 6.40 (mm x mm)	Long detector side vertical 2/3" w x h 6.60 x 8.80 (mm x mm)
(x)	1	(deg)	(deg)	(mm)	Field of view - w (W) x h - (mm x mm)			Field of view - w (W) x h - (mm x mm)		
										
1	6.3 (12.5)	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
		5.0	5.0	46.0	4.75 (4.85) x 3.61	6.33 (6.47) x 4.81	8.71 (8.89) x 6.61	3.55 (3.65) x 4.81	4.73 (4.87) x 6.41	6.51 (6.69) x 8.81
		10.0	10.0	46.0	4.70 (4.90) x 3.60	6.27 (6.53) x 4.80	8.62 (8.98) x 6.60	3.51 (3.70) x 4.81	4.68 (4.93) x 6.41	6.43 (6.78) x 8.81
		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
0.75	6.2 (10.9)	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	11.4	47.8	6.23 (6.63) x 4.89	8.31 (8.84) x 6.52	11.4 (12.2) x 8.97	4.63 (5.02) x 6.53	6.17 (6.70) x 8.71	8.48 (9.21) x 12.0
		20.0	15.3	47.8	6.17 (6.70) x 4.95	8.23 (8.93) x 6.60	11.3 (12.3) x 9.08	4.57 (1.83) x 6.61	6.09 (2.44) x 8.81	8.37 (3.35) x 12.1
0.5	6.3 (9.4)	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) x12.8	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	6.2 (8.3)	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	6.3 (7.5)	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	6.3 (6.9)	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

1 F/# = F-number, wF/# = Working F-number, the real F-number of a lens when used as a macro.

MCZR series

4x macro revolver with motorized control

KEY ADVANTAGES

Perfect magnification costancy
No need of re-calibration after zooming.

Perfect parfocality
No need of refocusing when changing magnification.

Excellent image center stability
Each magnification maintains its FOV center.

Full motorized control
Zoom magnification can be set either manually or via software.

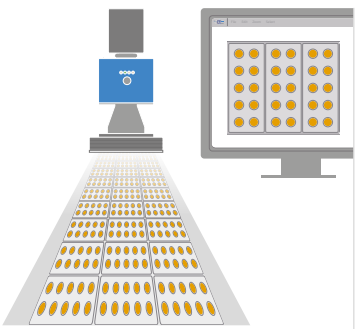
MANUAL AND SETUP

Please refer to our website for the updated MCZR manual and for a complete technical documentation of the setup process.
www.opto-engineering.com

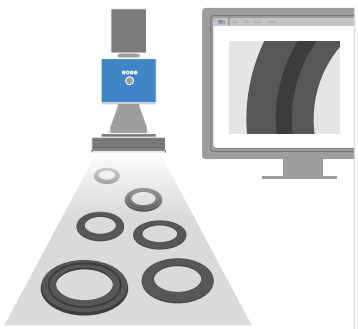
MCZR series are multiple-magnification optical systems which combine high resolution imaging with the flexibility of object format changing.
Unlike conventional zoom systems, MCZR have been specifically designed to work as **macro** lenses while the optical system ensures the same optical performances of very high-resolution fixed focal lenses.

The device can be both automatically and manually set to one of the four available magnifications; this optomechanical solution ensures that both magnification and image centering are maintained when returning to a specific configuration.
All of these features make these optical products perfect for all those on-line applications requiring frequent changes of format and high quality images all in one lens.

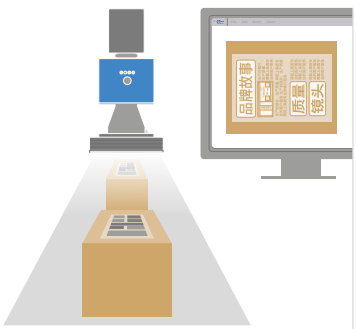
Application examples



Quality inspection of different sized objects



Quality inspection o-ring/gaskets



Package inspection

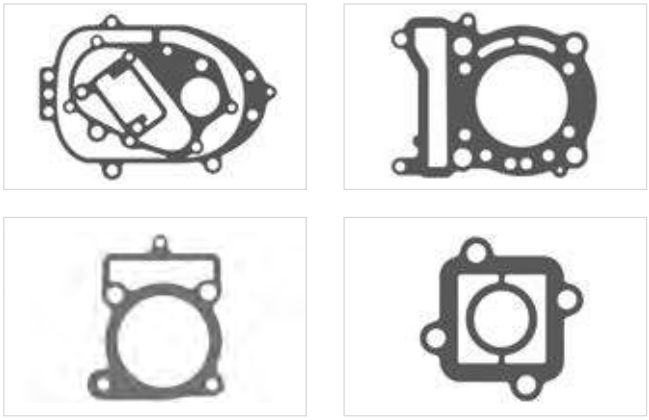
FOR TELECENTRIC MULTI-MAGNIFICATION OPTICS SEE ALSO

TCZR series p. 24

DEDICATED COMPATIBLE RING LIGHT

LTRN 036xx p. 120

Envelope barcode identification.



Gasket inspection.

			Detector type					Optical specifications					Dimensions		
Part number	**Mag.** (x)	**Image circle** Ø (mm)	**1/3" w x h** 4.80 x 3.60 (mm x mm)	**1/2.5" w x h** 5.70 x 4.28 (mm x mm)	**1/2" w x h** 6.40 x 4.80 (mm x mm)	**1/1.8" w x h** 7.13 x 5.37 (mm x mm)	**2/3" - 5 Mpx w x h** 8.45 x 7.07 (mm x mm)	**WD** (mm)	**F/# (wF/#)** 1	**Distortion** (%)	**Field depth** (mm) 2	**CTF** @50lp/mm (%)	**Mount**	**Length** (mm) 3	**Width x Height** (mm x mm)
			Object field of view (mm x mm)												
MCZR 033-008	0.083	11.0	57.7 x 43.3	68.6 x 51.4	77.0 x 57.7	85.7 x 64.6	101.6 x 85.0	208.4	4.6 (5)	< 0.2	18	> 40	C	146.4	98.1 x 91.9
	0.167		28.8 x 21.6	34.2 x 25.7	38.4 x 28.8	42.8 x 32.2	50.7 x 42.4		4.3 (5)	< 0.1	4.5	> 50			
	0.250		19.2 x 14.4	22.8 x 17.1	25.6 x 19.2	28.5 x 21.5	33.8 x 28.3		4.0 (5)	< 0.05	2	> 60			
	0.333		14.4 x 10.8	17.1 x 12.8	19.2 x 14.4	21.4 x 16.1	25.4 x 21.2		3.8 (5)	< 0.05	1.1	> 60			
MCZR 025-006	0.063	10.0	76.7 x 57.5	91.1 x 68.3	102.3 x 76.7	113.9 x 85.8	134.9 x 112.9	275.9	4.7 (5)	< 0.2	30	> 50	C	149.9	98.1 x 91.9
	0.125		38.3 x 28.7	45.5 x 34.1	51.0 x 38.3	56.8 x 42.8	67.3 x 56.3		4.4 (5)	< 0.1	8	> 50			
	0.188		25.5 x 19.2	30.3 x 22.8	34.1 x 25.5	37.9 x 28.6	44.9 x 37.6		4.2 (5)	< 0.05	3.5	> 60			
	0.251		19.1 x 14.4	22.7 x 17.1	25.5 x 19.1	28.4 x 21.4	33.7 x 28.2		4.0 (5)	< 0.05	1.9	> 50			
MCZR 018-004	0.047	10.0	102.3 x 76.7	121.5 x 91.1	136.4 x 102.3	151.9 x 114.4	179.9 x 150.5	384.8	4.8 (5)	< 1	55	> 40	C	154.5	98.1 x 91.9
	0.094		51.0 x 38.3	60.6 x 45.5	68.1 x 51.0	75.8 x 57.1	89.8 x 75.1		4.6 (5)	< 0.2	14	> 40			
	0.141		34.1 x 25.5	40.5 x 30.3	45.4 x 34.1	50.6 x 38.1	59.9 x 50.1		4.4 (5)	< 0.1	6	> 60			
	0.188		25.5 x 19.1	30.3 x 22.7	34.0 x 25.5	37.9 x 28.6	44.9 x 37.6		4.2 (5)	< 0.05	3.5	> 60			
MCZR 014-003	0.035	10.0	137.5 x 103.1	163.4 x 122.5	183.4 x 137.5	204.2 x 153.8	242.0 x 202.4	532.3	4.8 (5)	< 1	100	> 40	C	154.7	98.1 x 91.9
	0.070		68.6 x 51.5	81.5 x 61.2	91.5 x 68.6	101.9 x 76.8	120.8 x 101.0		4.7 (5)	< 0.2	25	> 40			
	0.105		45.8 x 34.4	54.4 x 40.8	61.1 x 45.8	68.0 x 51.2	80.6 x 67.4		4.5 (5)	< 0.1	11	> 60			
	0.140		34.3 x 25.8	40.8 x 30.6	45.8 x 34.3	51.0 x 38.4	60.4 x 50.5		4.4 (5)	< 0.05	6	> 60			

1 F/# = F-number, wF/# = Working F-number, the real F-number of a lens when used as a macro.

2 At the borders of the field depth the image can be still used for measurement but, to get a perfectly sharp image, only half of the nominal field depth should be considered.

3 Measured from the front end of the mechanics to the camera flange.

MCZM series

Macro zoom lenses

	Optical specifications							Dimensions		
Part number	**Focal length** (mm)	**Magnification**	**Image circle** (mm)	**WD** (mm)	**f/#**	**Back focal length** (mm)	**Distortion** (%)	**Length** (mm)	**Diam.** (mm)	**Mass** (g)
RT-MLM-3XMP	-	0.3 - 1.0	11	89.9	4.5	20.4	1.8	36.5	79.5	150
RT-MLH-10X-C	-	0.084 - 0.84	8	152 - 457	5.6	23.3	-	48.0	98.5	260
RT-TEC-M55	55	0.486 - 0.011	11	140 - 5000	2.8	29.8	0.6	53.0	92.9	320

FULL RANGE OF COMPATIBLE ILLUMINATORS

Backlights LTBP, LTBC, LTBFC p. 132-138

Domes LTDM series p. 114


OPTO

MZMT series

5X continuous macro zoom lenses with motorized control

NEW

KEY ADVANTAGES

Motorized zoom, focus and aperture.

Compact and robust design.

High resolution macro imaging.

Compatible MTDV controller
designed to drive MZMT stepper motors via Modbus RTU / USB or manual interface.

Suitable for high speed applications.

MZMT series motorized macro zoom lenses have been designed for inline applications where items of various sizes must be inspected with high resolution macro imaging.

Unlike many zoom lenses, MZMT working f-number is constant when magnification is changed, thus ensuring high optical throughput even at high magnifications. MZMT models feature a total continuous magnification range of 5x and fit detectors up 4/3", making them a very flexible solution to be used in many diverse applications.

Opto Engineering motorization design integrates three bipolar stepper motors that respectively control zooming, focusing and iris with fine incremental movements and accurate repetitive positioning.

MZMT moving parts are conveniently shielded and integrated within the lens barrel providing a zoom system that is both compact and robust. MZMT macro zoom lenses are complemented by dedicated stepper motor controller MTDV to be purchased separately.

All of these features make these zoom lenses perfect for all those on-line applications requiring changes of format and high quality images.

Product combinations*

MZMT lens + CBMT001 cable + MTDV controller

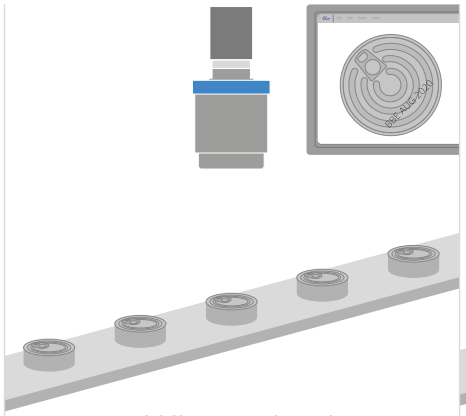
* To be ordered separately

Electrical specifications		
Iris		motorized
Focusing		
Zoom		
Connector		circular standard DIN 13Pos Male
Motor		
Number		3
Type		Stepper - bipolar
Supply voltage	(V, DC)	5 - 24
Amps/phase	(A)	0.5
Resistance/phase 1	(Ω)	10 ± 7%
Inductance/phase 2	(mH)	2.3 ± 20%
Holding Torque	(N·m)	0.135
Ratio		1:50
Step angle	(°)	18/50
Step accuracy		± 7%
Rotor inertia	(Kg/m^2)	1,0 x 10-7
Temperature rise	(°C)	80
Ambient temperature	(°C)	0 ÷ 50
Insulation resistance	(MΩ)	100
Insulation class		E - 120 °C
Dielectric strength 3	(V AC)	500
Ambient humidity		max 85% (no condensation)
Compatibility 4		
Stepper motors controller		MTDV3CH-00A1
Cable 5		CBMT001 (circular standard DIN 13Pos Female to DB15M connector cable, 2 m)

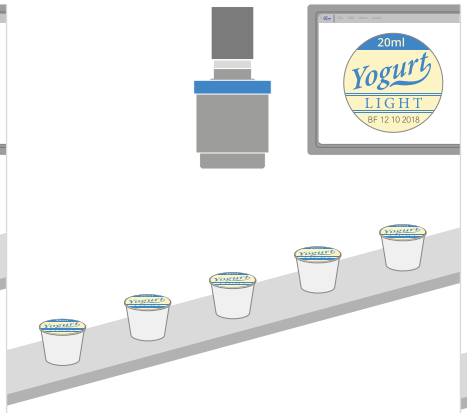
1 At 25 °C.
2 At 1 KHz.
3 For 1 min between the motor coils and the motor case.
4 All compatible products must be ordered separately.
5 Cable is required to connect MZMT series to MTDV3CH-00A1 controller and must be ordered separately.

DEDICATED COMPATIBLE RING LIGHT		
	LTRN 064 xx	p. 120
COMPATIBLE STEPPER MOTOR CONTROLLER		
	MTDV	p. 184

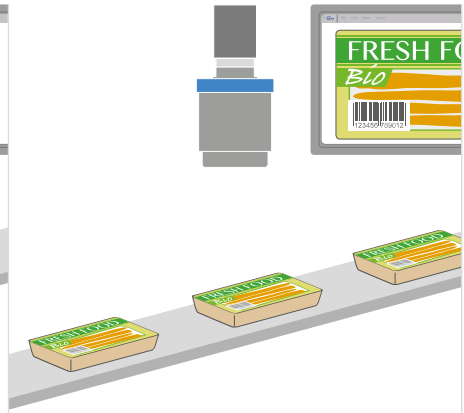
Application examples



Inspection of different sized metal containers



Inspection of different sized caps and closures



Inspection of different sized food packaging

				Detector type								Optical specifications						Mechanical spec.		
Part number		Mag.	Image circle	1/3'' w x h	1/2.5'' w x h	1/2'' w x h	1/1.8'' w x h	2/3" - 5 Mpx w x h	1'' w x h	1.2'' w x h	4/3'' w x h	WD	wF/#		Dist.	Field depth		CTF @50lp/mm	Mount	Length	Diam.
				4.80 x 3.60	5.70 x 4.28	6.40 x 4.80	7.13 x 5.37	8.47 x 7.07	12.80 x 9.60	15.20 x 15.20	18.10 x 13.60		min	max		min	max			
			Ø (mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm)			(%)	(mm)		(%)		(mm)	(mm)
				Object field of view (mm x mm) 1								2	3		4	5			6		
	max	0.327	16.0	14.7 x 11.0	17.4 x 13.1	19.6 x 14.7	21.8 x 16.4	25.9 x 21.6	39.2 x 29.4	Ø = 49.0	n.a.				< 2.0	1.8	13.2	50 @wF/# 5.6			
MZMT 10A5X-C		0.147	16.0	32.7 x 24.5	38.9 x 29.2	43.6 x 32.7	48.6 x 36.6	57.8 x 48.2	87.3 x 65.5	Ø = 109.1	n.a.	250.4	4.3	32	< 2.5	8.8	65.5	50 @wF/# 5.6	C	175	124
	min	0.069	16.0	69.9 x 52.4	83.0 x 62.3	93.2 x 69.9	103.8 x 78.2	123.3 x 103.0	186.4 x 139.8	Ø = 233.0	n.a.				< 3.5	32.8	298.6	65 @wF/# 5.6			
	max	0.463	22.7	10.4 x 7.8	12.3 x 9.3	13.8 x 10.4	15.4 x 11.6	18.3 x 15.3	27.7 x 20.8	32.9 x 32.9	39.1 x 29.4				< 2.0	1.6	6.6	50 @wF/# 8			
MZMT 43A5X-C		0.310	22.7	15.5 x 11.6	18.4 x 13.8	20.7 x 15.5	23.0 x 17.3	27.3 x 22.8	41.3 x 31.0	49.1 x 49.1	58.4 x 43.9	250.4	8.0	32	< 2.0	3.7	14.7	60 @wF/# 8	C	188	124
	min	0.097	22.7	49.4 x 37.0	58.6 x 44.0	65.8 x 49.4	73.4 x 55.2	87.1 x 72.7	131.7 x 98.8	156.4 x 156.4	186.2 x 139.9				< 3.5	37.3	121.9	40 @wF/# 8			
	max	0.463	22.7	10.4 x 7.8	12.3 x 9.3	13.8 x 10.4	15.4 x 11.6	18.3 x 15.3	27.7 x 20.8	32.9 x 32.9	39.1 x 29.4				< 2.0	1.3	6.6	50 @wF/# 8			
MZMT 43A5X-F		0.310	22.7	15.5 x 11.6	18.4 x 13.8	20.7 x 15.5	23.0 x 17.3	27.3 x 22.8	41.3 x 31.0	49.1 x 49.1	58.4 x 43.9	250.4	8.0	32	< 2.0	3.7	14.7	60 @wF/# 8	F	182	124
	min	0.097	22.7	49.4 x 37.0	58.6 x 44.0	65.8 x 49.4	73.4 x 55.2	87.1 x 72.7	131.7 x 98.8	156.4 x 156.4	186.2 x 139.9				< 3.5	37.3	149.0	40 @wF/# 8			
	max	0.463	22.7	10.4 x 7.8	12.3 x 9.3	13.8 x 10.4	15.4 x 11.6	18.3 x 15.3	27.7 x 20.8	32.9 x 32.9	39.1 x 29.4				< 2.0	1.6	6.6	50 @wF/# 8			
MZMT 43A5X-J		0.310	22.7	15.5 x 11.6	18.4 x 13.8	20.7 x 15.5	23.0 x 17.3	27.3 x 22.8	41.3 x 31.0	49.1 x 49.1	58.4 x 43.9	250.4	8.0	32		3.7	14.7	60 @wF/# 8	M42x1 FD12	193	124
	min	0.097	22.7	49.4 x 37.0	58.6 x 44.0	65.8 x 49.4	73.4 x 55.2	87.1 x 72.7	131.7 x 98.8	156.4 x 156.4	186.2 x 139.9				< 3.5	37.3	149.0	40 @wF/# 8			

1 For the fields with the indication "Ø =", the image of a circular object of such diameter is fully inscribed into the detector.
2 Working distance: distance between the front end of the mechanics and the object. Set this distance within +/- 3% of the nominal value for maximumresolution and minimum distortion.
3 Working F-number (wF/#): the real F-number of a lens when used as a macro.
4 Percent deviation of the real image compared to an ideal, undistorted image. Absolute values are listed.
5 At the borders of the field depth the image can be still used for measurement but, to get a very sharp image, only half of the nominal field depth should be considered. Pixel size used for calculation is 5.5 µm.
6 Measured from the front end of the mechanics to the camera flange.

MC4K series

Macro lenses for 4 k pixel linescan cameras

KEY ADVANTAGES

Macro design
Achieve unmatched resolution in critical applications: these objectives consistently deliver superior image quality than standard fixed focal length lenses used with extension tubes.

Exceptional low distortion
Perform measurement tasks with a high degree of accuracy and reliability.

Optimized aperture
For each magnification, the F/# is optimized to ensure the best field depth and image resolution.

Easy front filter insertion
Thanks to the front M30.5x0.5 thread.

MC4K series is a collection of macro lenses fitting both 4K linescan cameras and matrix detector cameras over 4/3".

These lenses are specifically designed to work as macros, as opposed to infinite conjugate lenses with added spacers: a common alternative but unable to deliver the same optical performances.

MC4K lenses feature a fixed aperture, selected to ensure optimal field depth, image resolution and brightness for each magnification range, while meeting the typical needs of machine vision applications. The absence of an iris adjustment mechanism leads to a simpler and streamlined build, granting extra durability and precision.

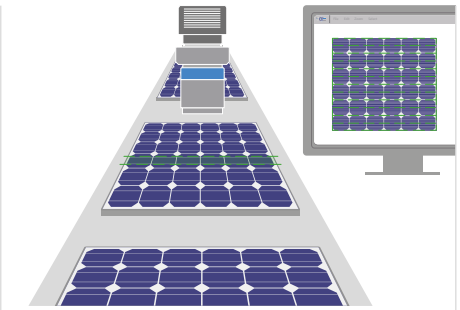
Machine integration is made easy thanks to the precise focusing mechanism and the possibility to choose from an F or M42x1 mount (-N). MC4K series additionally features a front M30.5x0.5 thread for the insertion of an optional filter as well as easy phase adjustment.

Mount F

Mount N = M42x1

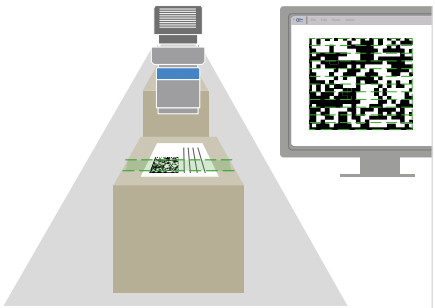
FULL RANGE OF COMPATIBLE ILLUMINATORS		
	Bar lights LTBRDC series	p. 139
	Backlights LTBP, LTBC, LTBFC	p. 132-138

Application examples



Solar cell inspection

Print and web inspection



Identification: data-matrix and barcode reading

Phase adjustment

Adjusting the phase of the camera mounted on MC4K macro lenses is easy: simply loosen the three set screws and rotate the camera mount until you achieve the desired angular alignment.

			Detector type						Optical specifications							Dimensions			
			KAI-04050 16 mm diag	line 2k	KAI4022/4021 21.5 mm diag	KAI-08050 22.6 mm diag	APS-C 28.35 mm	line 4k											
Part number	Focusing	Mag.	w x h 12.8 x 9.6	2k x 10 µm 20.5	w x h 15.2 x 15.2	w x h 18.1 x 13.6	w x h 23.6 x 15.7	4k x 7 µm 28.67	WD	F/# (wF/#)	Distortion typical (max)	Field depth	CTF @50lp/mm	Image side NA	Object side NA	Length		Diam.	
	1	(x)	(mm x mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	2	(%) 3	(mm) 4	(%)			(mm) 5		(mm)	
			Object field of view (mm x mm)													F	N	F	N
	near	0.295	43.4 x 32.5	69.4	51.5 x 51.5	61.4 x 46.1	80.0 x 53.2	97.2	298.5										
MC4K 025X-x	nominal	0.250	51.2 x 38.4	81.9	60.8 x 60.8	72.4 x 54.4	94.4 x 62.8	114.7	346.1	6.4 (8)	< 0.08 (0.1)	6.8	>60	0.063	0.018	80.0	115.9	64.0	52.0
	far	0.205	62.4 x 46.8	99.9	74.1 x 74.1	88.3 x 66.3	115.1 x 64.9	139.9	414.3										
	near	0.545	23.5 x 17.6	37.6	27.9 x 27.9	33.2 x 25.0	43.3 x 28.8	52.6	177.0										
MC4K 050X-x	nominal	0.500	25.6 x 19.2	41.0	30.4 x 30.4	36.2 x 27.2	47.2 x 31.4	57.3	189.9	6.7 (10)	< 0.04 (0.08)	2.5	> 50	0.050	0.027	99.5	135.4	64.0	52.0
	far	0.455	28.1 x 21.1	45.0	33.4 x 33.4	39.8 x 29.9	51.9 x 31.6	63.0	205.2										
	near	0.795	16.1 x 12.1	25.8	19.1 x 19.1	22.8 x 17.1	29.7 x 19.7	36.1	131.4										
MC4K 075X-x	nominal	0.750	17.1 x 12.8	27.3	20.3 x 20.3	24.1 x 18.1	31.5 x 20.9	38.2	137.3	6.3 (11)	< 0.04 (0.08)	1.3	> 50	0.045	0.036	113.6	149.5	64.0	52.0
	far	0.704	18.2 x 13.6	29.1	21.6 x 21.6	25.7 x 19.3	33.5 x 21.0	40.7	143.9										
	near	1.045	12.2 x 9.19	19.6	14.5 x 14.5	17.3 x 13.0	22.5 x 15.0	27.4	108.2										
MC4K 100X-x	nominal	1.000	12.8 x 9.60	20.5	15.2 x 15.2	18.1 x 13.6	23.6 x 15.7	28.7	111.6	6.5 (13)	< 0.01 (0.03)	0.9	> 50	0.038	0.040	132.9	168.8	64.0	52.0
	far	0.954	13.4 x 10.1	21.5	15.9 x 15.9	19.0 x 14.3	24.7 x 15.7	30.1	115.2										
	near	1.295	9.88 x 7.41	15.8	11.7 x 11.7	14.0 x 10.5	18.2 x 12.2	22.1	94.0										
MC4K 125X-x	nominal	1.250	10.2 x 7.68	16.4	12.2 x 12.2	14.5 x 10.9	18.9 x 12.6	22.9	96.1	6.7 (15)	< 0.01 (0.03)	0.7	> 40	0.033	0.043	152.2	188.1	64.0	52.0
	far	1.204	10.6 x 7.97	17.0	12.6 x 12.6	15.0 x 11.3	19.5 x 12.6	23.8	98.5										
	near	1.543	8.30 x 6.22	13.3	9.85 x 9.85	11.7 x 8.81	15.3 x 10.2	18.6	89.9										
MC4K 150X-x	nominal	1.500	8.53 x 6.40	13.7	10.1 x 10.1	12.1 x 9.07	15.7 x 10.5	19.1	91.4	6.8 (17)	< 0.01 (0.03)	0.5	> 35	0.029	0.045	178.6	214.5	64.0	52.0
	far	1.455	8.80 x 6.60	14.1	10.4 x 10.4	12.4 x 9.35	16.2 x 10.6	19.7	93.0										
	near	1.793	7.14 x 5.35	11.4	8.48 x 8.48	10.1 x 7.59	13.2 x 8.8	16.0	82.7										
MC4K 175X-x	nominal	1.750	7.31 x 5.49	11.7	8.69 x 8.69	10.3 x 7.77	13.5 x 9.0	16.4	83.8	6.5 (18)	< 0.01 (0.03)	0.4	> 35	0.028	0.049	198.5	234.4	64.0	52.0
	far	1.705	7.51 x 5.63	12.0	8.91 x 8.91	10.6 x 7.98	13.8 x 9.0	16.8	85.0										
	near	2.042	6.27 x 4.70	10.0	7.44 x 7.44	8.86 x 6.66	11.6 x 7.7	14.0	77.3										
MC4K 200X-x	nominal	2.000	6.40 x 4.80	10.2	7.60 x 7.60	9.05 x 6.80	11.8 x 7.9	14.3	78.1	6.7 (20)	< 0.01 (0.03)	0.4	> 30	0.025	0.050	218.4	254.4	64.0	52.0
	far	1.955	6.55 x 4.91	10.5	7.77 x 7.77	9.26 x 6.96	12.1 x 7.9	14.7	79.0										

1 Maximum and minimum magnification changes when focusing.
2 F/# = F-number, wF/# = Working F-number, the real F-number of a lens when used as a macro.
3 Percent deviation of the real image compared to an ideal, undistorted image: typical (average production) values and maximum (guaranteed) values are listed.
4 At the borders of the field depth the image can be still used for measurement but to get a perfectly sharp image only half of the nominal field depth should be taken into account.
5 Measured from the front end of the mechanics to the camera flange; take into account a +/- 2.5 mm tolerance due to the focussing mechanism.

Ordering information

It's easy to select the right lens for your application: our part numbers are coded as **MC4K yyyX -x** where **yyy** refers to the magnification and **-x** refers to the mount option:
- **F** for F-mount
- **N** for M42x1 mount (flange distance FD 10.56 mm).

E.g. MC4K100X-N for a MC4K100X with M42x1 mount.

MC12K series

Macro lenses for 12 k and 16 k pixel linescan cameras

Mount F | Mount I = M58x0.75 | Mount R = M72x0.75

MC12K series are macro lenses specifically optimized to work with high resolution line scan cameras with sensor size up to 62 mm. Infinite conjugate lenses, like photographic equipment optics, will offer poor performances when used to observe objects from up close: MC12K series are macro by design, enabling unmatched and uniform optical performances at short working distances.

MC12K series are the ideal choice for industrial applications where maximum image resolution is required: solar cells and printed sheets inspection, web inspection or high speed product sorting are just a few examples.

In addition to the standard M72x0.75 mount, MC12K lenses can be easily equipped with any camera mount at no additional cost ensuring wide compatibility with most common linescan cameras.

KEY ADVANTAGES

Macro design
Achieve unmatched resolution in critical applications.

Exceptional low distortion
Perform measurement tasks with a high degree of accuracy and reliability.

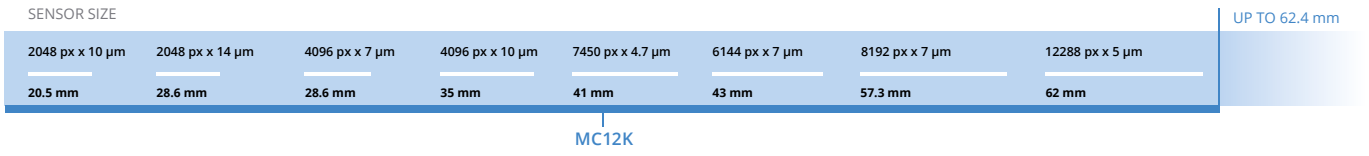
Optimized for high resolution linescan cameras
MC12K feature a large image circle ensuring wide compatibility with line scan sensors (up to 62.4 mm).

Color correction
MC12K can distinguish the finest tonal gradations and are the ideal solution for demanding applications where color consistency is required.

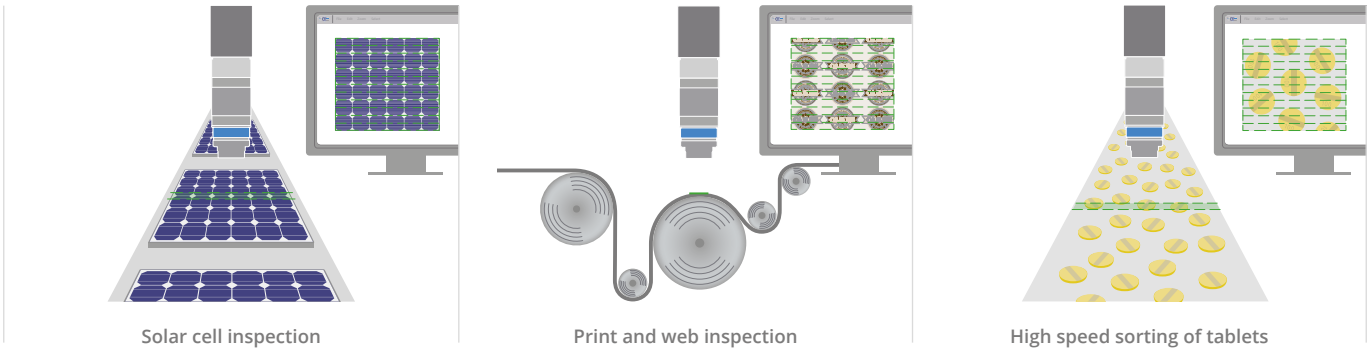
Industrial design for factory automation
MC12K feature precise manual focusing mechanism to achieve the best possible image sharpness.

Wide image circle

MC12K is optimized to cover the line scan sensor sizes up to 62.4 mm.



Application examples



Solar cell inspection | Print and web inspection | High speed sorting of tablets

Part number	Focusing [1]	Mag. (x)	Detector type: Full frame 35 mm w x h 36.0 x 24.0 (mm x mm)	Detector type: Line 16 kpx 16 k x 3.5 µm 57.3 (mm)	Detector type: Line 2 kpx 12 k x 5 µm 61.4 (mm)	Detector type: Line 12 kpx 12 k x 5.2 µm 62.4 (mm)	WD (mm)	F/# (wF/#) [2]	Distortion typical (max) (%) [3]	Field depth (mm) [4]	CTF @50lp/mm (%)	Image side NA	Object side NA	Mount [6]	Length (mm) [5]	Diam. (mm)
			Object field of view (mm x mm)													
	near	2.017	17.8 x 11.9	n.a.	n.a.	n.a.	93.6							F		
MC12K 200X-F	**nominal**	**2.000**	**18.0 x 12.0**	**n.a.**	**n.a.**	**n.a.**	**94.0**	6.0 (18)	< 0.01 (0.02)	0.15	> 30	0.028	0.056		242.2	76
	far	1.983	18.2 x 12.1	n.a.	n.a.	n.a.	94.4									
	near	2.017	17.8 x 11.9	28.7	n.a.	n.a.	93.6							M58 x 0.75		
MC12K 200X-I	**nominal**	**2.000**	**18.0 x 12.0**	**28.7**	**n.a.**	**n.a.**	**94.0**	6.0 (18)	< 0.01 (0.02)	0.15	> 30	0.028	0.056	FD 11.48	276.7	76
	far	1.983	18.2 x 12.1	29.2	n.a.	n.a.	94.4									
	near	2.017	17.8 x 11.9	28.7	30.5	30.7	93.6							M72 x 0.75		
MC12K 200X-R	**nominal**	**2.000**	**18.0 x 12.0**	**28.7**	**30.7**	**31.2**	**94.0**	6.0 (18)	< 0.01 (0.02)	0.15	> 30	0.028	0.056	FD 6.56	281.8	76
	far	1.983	18.2 x 12.1	29.2	31.0	31.3	94.4									
	near	1.517	23.7 x 15.8	38.2	n.a.	n.a.	109.3							F		
MC12K 150X-F	**nominal**	**1.500**	**24.0 x 16.0**	**38.2**	**n.a.**	**n.a.**	**110.0**	6.0 (15)	< 0.01 (0.02)	0.2	> 40	0.033	0.05		202.8	76
	far	1.484	24.3 x 16.2	39.0	n.a.	n.a.	110.7									
	near	1.517	23.7 x 15.8	38.2	n.a.	n.a.	109.3							M58 x 0.75		
MC12K 150X-I	**nominal**	**1.500**	**24.0 x 16.0**	**38.2**	**n.a.**	**n.a.**	**110.0**	6.0 (15)	< 0.01 (0.02)	0.2	> 40	0.033	0.05	FD11.48	237.4	76
	far	1.484	24.3 x 16.2	39.0	n.a.	n.a.	110.7									
	near	1.517	23.7 x 15.8	38.2	40.5	40.9	109.3							M72 x 0.75		
MC12K 150X-R	**nominal**	**1.500**	**24.0 x 16.0**	**38.2**	**41.0**	**41.6**	**110.0**	6.0 (15)	< 0.01 (0.02)	0.2	> 40	0.033	0.05	FD 6.56	242.5	76
	far	1.484	24.3 x 16.2	39.0	41.4	41.8	110.7									
	near	1.018	35.4 x 23.6	56.9	n.a.	n.a.	134.0							F		
MC12K 100X-F	**nominal**	**1.000**	**36.0 x 24.0**	**57.3**	**n.a.**	**n.a.**	**135.5**	6.0 (12)	< 0.01 (0.02)	0.3	> 50	0.042	0.042		155.4	76
	far	0.984	36.6 x 24.4	58.9	n.a.	n.a.	137.0									
	near	1.018	35.4 x 23.6	56.9	n.a.	n.a.	134.0							M58 x 0.75		
MC12K 100X-I	**nominal**	**1.000**	**36.0 x 24.0**	**57.3**	**n.a.**	**n.a.**	**135.5**	6.0 (12)	< 0.01 (0.02)	0.3	> 50	0.042	0.042	FD11.48	189.9	76
	far	0.984	36.6 x 24.4	58.9	n.a.	n.a.	137.0									
	near	1.018	35.4 x 23.6	56.9	60.4	61.0	134.0							M72 x 0.75		
MC12K 100X-R	**nominal**	**1.000**	**36.0 x 24.0**	**57.3**	**61.4**	**62.4**	**135.5**	6.0 (12)	< 0.01 (0.02)	0.3	> 50	0.042	0.042	FD 6.56	195.0	76
	far	0.984	36.6 x 24.4	58.9	62.5	63.1	137.0									
	near	0.684	52.7 x 35.1	84.7	n.a.	n.a.	179.7							F		
MC12K 067X-F	**nominal**	**0.667**	**54.0 x 36.0**	**86.0**	**n.a.**	**n.a.**	**183.0**	6.0 (10)	< 0.01 (0.02)	0.6	> 60	0.050	0.033		130.0	76
	far	0.650	55.4 x 36.9	88.2	n.a.	n.a.	186.4									
	near	0.684	52.7 x 35.1	84.7	n.a.	n.a.	179.7							M58 x 0.75		
MC12K 067X-I	**nominal**	**0.667**	**54.0 x 36.0**	**86.0**	**n.a.**	**n.a.**	**183.0**	6.0 (10)	< 0.01 (0.02)	0.6	> 60	0.050	0.033	FD 11.48	164.5	76
	far	0.650	55.4 x 36.9	88.2	n.a.	n.a.	186.4									
	near	0.684	52.7 x 35.1	84.7	89.9	90.7	179.7							M72 x 0.75		
MC12K 067X-R	**nominal**	**0.667**	**54.0 x 36.0**	**86.0**	**92.2**	**93.6**	**183.0**	6.0 (10)	< 0.01 (0.02)	0.6	> 60	0.050	0.033	FD 6.56	169.6	76
	far	0.650	55.4 x 36.9	88.2	94.5	96.0	186.4									
	near	0.517	69.6 x 46.4	111.9	n.a.	n.a.	217.1							F		
MC12K 050X-F	**nominal**	**0.500**	**72.0 x 48.0**	**114.7**	**n.a.**	**n.a.**	**223.0**	6.0 (9)	< 0.01 (0.02)	0.9	> 50	0.056	0.028		113.6	76
	far	0.483	74.5 x 49.6	119.7	n.a.	n.a.	229.1									
	near	0.517	69.6 x 46.4	111.9	n.a.	n.a.	217.1							M58 x 0.75		
MC12K 050X-I	**nominal**	**0.500**	**72.0 x 48.0**	**114.7**	**n.a.**	**n.a.**	**223.0**	6.0 (9)	< 0.01 (0.02)	0.9	> 50	0.056	0.028	FD 11.48	148.2	76
	far	0.483	74.5 x 49.6	119.7	n.a.	n.a.	229.1									
	near	0.517	69.6 x 46.4	111.9	118.8	119.9	217.1							M72 x 0.75		
MC12K 050X-R	**nominal**	**0.500**	**72.0 x 48.0**	**114.7**	**122.9**	**124.8**	**223.0**	6.0 (9)	< 0.01 (0.02)	0.9	> 50	0.056	0.028	FD 6.56	153.3	76
	far	0.483	74.5 x 49.6	119.7	127.1	128.3	229.1									
	near	0.266	135.3 x 90.2	217.6	n.a.	n.a.	393.6							F		
MC12K 025X-F	**nominal**	**0.250**	**144.0 x 96.0**	**229.4**	**n.a.**	**n.a.**	**415.5**	6.4 (8)	< 0.05 (0.1)	3.2	> 50	0.063	0.016		99.3	76
	far	0.234	154.2 x 102.8	247.9	n.a.	n.a.	393.6									
	near	0.266	135.3 x 90.2	217.6	n.a.	n.a.	393.6							M58 x 0.75		
MC12K 025X-I	**nominal**	**0.250**	**144.0 x 96.0**	**229.4**	**n.a.**	**n.a.**	**415.5**	6.4 (8)	< 0.05 (0.1)	3.2	> 50	0.063	0.016	FD 11.48	133.8	76
	far	0.234	154.2 x 102.8	247.9	n.a.	n.a.	393.6									
	near	0.266	135.3 x 90.2	217.6	231.1	233.2	393.6							M72 x 0.75		
MC12K 025X-R	**nominal**	**0.250**	**144.0 x 96.0**	**229.4**	**245.8**	**249.6**	**415.5**	6.4 (8)	< 0.05 (0.1)	3.2	> 50	0.063	0.016	FD 6.56	138.9	76
	far	0.234	154.2 x 102.8	247.9	263.2	265.6	393.6									
	near	0.142	254.4 x 169.6	409.1	n.a.	n.a.	678.5							M58 x 0.75		
MC12K 012X-I	**nominal**	**0.125**	**287.0 x 192.0**	**458.4**	**n.a.**	**n.a.**	**762.0**	6.2 (7)	< 0.05 (0.1)	11	> 50	0.071	0.009	FD 11.48	120.2	76
	far	0.108	332.5 x 221.7	534.5	n.a.	n.a.	873.2									
	near	0.142	254.4 x 169.6	409.1	434.4	438.3	678.5							M72 x 0.75		
MC12K 012X-R	**nominal**	**0.125**	**287.0 x 192.0**	**458.4**	**491.1**	**498.8**	**762.0**	6.2 (7)	< 0.05 (0.1)	11	> 50	0.071	0.009	FD 6.56	125.3	76
	far	0.108	332.5 x 221.7	534.5	567.5	572.6	873.2									
	near	0.100	359.2 x 239.5	577.7	n.a.	n.a.	924.1							M58 x 0.75		
MC12K 008X-I	**nominal**	**0.083**	**432.0 x 288.0**	**687.3**	**n.a.**	**n.a.**	**1102.5**	6.5 (7)	< 0.05 (0.1)	15	> 50	0.071	0.006	FD 11.48	115.9	76
	far	0.067	541.1 x 360.7	869.9	n.a.	n.a.	1370.9									
	near	0.100	359.2 x 239.5	577.7	613.5	619.1	924.1							M72 x 0.75		
MC12K 008X-R	**nominal**	**0.083**	**432.0 x 288.0**	**687.3**	**736.4**	**747.9**	**1102.5**	6.5 (7)	< 0.05 (0.1)	15	> 50	0.071	0.006	FD 6.56	121.0	76
	far	0.067	541.1 x 360.7	869.9	923.6	932.0	1370.9									

1 Maximum and minimum magnification changes when focusing.
2 F/# = F-number, wF/# = Working F-number, the real F-number of a lens when used as a macro.
3 Percent deviation of the real image compared to an ideal, undistorted image: typical (average production) values and maximum (guaranteed) values are listed.
4 At the borders of the field depth the image can be still used for measurement but to get a perfectly sharp image only half of the nominal field depth should be taken into account.
5 Measured from the front end of the mechanics to the camera flange; take into account a +/- 2.5 mm tolerance due to the focussing mechanism.
6 FD stands for Flange Distance (in mm), defined as the distance from the mounting flange (the "metal ring" in rear part of the lens) to the camera detector plane.
F Mount (-F) may cause vignetting with sensor diagonal > 50 mm.
For such sensor size we suggest mount M72x0.75, FD 6.56 (-R).
Mount M58x0.75 (-I) may cause vignetting with sensor diagonal > 52 mm.
For such sensor size we suggest mount M72x0.75, FD 6.56 (-R).

Ordering information

It's easy to select the right lens for your application: our part numbers are coded as **MC12K yyyX-x** where **yyy** refers to the magnification and **-x** refers to the mount option:
- R for M72x0.75 mount (flange distance FD 6.56 mm)
- F for F-mount
- I for M58x0.75 mount (flange distance FD 11.48 mm).

E.g. MC12K100X-I for a MC12K100X with M58x0.75 mount.

FULL RANGE OF COMPATIBLE ILLUMINATORS


Bar lights LTBRDC series p. 139


Backlights LTBP, LTBC, LTBFC p. 132-138

FULL RANGE OF COMPATIBLE CLAMPING MECHANICS


CMHOMC12Kxxx p. 162

MC16K series

Macro Lenses for up to 82 mm line detectors

				Detector type						Optical specifications				Dimension		
Part number	**Focal length**	**Mag.**	**Image circle**	**35 mm** w x h 36.0 x 24.0	**Line - 8k** 8k x 7µm 57.3	**Line - 16k** 16k x 3.5µm 57.3	**Line - 12k** 12k x 5µm 61.4	**Line - 12k** 12k x 5.2µm 62.4	**Line - 16k** 16k x 5µm 81.9	**WD**	**wF/#**	**Back focal length**	**Distort.**	**Mount**	**Length**	**Diam.**
	(mm)		Ø (mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm)	(mm)			(%)		(mm)	(mm)
				Object field of view												
RT-OPKE16-050M95	116	0.5	82	70.0	114.7	114.7	122.9	124.8	162.6	296 ± 5	3.8	10	0.01	M95X1	496 ± 9	47
RT-OPKE16-070M95	116	0.7	82	50.0	81.9	81.9	87.8	89.1	116.1	221.9 ± 5	3.8	10	0.01	M95X1	447.9 ± 9	47
RT-OPKE16-100M95	116	1	82	35.0	57.3	57.3	61.4	62.4	81.3	182.9 ± 5	3.8	10	0.01	M95X1	439.4 ± 8	47
RT-OPKE16-150M95	116	1.5	82	23.3	38.2	38.2	41.0	41.6	54.2	143.9 ± 5	3.8	10	0.01	M95X1	453.7 ± 9	47
RT-OPKE16-200M95	116	2	82	17.5	28.7	28.7	30.7	31.2	40.6	127.1 ± 5	3.8	10	0.01	M95X1	496 ± 9	47
RT-OPKE16-300M95	116	3	82	11.7	19.1	19.1	20.5	20.8	27.1	111.4 ± 3	4.2	10	0.01	M95X1	591.4 ± 8	47

FULL RANGE OF COMPATIBLE ILLUMINATORS

Bar lights LTBRDC series p. 139

Backlights LTBP, LTBC, LTBFC p. 132-138

FIXED FOCALS LENSES

A wide range of solutions for every machine vision challenge.

Opto Engineering family of fixed focal lenses comprises many optics with special features in addition to the most common types of optics used in machine vision: we offer a wide variety of fixed focal lenses, covering small, medium and large detectors, including options for high resolution and UV imaging.

Specifically, these optics are regarded as a valid alternative to macro lenses in applications where a large field of view must be imaged and the required magnification is low.

At Opto Engineering we are constantly working to provide **added-value** products to our customers and this family is no exception: in fact, in addition to common fixed focal lenses, you will find a whole new line-up of optics featuring **full motorized iris and focusing** that can be easily controlled with a dedicated stepper motor controller featuring open protocol and software.

Refer to specific datasheets available at **www.opto-engineering.com** for product compliancy with regulations, certifications and safety labels.

ENMT series

Fixed focal length lenses with motorized focus and aperture control

NEW

KEY ADVANTAGES

Motorized focusing and aperture
for fine and repeatable tuning of image focus and F-number setting.

Fully automated installations with remote operation possibility.

Compact and robust design.

High optical resolution.

Compatible MTDV controller
designed to drive ENMT stepper motors via Modbus RTU / USB or manual interface.

ENMT series are high resolution fixed focal length lenses with automated adjustment of focus and aperture.
These motorized lenses guarantee programmable precise and repeatable adjustment of both the aperture and focus to realize fully automated systems. This feature is ideal for installations where remote operation is necessary (e.g. in clean rooms where an operator cannot manually adjust the optical parameters), besides those requiring possibility to change format, lighting conditions, working distance or even inspection task. Additionally, different machines can be set with the exact same aperture/focus setting by automatically loading a pre-set configuration.
Thanks to ENMT precise motorization system, the user fully exploits the high resolution of ENMT fixed focal length optics.
In fact, when compared to coarse manual operation, motorized adjustment allows for very fine and repeatable tuning of both the image focus and F-number setting.
Opto Engineering motorization design integrates two bipolar stepper motors that respectively control focusing and aperture with fine incremental movements and accurate repeatable positioning. ENMT moving parts are conveniently shielded and integrated within a compact and robust enclosure.
Focus and aperture can be adjusted by means of dedicated MTDV controller (to be ordered separately) specifically designed to drive up to three bi-polar stepper motors via Modbus RTU/USB or manually.

ENMT series integrate high resolution optics featuring minimum distortion and 11 mm image circle for 5 Megapixel detectors up to 2/3″.

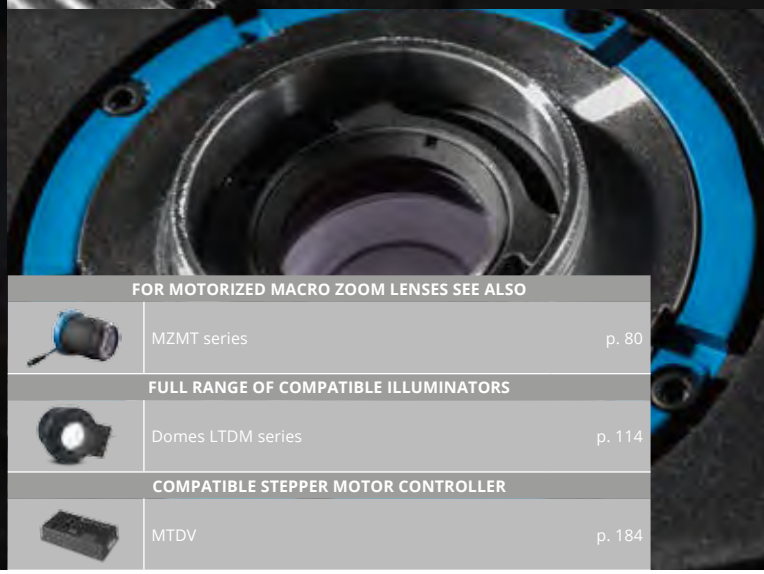
Product combinations*

ENMT lens + CBMT001 cable + MTDV controller

* To be ordered separately

Electrical specifications		
Iris		motorized
Focusing		
Connector		circular standard DIN 13Pos Male
Motor		
Number		2
Type		Stepper - bipolar
Supply voltage	(V, DC)	5 - 24
Amps/phase	(A)	0.5
Resistance/phase 1	(Ω)	10 ± 7%
Inductance/phase 2	(mH)	2.3 ± 20%
Holding Torque	(N·m)	0.135
Ratio		1:50
Step angle	(°)	18/50
Step accuracy		± 7%
Rotor inertia	(Kg/m^2)	1,0 x 10-7
Temperature rise	(°C)	80
Ambient temperature	(°C)	0 ÷ 50
Insulation resistance	(MΩ)	100
Insulation class		E - 120 °C
Dielectric strength 3	(V AC)	500
Ambient humidity		max 85% (no condensation)
Compatibility 4		
Stepper motors controller		MTDV3CH-00A1
Cable 5		CBMT001 (circular standard DIN 13Pos Female to DB15M connector cable, 2 m)

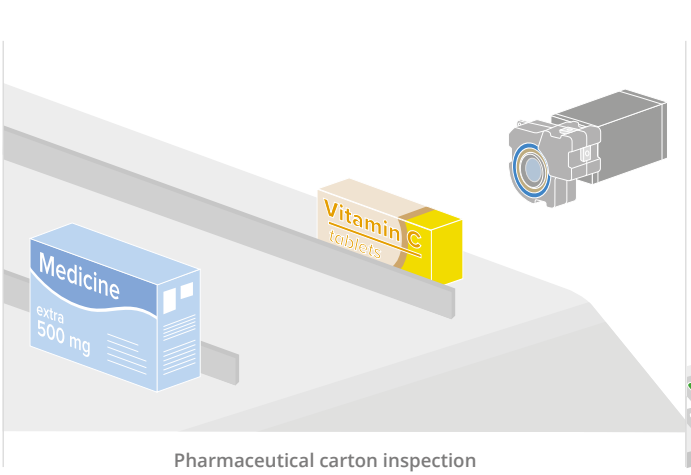
1 At 25 °C.
2 At 1 KHz.
3 For 1 min between the motor coils and the motor case.
4 All compatible products must be ordered separately.
5 Cable is required to connect MZMT series to MTDV3CH-00A1 controller and must be ordered separately.



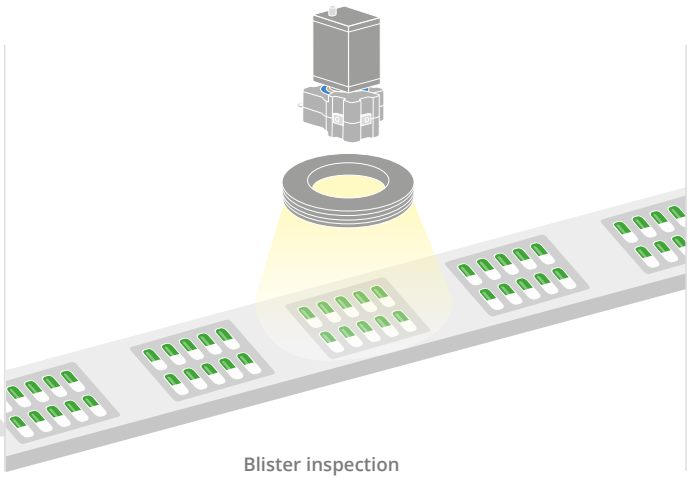
FOR MOTORIZED MACRO ZOOM LENSES SEE ALSO		
	MZMT series	p. 80
FULL RANGE OF COMPATIBLE ILLUMINATORS		
	Domes LTDM series	p. 114
COMPATIBLE STEPPER MOTOR CONTROLLER		
	MTDV	p. 184

	Optical specifications								Mechanical specifications			
Part number	**Focal length** (mm)	**Mag.**	**Image circle** Ø (mm)	**Max detector size**	**WD** (mm)	**F/#**	**Back focal length** (mm)	**Distortion** (%)	**Mount**	**Length** (mm)	**Width** (mm)	**Height** (mm)
ENMT-M1224-MPW2-MM	12	0.100 - 0	11	2/3"	100 - ∞	2.4 - 16	14.4	0.35	C	81.5	41.3	70
ENMT-M1620-MPW2-MM	16	0.075 - 0	11	2/3"	200 - ∞	2.0 - 16	14.7	0.1	C	81.5	41.3	70
ENMT-M2518-MPW2-MM	25	0.081 - 0	11	2/3"	300 - ∞	1.8 - 16	13.8	0.03	C	81.5	41.3	70
ENMT-M3520-MPW2-MM	35	0.190 - 0	11	2/3"	200 - ∞	2.0 - 22	18.0	0.01	C	81.5	41.3	70
ENMT-M5028-MPW2-MM	50	0.138 - 0	11	2/3"	400 - ∞	2.8 - 32	27.7	0.027	C	81.5	52.3	70

Application examples



Pharmaceutical carton inspection



Blister inspection

ENMP series

Megapixel C-mount lenses for detectors up to 2/3"

	Optical specifications								Mechanical specifications		
Part number	**Focal length** (mm)	**Magnification** (x)	**Image circle** Ø (mm)	**Max detector size**	**WD** (mm)	**F/#**	**Back focal length** (mm)	**Distortion** (%)	**Mount**	**Length** (mm)	**Diameter** (mm)
RT-H0514-MP2	5	0.044 - 0	8	1/2"	100 - ∞	1.4 - 16C	10.8	0.5	C	45.5	44.5
RT-M0814-MP2	8	0.075 - 0	11	2/3"	100 - ∞	1.4 - 16C	13.1	0.1	C	28.2	33.5
RT-M1214-MP2	12	0.074 - 0	11	2/3"	150 - ∞	1.4 - 16C	13.1	0.1	C	28.2	33.5
RT-M1614-MP2	16	0.052 - 0	11	2/3"	300 - ∞	1.4 - 16C	13.1	0.1	C	28.2	33.5
RT-M2514-MP2	25	0.084 - 0	11	2/3"	300 - ∞	1.4 - 16C	13.1	0.3	C	36.0	33.5
RT-M3514-MP	35	0.110 - 0	11	2/3"	300 - ∞	1.4 - 16C	17.1	0.8	C	38.2	33.5
RT-M5018-MP2	50	0.100 - 0	11	2/3"	500 - ∞	1.8 - 16C	13.1	0.3	C	38.2	33.5
RT-M7528-MP	75	0.214 - 0	11	2/3"	300 - ∞	2.8 - 16C	21.5	0.4	C	57.8	35.0

FIXED FOCAL LENSES | 1/3" TO 2/3" SENSORS

ENHR series

5 Megapixel C-mount lenses for detectors up to 2/3"

	Optical specifications								Mechanical specifications		
Part number	**Focal length** (mm)	**Magnification** (x)	**Image circle** Ø (mm)	**Max detector size**	**WD** (mm)	**F/#**	**Back focal length** (mm)	**Distortion** (%)	**Mount**	**Length** (mm)	**Diameter** (mm)
RT-M0824-MPW2	8	0.100 - 0	11	2/3"	50 - ∞	2.4 - 16	13.7	1.87	C	32.0	45.7
RT-M1224-MPW2	12	0.100 - 0	11	2/3"	100 - ∞	2.4 - 16	14.4	0.35	C	29.0	42.7
RT-M1620-MPW2	16	0.075 - 0	11	2/3"	200 - ∞	2.0 - 16	14.7	0.1	C	29.0	33.5
RT-M2518-MPW2	25	0.081 - 0	11	2/3"	300 - ∞	1.8 - 16	13.8	0.03	C	29.0	36.3
RT-M3520-MPW2	35	0.190 - 0	11	2/3"	200 - ∞	2.0 - 22	18.0	0.01	C	29.0	37.3
RT-M5028-MPW2	50	0.138 - 0	11	2/3"	400 - ∞	2.8 - 32	27.7	0.027	C	29.0	45.3

ENVF series

Vari-focal lenses for detectors up to 2/3"

	Optical specifications								Mechanical specifications		
Part number	**Focal length**	**Magnification**	**Image circle**	**Max detector size**	**WD**	**F/#**	**Back focal length**	**Distortion**	**Mount**	**Length**	**Diameter**
	(mm)	(x)	Ø (mm)		(mm)		(mm)	(%)		(mm)	(mm)
RT-M3Z1228C-MP	12 - 36	~	11	2/3"	200-∞ (tele) / 50-∞<(wide)	2.8 - 16C	29.8	3.5	C	53.0	41.6

EN2M series

Megapixel C-mount lenses for up to 1" detectors

	Optical specifications						Mechanical specifications		
Part number	**Focal length**	**Image circle**	**Max detector size**	**WD**	**F/#**	**Back focal length**	**Distortion**	**Mount**	**Length**	**Diameter**
	(mm)	Ø (mm)		(mm)		(mm)	(%)		(mm)	(mm)
RT-VHF8MK	8	16	1"	100 - ∞	1.4	11.2	-1.20	C	38	57
RT-VHF12-5MK	12.5	16	1"	300 - ∞	1.4	12.6	-1.58	C	44	42
RT-VHF16MK	16	16	1"	300 - ∞	1.4	12.6	-1.00	C	46	42
RT-FL-BC2518-9M	25	16	1"	100 - ∞	1.8 - 16	14.1	n.a.	C	57.5	42
RT-FL-BC3518-9M	35	16	1"	150 - ∞	1.8 - 22	16.8	n.a.	C	60.0	42
RT-FL-BC5024-9M	50	16	1"	200 - ∞	2.4 - 22	18.8	n.a.	C	69.0	42
RT-FL-BC7528-9M	75	16	1"	250 - ∞	2.8 - 32	21.3	n.a.	C	81.0	42

ENUV2M series

UV C-mount lenses for up to 1" detectors

	Optical specifications								Mechanical specifications		
Part number	**Focal length** (mm)	**Magnification** (x)	**Image circle** Ø (mm)	**Max detector size**	**WD** (mm)	**F/#**	**Back focal length** (mm)	**Distortion** (mm)	**Mount**	**Length** (mm)	**Diameter** (mm)
RT-FL-BC2528-VGUV	25	0.10 - 0	16	1"	230 - ∞	2.8-16	22.1	-	C	58.7	60.0
RT-FL-BC7838-VGUV	78	0.15 - 0	16	1"	440 - ∞	3.8-16	71.3	-	C	109.3	62.5

EN4K series

Lenses for 4k line detectors and 4/3" matrix detectors

	Optical specifications							Mechanical specifications		
Part number	**Focal length** (mm)	**Magnification** (x)	**Image circle** Ø (mm)	**Max detector size**	**WD** (mm)	**F/#**	**Back focal length** (mm)	**Mount**	**Length** (mm)	**Diameter** (mm)
RT-FL-YFL5028A-02	50	0.23 - 0.15	45	Full frame - 35 mm	242 - 361	2.8-22	30.43 - 34.54	F	60	63.6
RT-FL-YFL5028A-035	50	0.4 - 0.28	45	Full frame - 35 mm	146 -201	2.8-22	37.16 - 43.29	F	60	70.4
RT-FL-YFL3528	35	0.5 - 0	45	Full frame - 35 mm	190 - ∞	2.8-22	33.22	F	72	56.8
RT-FL-YFL5028	50	0.5 - 0	45	Full frame - 35 mm	250 - ∞	2.8-22	36.99	F	72	56.8

INFRARED OPTICS

Beyond the visible range, for advanced optical applications.

Opto Engineering offers a wide variety of **high resolution IR optics** for both cooled and uncooled IR cameras spanning all IR spectral bands. Our IR optics feature large field of view and low distortion and can be equipped with custom mount interface. MWIR and LWIR thermal series additionally include HCAR coating for usage in harsh environment.

IR optics are used in a wide variety of sectors including defense, security/surveillance, industrial, medical and R&D. Applications include tracking/targeting systems, predictive maintenance, monitor of hot industrial processes, thermography, flame detection, quality control /inspection.

Refer to specific datasheets available at **www.opto-engineering.com** for product compliancy with regulations, certifications and safety labels.

SWIR series

Short-wave infrared lenses

KEY ADVANTAGES

High resolution
Designed for high resolution detectors up to 15 µm pixel pitch and 21 mm diameter.

Custom mount interface
Can be provided upon request.

Large field of view and low distortion
Superior optical performances.

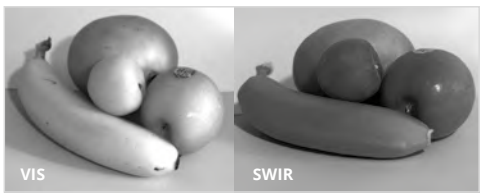
SWIR series is a range of **short-wave infrared lenses** specifically designed to operate in the 0.9-1.7 µm wavelenght region. This serie has been specifically designed to match the new 15 µm format InGaAs FPA Focal Plane Arrays.
These lenses offer an industry standard C-mount threaded style interface or, alternatively, they can be equipped with a custom mount interface.

In the design of the lenses, great importance was attached to a good image quality and a large aperture (small F-number).
These lenses, mounted on a SWIR camera, are the perfect choice for a variety of applications, including solar cell inspection, night vision imaging of outdoors scenes without additional illumination (security applications), detecting bruises on fruit, imaging through silicon, biomedical imaging and many other infrared applications.

Application examples

Solar cell inspection

Liquid level inspection



Fruit sorting

	Optical specifications										Mechanical specifications						
Part number	**Focal length** (mm)	**F/#**	**Wave length** (µm)	**Average trans.** (%) [1]	**Circular FOV** (deg)	**WD** (mm)	**Image Diagonal** (mm) [2]	**Distortion** (%) [3]	**CTF** @ 30lp/mm (%)	**Image side** NA	**Mount** [4]	**Focus type**	**Locking screw**	**Back focal length** (mm)	**Length** (mm) [5]	**Diam.** (mm)	**Mass** (g) [6]
SW03520	35.00	2.0	0.9-1.7	90	33.4	350 - ∞	21.0	-0.50	39.09	0.243	C	Manual	Yes	12.16	49.34	71	340
SW05020	50.00	2.0	0.9-1.7	90	23.7	500 - ∞	21.0	0.41	43.09	0.243	C	Manual	Yes	14.07	71.00	71	400
SW07520	75.00	2.0	0.9-1.7	90	15.9	750 - ∞	21.0	0.50	30.19	0.243	C	Manual	Yes	14.10	101.20	71	540

1 Based on the listed image diagonal.
2 Maximum value at central wavelength.
3 Mean value at all the different fields.
4 Any custom mount is available at no additional cost.
5 Measured from the front end of the mechanics to the camera flange.
6 Given with no mount attached. See layout drawings.

ENSWIRMP series

SWIR C-mount lenses for up to 2/3″ detectors

	Optical specifications								Mechanical specifications		
Part number	**Focal length** (mm)	**Magnification**	**Image circle** Ø (mm)	**Max detector size**	**WD** (mm)	**F/#**	**Back focal length** (mm)	**Distortion** (%)	**Mount**	**Length** (mm)	**Diameter** (mm)
RT-M1614-SW	16	0.05 - 0	12.3	2/3″	300 - ∞	1.4 - 16	13.3	0.5	C	28.2	33.5
RT-M2514-SW	25	0.08 - 0	12.3	2/3″	300 - ∞	1.4 - 16	14.6	0.5	C	36.0	33.5
RT-M3514-SW	35	0.10 - 0	12.3	2/3″	300 - ∞	1.4 - 16	14.6	0.1	C	38.2	33.5
RT-M5018-SW	50	0.15 - 0	12.3	2/3″	300 - ∞	1.4 - 16	13.3	0.5	C	28.2	33.5

MWIR series

Medium-wave infrared lenses

KEY ADVANTAGES

High resolution
Designed for high resolution detectors up to 15 µm pixel pitch and 21 mm diameter.

Custom mount interface
Can be equipped with any custom mount interface.

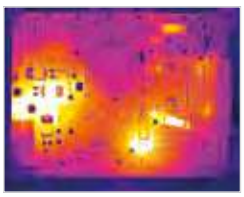
Large field of view and low distortion
Superior optical performances.

HCAR coating
For applications exposing optical elements to harsh environments.

MWIR series is a range of **medium-wave infrared lenses** specifically designed to operate in the 3-5 µm wavelenght region with InSb Focal Plane Arrays (FPA). The lenses offer a standard Bayonet interface or, alternatively, they can be equipped with a custom mount interface.
In the design of the lenses, great importance was attached to a good image quality and a large aperture (small F-number).

These lenses, mounted on a MWIR camera, are the perfect choice for a variety of applications, including imaging through fog, high-speed thermal imaging, thermography, R&D (MWIR range), non-destructive testing.

Application examples



Electronic boards inspection

Thermal imaging

Automotive

	Optical specifications										Mechanical specifications						
Part number	Focal length	F/#	Wave length	Average trans.	Circular FOV	WD	Image Diagonal	Distortion	CTF @ 30lp/mm	Image side NA	Mount	Focus type	Locking screw	Back focal length	Length	Diam.	Mass
	(mm)		(µm)	(%) 1	(deg)	(mm)	(mm) 2	(%) 3	(%)		4			(mm)	(mm) 5	(mm)	(g) 6
MW03523	35.00	2.3	3.0-5.0	90	33.4	350 - ∞	21.0	-0.20	39.68	0.212	Bayonet	Manual	Yes	32.45	57.69	71	263
MW05023	50.00	2.3	3.0-5.0	90	23.7	500 - ∞	21.0	-0.20	57.02	0.212	Bayonet	Manual	Yes	34.44	55.70	71	245
MW07523	75.00	2.3	3.0-5.0	90	15.9	750 - ∞	21.0	-0.20	56.86	0.212	Bayonet	Manual	Yes	57.14	57.02	84	335
MW10023	100.00	2.3	3.0-5.0	90	12.0	1000 - ∞	21.0	-0.20	61.01	0.212	Bayonet	Manual	Yes	52.00	90.51	108	1060

1 Based on the listed image diagonal.
2 Maximum value at central wavelength.
3 Mean value at all the different fields.
4 Any custom mount is available at no additional cost.
5 Measured from the front end of the mechanics to the camera flange.
6 Given with no mount attached. See layout drawings.

LWIR series

Long-wave infrared lenses

KEY ADVANTAGES

High resolution
Designed for high resolution detectors up to 15 µm pixel pitch and 21 mm diameter.

Custom mount interface
Can be equipped with any custom mount interface.

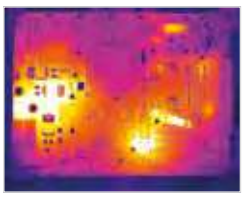
Large field of view and low distortion
Superior optical performances.

HCAR coating
For applications exposing optical elements to harsh environments.

LWIR series is a range of **long-wave infrared lenses** specifically designed to operate in the 8-14 µm wavelenght region with uncooled detectors (a-Si, VOx, ...).
In the design of the lenses great importance was assigned to high image quality and large aperture (small F-number). These lenses can also be equipped with custom mount interfaces.

These lenses, mounted on an uncooled LWIR camera are the perfect choice for a variety of applications spanning from industrial to military, including temperature measurement for process quality control and monitoring, predictive maintenance, imaging through smoke and fog, medical imaging.

Application examples



Electronic boards inspection

Thermal imaging

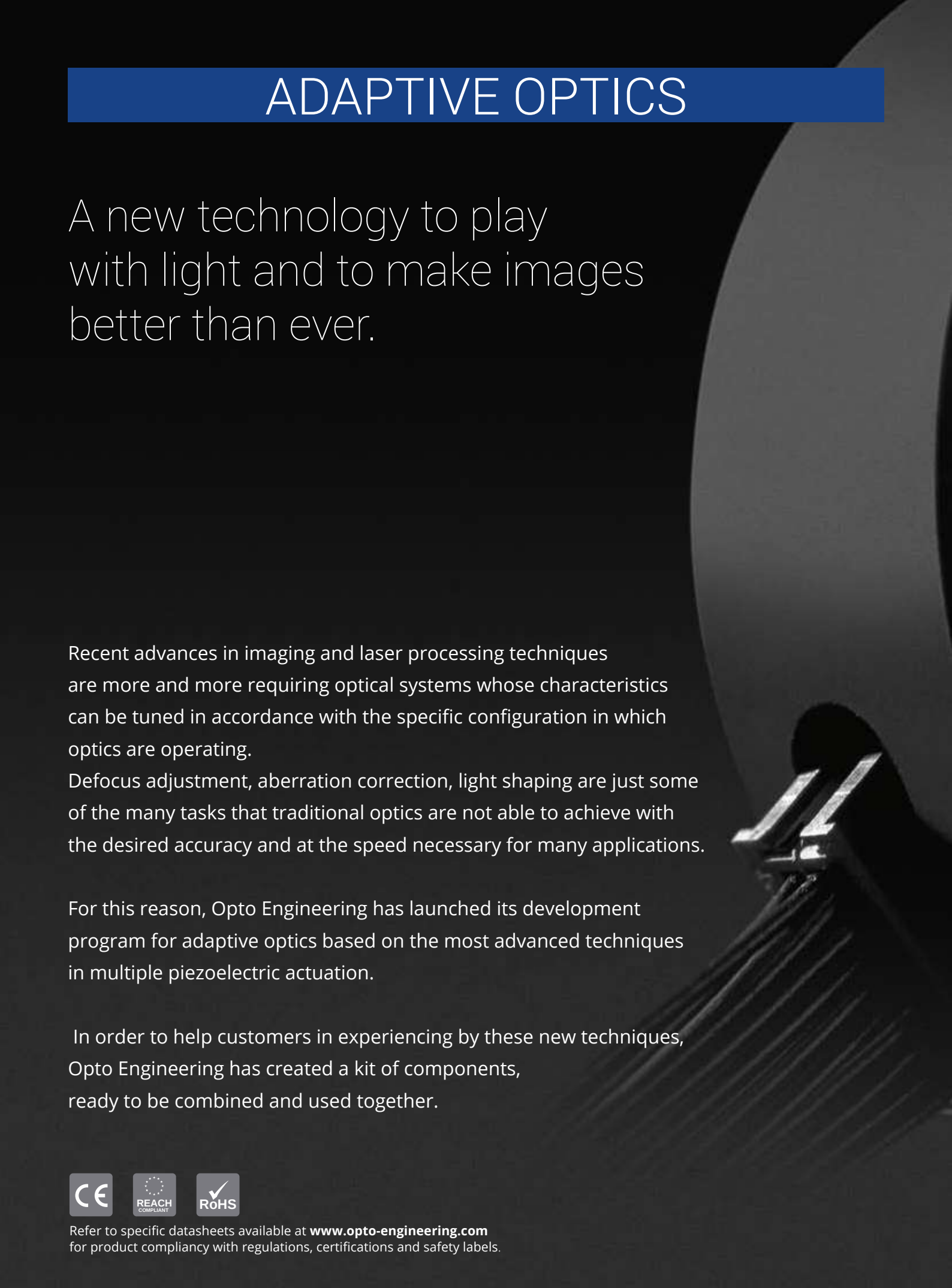
Automotive

	Optical specifications										Mechanical specifications						
Part number	**Focal length** (mm)	**F/#**	**Wave length** (µm)	**Average trans.** (%) [1]	**Circular FOV** (deg)	**WD** (mm)	**Image Diagonal** (mm) [2]	**Distortion** (%) [3]	**CTF** @ 30lp/mm (%)	**Image side NA**	**Mount** [4]	**Focus type**	**Locking screw**	**Back focal length** (mm)	**Length** (mm) [5]	**Diam.** (mm)	**Mass** (g) [6]
LW03514	35.00	1.4	8.0-14.0	90	33.4	350 - ∞	21.0	0.20	44.99	0.336	M46X1	Manual	Yes	11.88	57.62	71	300
LW05014	50.00	1.4	8.0-14.0	90	23.7	500 - ∞	21.0	0.20	40.70	0.336	M46X1	Manual	Yes	18.00	51.50	71	300
LW07514	75.00	1.4	8.0-14.0	90	15.9	750 - ∞	21.0	0.20	38.43	0.336	M46X1	Manual	Yes	14.63	106.41	85	850

1 Based on the listed image diagonal.
2 Maximum value at central wavelength.
3 Mean value at all the different fields.
4 Any custom mount is available at no additional cost.
5 Measured from the front end of the mechanics to the camera flange.
6 Given with no mount attached. See layout drawings.

ADAPTIVE OPTICS

A new technology to play with light and to make images better than ever.



Recent advances in imaging and laser processing techniques are more and more requiring optical systems whose characteristics can be tuned in accordance with the specific configuration in which optics are operating.
Defocus adjustment, aberration correction, light shaping are just some of the many tasks that traditional optics are not able to achieve with the desired accuracy and at the speed necessary for many applications.

For this reason, Opto Engineering has launched its development program for adaptive optics based on the most advanced techniques in multiple piezoelectric actuation.

In order to help customers in experiencing by these new techniques, Opto Engineering has created a kit of components, ready to be combined and used together.

CE REACH COMPLIANT RoHS

Refer to specific datasheets available at **www.opto-engineering.com** for product compliancy with regulations, certifications and safety labels.

ADKIT case

Adaptive optics kit, for aberrations compensation and irregular surface focusing

NEW

Part number	Products included	Description
ADKIT	**MAAL10**	Multi-actuators adaptive lens 10 mm aperture
	EDAL18	Electronic driver 18 channels for adaptive lens control
	n.a.	Power supply
	n.a.	USB 2.0 cable
	n.a.	Multi-wire cable
	n.a.	USB key with manual and software suite include
	MCAL200X-C	2x macro lens for adaptive lens
	n.a.	Spacer for adaptive lens substitution inside macro
	RT-M1620-MPW2	16 mm C-mount lens
	n.a.	Adaptor from C-mount lens to adaptive lens
	n.a.	Adaptors for RMS microscopy thread
	RT-STC-MBCM401U3V	4 Mpix CMOS 1" Sentech camera
	n.a.	USB 3.0 cable

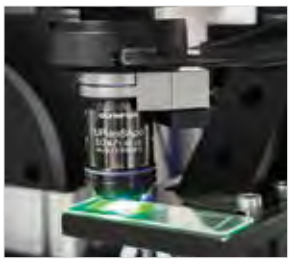
This kit is particularly indicated for performing experiments and building systems for:

• Machine Vision

- Imaging of irregular surfaces
- Defocus correction
- Specific aberration management

• Microscopy

- imaging of convex samples
- imaging of inhomogeneous biologic specimens
- two-photons imaging
- confocal imaging



• 3D reconstruction imaging

• Ophthalmology

The adaptive lens can be combined with the Macro Lens supplied within the KIT in order to create a macro-adaptive optical system; alternatively you can connect it to a standard C-mount lens for wider field of view imaging experiments.

Moreover you can integrate the adaptive element into a microscope system, by means of its specific adaptors, in order to work at very high magnifications.

The adaptive lens is operated through its specific electronic driver, which is controlled by PC via USB 2.0.

The software suite includes a demo application, which will make extremely easy to modify the lens' surfaces, in order either to obtain some specific type of aberration patterns or to create user specific aberration figures.
By means of a second application of the software suite, which includes advanced adaptive optimization algorithms, you can easily build an image-based or an open-loop system.
The software grabs an image from the camera, analyzes it, calculates all the aberration coefficients, and modifies the driver parameters until the adaptive lens deformation is such that an almost complete aberration correction is achieved.

All of these software functions are made available for further integration, by means of a specific .dll library.
The combination of the adaptive elements, software and driver with different types of imaging optics, makes possible to achieve fine autofocus and aberration correction and to enhance the image quality in non-standard configurations. Besides correcting aberrations, these systems can fit curved or toroidal fields of view and image highly 3D and asymmetric samples.

Adaptive lens

	Optical specifications									Dimensions		
Part number	**Trasmittance** (%)		**Flatness** (RMS waves at λ=633 nm)							**Clear aperture** (mm)	**Diameter** (mm)	**Heigth** (mm)
MAAL10	90		< 0.05							10	56	17.5
	Zernike terms strokes (RMS waves at λ=633 nm) 1											
	Oblique astigmatism	**Defocus**	**Vertical astigmatism**	**Vertical trefoil**	**Vertical coma**	**Horizontal coma**	**Oblique trefoil**	**Oblique quadrifoil**	**Oblique secondary astigmatism**	**Primary spherical**	**Vertical secondary astigmatism**	**Vertical quadrifoil**
	2.25	1.75	2.25	0.75	0.60	0.60	0.75	0.20	0.25	0.15	0.25	0.20

Electronic driver

	Electrical specifications			Dimensions		
Part number	**Output channels**	**Supply voltage** (V)	**Comunication port**	**Length** (mm) 4	**Width** (mm)	**Heigth** (mm)
EDAL18	18	12	USB 2.0 Type B	117	79	32

Macro lens

			Optical specifications								Dimensions		
Part number	**Focusing** 2	**Mag.**	**Object field of view** (mm x mm)	**WD** (mm)	**F/# (wF/#)** 3	**Distortion** (%) 4	**Field depth** (mm)	**CTF 50 lp/mm** (%)	**Image side N.A.**	**Object side N.A.**	**Mount**	**Length** (mm)	**Diam** (mm)
MCAL200X-C	Near	2.045	2.75 x 2.75	81.5	15	<0.01	0.3	>45	0.034	0.068	C	248.7	72
	Nominal	2.000	2.81 x 2.81	82.4	15	<0.01	0.3	>45	0.034	0.068	C	248.7	72
	Far	1.983	2.88 x 2.88	82.8	15	<0.01	0.3	>45	0.034	0.068	C	248.7	72

C-Mount lens

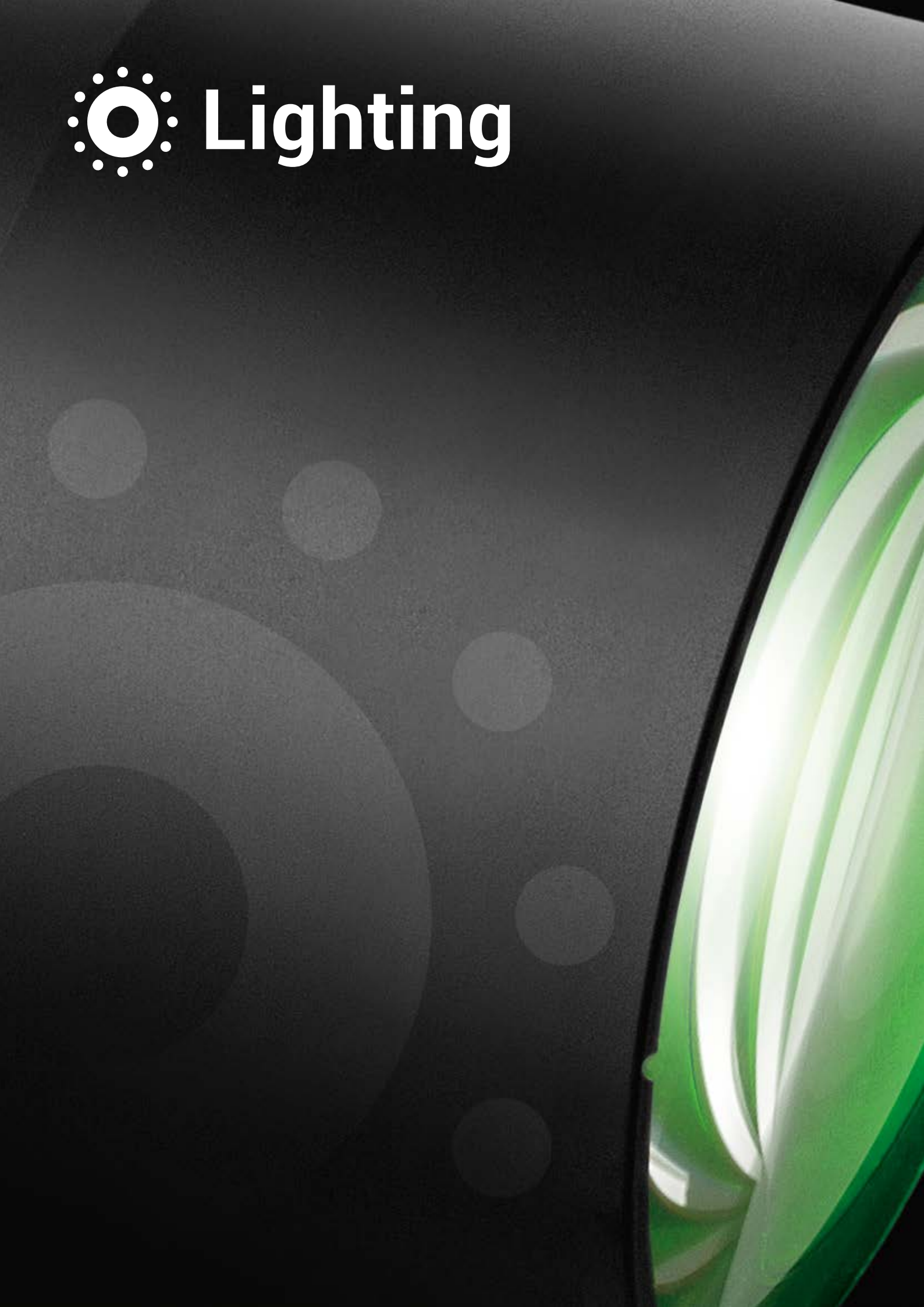
	Optical specifications									Dimensions		
Part number	**Adaptive lens**	**Focal lenght** (mm)	**Mag.**	**Image circle** (mm)	**Max detector size**	**WD** (mm)	**F/#**	**Back focal length** (mm) 4	**Distortion** (%)	**Mount**	**Length** (mm)	**Diam** (mm)
RT-M1620-MPW2	NO	16	0.075 - 0	11	2/3"	200 - ∞	2.0 - 16	14.7	0.1	C	29.0	72
	YES	16	0.075 - 0	6	1/3"	200 - ∞	2.0 - 16	14.7	0.1	C	29.0	72

Camera

	Sensor specifications					Functions				Comunications		Dimensions			
Part number	**Size**	**Type** 5	**Color**	**Resolution** (pixel)	**Pixel size** (um)	**Scanning system**	**Shutter type**	**Scan rate** (fps)	**Operational mode**	**Interface**	**Input/ output**	**Mount**	**Length** (mm)	**Width** (mm)	**Heigth** (mm)
RT-STC-MBCM401U3V	1"	CMOS	Monochrome	2048 x 2048	5.5	Progressive	global	89	Free-run, edge-preset trigger, pulse width trigger	USB 3.0 micro B	Three GPIO, one camera hardwer reset	C	28.0	28.0	40.0

1 Measured in closed loop with Shack-Hartmann wavefront sensor.
2 Maximum and minimum magnification changes when focusing.
3 Working F-number: the real F-number of a lens when used as a macro.
4 Percent deviation of the real image compared to an ideal, undistorted image.
5 CMOSIS, CMV4000.

Lighting



Lighting can be considered as one of the most critical elements of a vision system: incorrect illumination choice may result in extensive and time consuming software pre-processing or, in the worst case, in crucial information loss.

Opto Engineering lighting solutions, from standard to custom products, are the result of our optical knowledge and are designed keeping in mind our guiding principle “simple works better”: optimized illumination is in fact a key factor to achieve stable and repeatable results without extensive and time consuming image processing.

Since we design and manufacture both lighting and optics, many of our lighting solutions are conceived to perfectly match our lenses or even to be directly integrated into our optical systems: such approach allows you to make the most out of lighting and greatly simplifies its integration and usage into your vision system because our products are truly optimized both optically and from a mechanical point of view.

Opto Engineering machine vision lighting products are designed to meet the needs of the most demanding industrial automation environments and include both LED illuminators and pattern projectors. Our innovative products enable reliable inspections in many diverse applications thanks to their flexibility, robustness and ease of use.

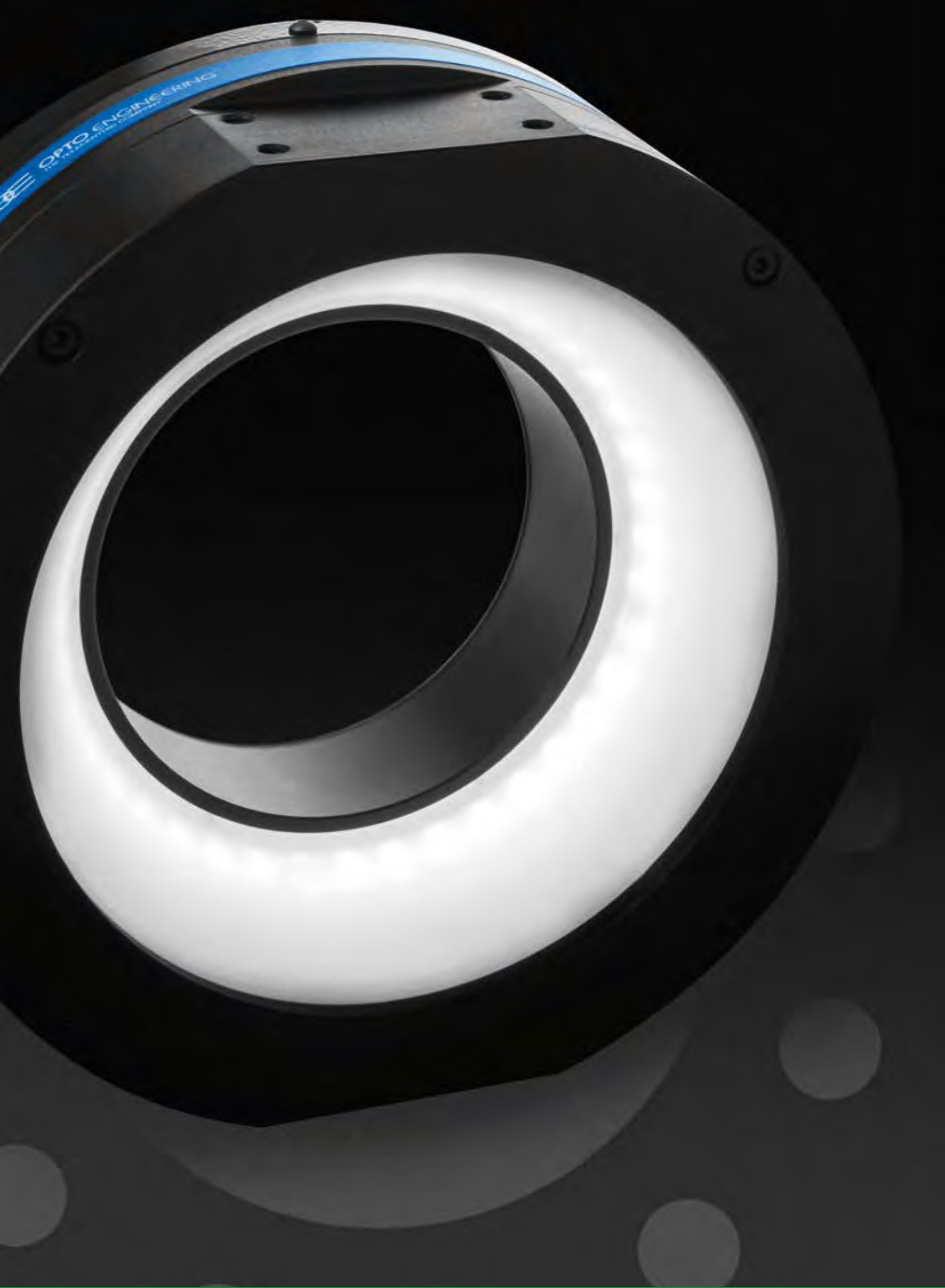
LED ILLUMINATORS

Advanced lighting solutions.

Illumination is a critical part of every machine vision setup: **proper choice of lighting color and geometry can be used to effectively mask or reveal different features of an object**, leading to a vastly simpler and accurate image processing stage.

Opto Engineering offers a wide range of illumination solutions including ring lights, dome illuminators and a unique space-saving lighting system complemented by specific power/strobe controllers. The Opto Engineering illuminators family provides innovative and robust lighting units, **designed to deal with fast-moving objects of varying sizes and surface types,** such as highly reflective or curved samples.

Refer to specific datasheets available at **www.opto-engineering.com** for product compliancy with regulations, certifications and safety labels.


OPTO ENGINEERING

LTCLHP series

Telecentric high-performance illuminators

KEY ADVANTAGES

Complete light coupling
All the light emitted by a LTCLHP source is collected by a telecentric lens and transferred to the camera detector, ensuring very high signal-to-noise ratios.

Border effects removal
Diffused back-illuminators often make objects seem smaller than their actual size because of light reflections on the object sides, while collimated rays are typically much less reflected.

Field depth and telecentricity improvement
Collimated illumination geometry increases a telecentric lens natural field depth and telecentricity far beyond its nominal specs.

LTCLHP series are high-performance telecentric illuminators specifically designed to back illuminate objects imaged by telecentric lenses.

LTCLHP telecentric illuminators offer higher edge contrast when compared to diffused back light illuminators and therefore higher measurement accuracy.

This type of illumination is especially recommended for high accuracy measurement of round or cylindrical parts where diffusive back lighting would offer poor performances because of the diffuse reflections coming from the edges of objects under inspection.

FEATURES

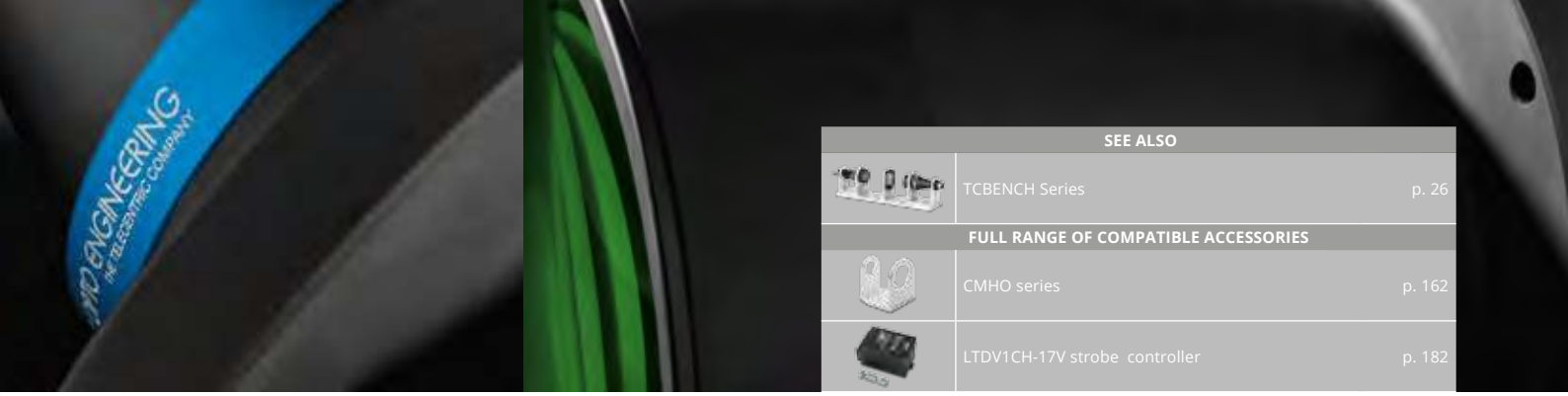
- Excellent **illumination stability** featuring no light flickering thanks to very high current stability over time even at low currents.
- Precise **light intensity** tuning thanks to the leadscrew multi-turn trimmer positioned in the back.
- **Easy LED source replacement** and alignment for all the LED colors offered by Opto Engineering.

		Available colours				Optical specs	Mechanical specs		Compatibility
Part number (*)	**Beam diameter** (mm)	**R**	**G** [1]	**B**	**W**	**Working distance range** (mm)	**Length** (mm) [2]	**Outer diameter** (mm)	
LTCLHP 023-x	16	x	x	x	x	45 ~ 90	96.8	28	TC2300y, TC23012, TC4M00y-x,
LTCLHP 016-x	20	x	x	x	x	35 ~ 70	99.9	38	TCxx016, TC4MHR016-x, TC2MHR016-x, TCLWD series
LTCLHP 024-x	30	x	x	x	x	45 ~ 90	124.7	44	TCxx024, TCxMHR024-x, TC16M009-x, TC16M012-x, TC16M018-x
LTCLHP 036-x	45	x	x	x	x	70 ~ 140	152.1	61	TCxx036, TCxMHR036-x, TC16M036-x
LTCLHP 048-x	60	x	x	x	x	90 ~ 180	187.2	75	TCxx048, TCCRxx048, TCxMHR048-x, TC16M048-x
LTCLHP 056-x	70	x	x	x	x	100 ~ 200	210.5	80	TCxx056, TCCRxx056, TCxMHR056-x, TC16M056-x
LTCLHP 064-x	80	x	x	x	x	120 ~ 240	231.6	100	TCxx064, TCCRxx064, TCxMHR064-x, TC16M064-x, TC12K064
LTCLHP 080-x	100	x	x	x	x	150 ~ 300	277.2	116	TC23072, TCxx080, TCCRxx080, TCxMHR080-x, TC16M080-x, TC12K080
LTCLHP 096-x	120	x	x	x	x	200 ~ 350	322.2	143	TC23085, TCxx096, TCCRxx096, TCxMHR096-x, TC16M096-x
LTCLHP 120-x	150	x	x		x	220 ~ 440	408.2	180	TC23110, TCxx120, TCxMHR120-x, TC16M120-x, TC12K120
LTCLHP 144-x	180	x	x			270 ~ 540	467.2	200	TC23130, TCxx144, TCxMHR144-x, TC16M144-x, TC12K144
LTCLHP 192-x	250	x	x		x	350 ~ 700	608.2	260	TC23172, TCxx192, TCxMHR192-x, TC12K192
LTCLHP 240-x	300	x	x			350 ~ 700	769.2	322	TC23200, TC23240, TCxMHR240-x

(*) The last digit of the part number "-x" defines the source colour.

1 Opto Engineering recommends green light for high precision measurement applications.

2 Nominal value, with no spacers in place.



SEE ALSO		
	TCBENCH Series	p. 26
FULL RANGE OF COMPATIBLE ACCESSORIES		
	CMHO series	p. 162
	LTDV1CH-17V strobe controller	p. 182

Precise light intensity tuning

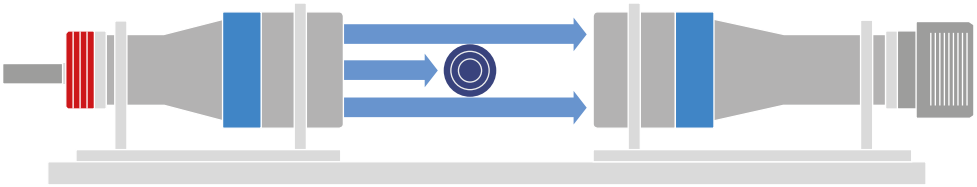
Easily and precisely tune the light intensity level thanks to the leadscrew multi-turn trimmer positioned in the back.

Direct LED control

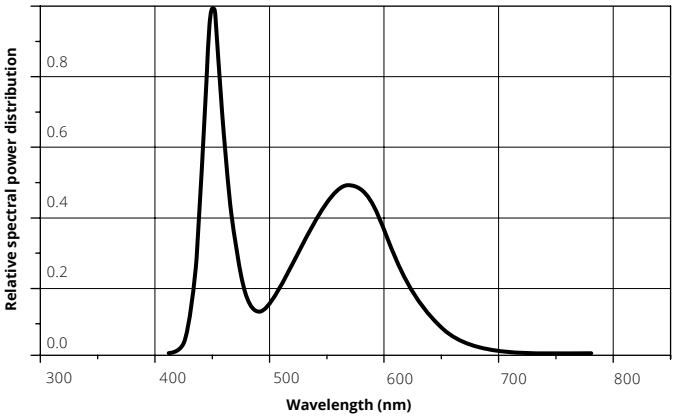
The built-in electronics can be bypassed in order to drive the LED directly for use in continuous or pulsed mode.
When bypassed, built-in electronics behave as an open circuit allowing direct control of the LED source.

Easy and precise alignment with bi-telecentric lenses

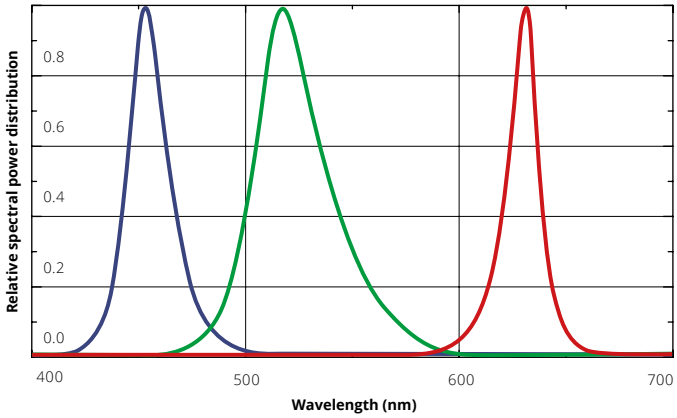
Create the perfect optical bench for precision measurement applications by interfacing our bi-telecentric lenses and LTCLHP collimated illuminators using Opto Engineering precision clamping mechanics CMHO series.



Typical emission spectrum of white LEDs



Typical emission spectrum of R,G,B LEDs



Wide selection of different colors

	Light	Device power ratings				LED power ratings		
Part number	**Light color, wavelength peak**	**DC voltage**		**Power consumption**	**Max LED fwd current**	**Forward voltage**		**Max pulse current**
		min	max			typical	max	
		(V)	(V)	(W)	(mA)	(V)	(V)	(mA)
		1			2	3		4
LTCLHP xxx-R	red, 630 nm	12	24	< 2.5	350	2.4	3.00	2000
LTCLHP xxx-G	green, 520 nm	12	24	< 2.5	350	3.3	4.00	2000
LTCLHP xxx-B	blue, 460 nm	12	24	< 2.5	350	3.3	4.00	2000
LTCLHP xxx-W	white	12	24	< 2.5	350	2.78	n.a.	2000

1 Tolerance ± 10%.
2 Used in continuous (not pulsed) mode.
3 At max forward current. Tolerance is ±0.06V on forward voltage measurements.
4 At pulse width <= 10 ms, duty cycle <= 10% condition.
Built-in electronics board must be bypassed (see tech info online).

LTCLHP CORE series

Ultra compact telecentric illuminators

NEW

INTERNATIONAL PATENT PENDING

KEY ADVANTAGES

Deliver excellent performances
LTCLHP CORE telecentric illuminators deliver exactly the same excellent optical performances as other Opto Engineering telecentric illuminators.

Downsize your vision system
LTCLHP CORE telecentric illuminators are up to 60% smaller than other telecentric illuminators on the market.

Easily fit into existing systems
LTCLHP CORE illuminators can be mounted in different directions in your machine.

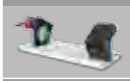
Improve your system performances
LTCLHP CORE illuminators may be used instead of flat backlights to improve your system.

Help to spare and sell
A smaller system means less expenses and less space and is preferred by the industry.

LTCLHP CORE Series are ultra compact telecentric illuminators. They are up to 60% more compact than other collimated illuminators on the market.
The ultra compact size allows to greatly reduce the size of your machine and to easily integrate true collimated illumination instead of common flat backlights, thus improving your system's performance.
The smart design also makes them easy to retrofit into existing systems. They can easily be mounted in different directions using any of their 4 sides, with or without clamps.

A smaller system means lower manufacturing, shipping and storage costs, as well as less use of factory space and is the solution preferred by the industry.
LTCLHP CORE illuminators can be used both with classic telecentric lenses and with ultra compact telecentric lenses from CORE family like TC CORE, TC2MHR CORE and TC4MHR CORE series.

LTCLHP CORE telecentric illuminators are up to 60% shorter than other telecentric illuminators on the market.

SEE ALSO		
	TCBENCH CORE series	p. 27
FULL RANGE OF COMPATIBLE ACCESSORIES		
	Mounting mechanics CMHO CR and CMPT CR series	p. 165
	LTDV1CH-17V strobe controller	p. 182

Precise light intensity tuning

Easily and precisely tune the light intensity level thanks to the leadscrew multi-turn trimmer positioned in the back.

Direct LED control

The built-in electronics can be bypassed in order to drive the LED directly for use in continuous or pulsed mode. When bypassed, built-in electronics behave as an open circuit allowing direct control of the LED source.

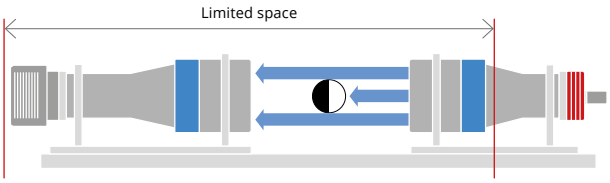
	Light	Device power ratings				LED power ratings		
Part number	**Light color, wavelength peak**	**DC voltage**		**Power consumption**	**Max LED fwd current**	**Forward voltage**		**Max pulse current**
		min	max			typical	max	
		(V)	(V)	(W)	(mA)	(V)	(V)	(mA)
		1			2	3		4
LTCLCR xxx-R	red, 630 nm	12	24	< 2.5	350	2.4	3.00	2000
LTCLCR xxx-G	green, 520 nm	12	24	< 2.5	350	3.3	4.00	2000
LTCLCR xxx-W	white	12	24	< 2.5	350	2.78	n.a.	2000

1 Tolerance ± 10%.
2 Used in continuous (not pulsed) mode.
3 At max forward current. Tolerance is ±0.06V on forward voltage measurements.
4 At pulse width <= 10 ms, duty cycle <= 10% condition.
Built-in electronics board must be bypassed (see tech info online).

LTCLHP CORE series

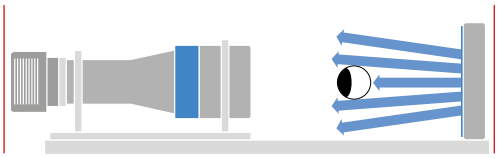
Ultra compact telecentric illuminators

LTCLHP CORE - True collimated illumination in very limited space



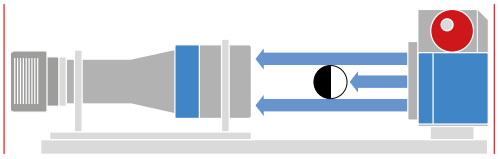
Telecentric lens and collimated illuminator.

A standard collimated illuminator is impossible to use due to lack of space.



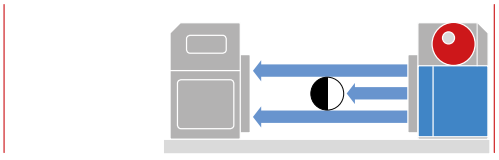
"Classic" telecentric lens and flat backlight.

Classic solution with diffuse backlight: less precise measurements due to surface eflections and uncertain edge position.



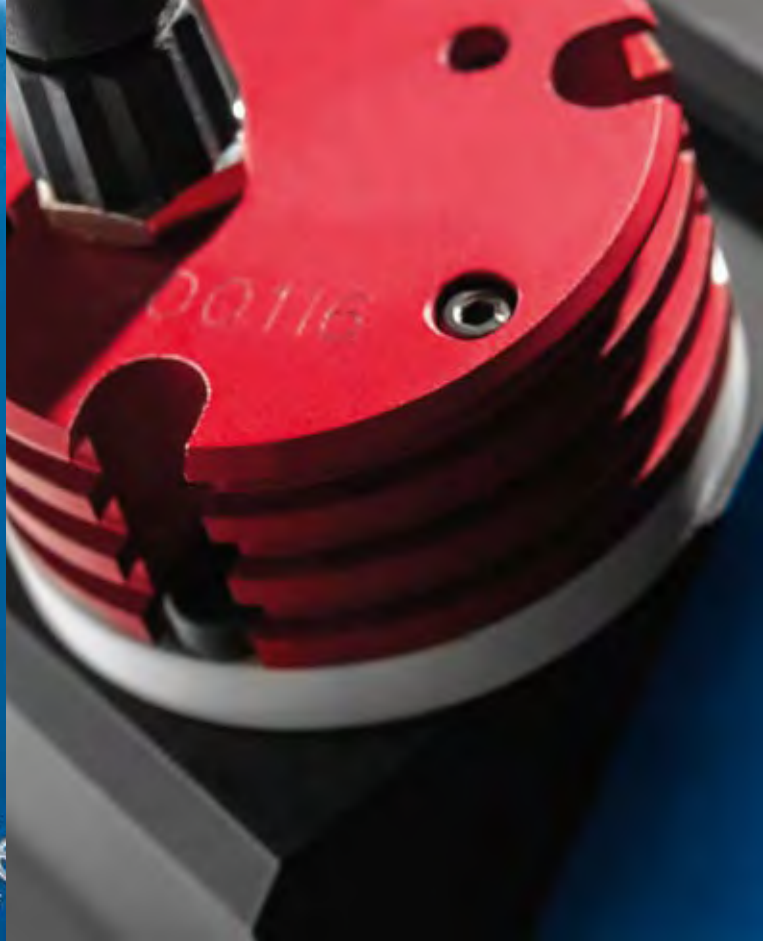
"Classic" telecentric lens and LTCLHP CORE collimated illuminator.

Smart solution with LTCLHP CORE telecentric illuminator: no edge uncertainty for excellent measurement results.

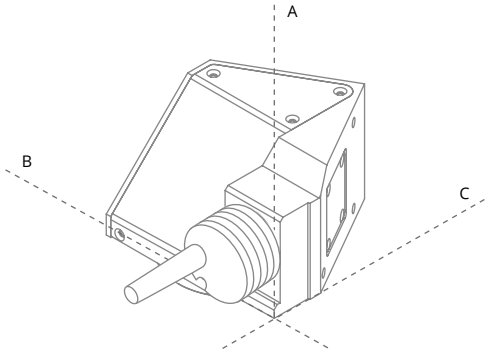


TC CORE telecentric lens and LTCLHP CORE collimated illuminator.

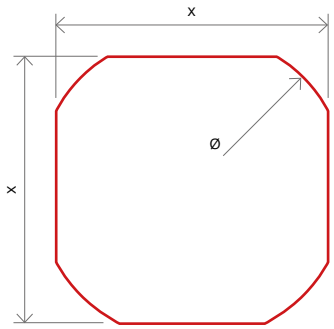
The smartest solution with TC CORE telecentric lens and LTCLHP CORE telecentric illuminator: excellent measurement results in a super compact space.



LTCLHP CORE illuminator dimensions (A, B, C):



Minimum beam shape dimensions:



	Optical specifications			Dimensions			Compatibility
Part number	**Light color, wavelength peak** [1]	**Minimum beam shape dimensions** (mm)	**Working distance range** (mm)	**A**	**B**	**C** [2]	
LTCLCR 048-R	red, 630 nm	Ø = 56; x = 50	90 - 180	77	106	162	TCCRxx048, CMHOCR048, CMPTCR048, TCCR2M048-x, TCCR4M048-x, TCxx048, TCxMHR048-x, TC16M048, TC16M048-Q
LTCLCR 048-G	green, 520 nm	Ø = 56; x = 50	90 - 180	77	106	162	
LTCLCR 048-W	white	Ø = 56; x = 50	90 - 180	77	106	162	
LTCLCR 056-R	red, 630 nm	Ø = 74; x = 66	100 - 200	94	110	172	TCCRxx056, CMHOCR056, CMPTCR056, TCCR2M056-x, TCCR4M056-x, TCxx056, TCxMHR056-x, TC16M056, TC16M056-Q
LTCLCR 056-G	green, 520 nm	Ø = 74; x = 66	100 - 200	94	110	172	
LTCLCR 056-W	white	Ø = 74; x = 66	100 - 200	94	110	172	
LTCLCR 064-R	red, 630 nm	Ø = 86; x = 67	120 - 240	101	122	179	TCCRxx064, CMHOCR064, CMPTCR064, TCCR2M064-x, TCCR4M064-x, TCxx064, TCxMHR0564-x, TC16M064, TC16M064-Q, TC12K064
LTCLCR 064-G	green, 520 nm	Ø = 86; x = 67	120 - 240	101	122	179	
LTCLCR 064-W	white	Ø = 86; x = 67	120 - 240	101	122	179	
LTCLCR 080-R	red, 630 nm	Ø = 98; x = 90	150 - 300	119	145	198	TCCRxx080, CMHOCR080, CMPTCR080, TCCR2M080-x, TCCR4M080-x, TCxx080, TCxMHR080x, TC16M080, TC16M080-Q, TC12K080, TCZR072
LTCLCR 080-G	green, 520 nm	Ø = 98; x = 90	150 - 300	119	145	198	
LTCLCR 080-W	white	Ø = 98; x = 90	150 - 300	119	145	198	
LTCLCR 096-G	green, 520 nm	Ø = 120; x = 99	200 - 350	139	172	223	TCCRxx096, CMHOCR096, CMPTCR096, TCCR2M096-x, TCCR4M096-x, TCxx096, TCxMHR096x, TC16M096, TC16M096-Q, TC12K096
LTCLCR 096-R	red, 630 nm	Ø = 120; x = 99	200 - 350	139	172	223	
LTCLCR 096-W	white	Ø = 120; x = 99	200 - 350	139	172	223	

1 Opto Engineering recommends green light for high precision measurement applications.

2 Nominal value, with no spacers in place.

LTCL4K series

Flat telecentric illuminators for linescan cameras

KEY ADVANTAGES

Compact design
"Flat" shape for easy integration.

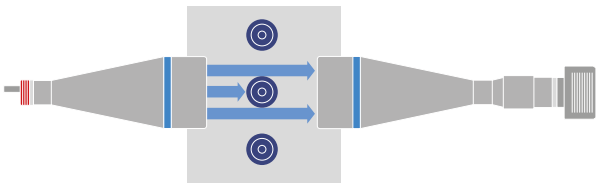
High optical throughput and enhanced field depth
When coupled with compatible TC4K telecentric lenses.

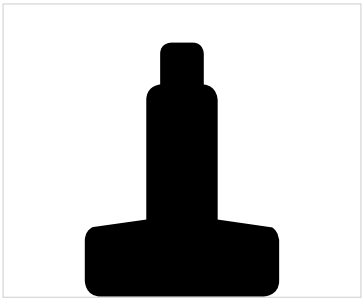
Dedicated CMMR4K mirrors
Right-angle deflection of the light path for usage in tight spaces.

LTCL4K telecentric illuminators are specifically designed to be paired with TC4K telecentric lenses, in order to provide the high optical throughput needed for high-speed linescan measurement applications involving for instance steering components, gear and cam shafts, grinding and turning parts.
These illuminators are equipped with state-of-the-art LED driving electronics, providing exceptional illumination stability, precise light intensity tuning and easy replacement of the LED source. The unique "slim" form factor allows these units to be used in constrained spaces, often a critical factor in many industrial environments.
Also, CMMR4K deflecting mirror accessories can be integrated to quickly assemble different illumination geometries, compatible with most type of inspection configurations.

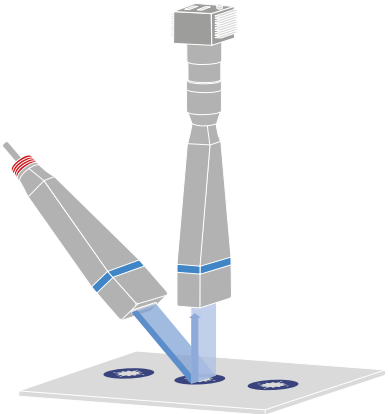
Application examples

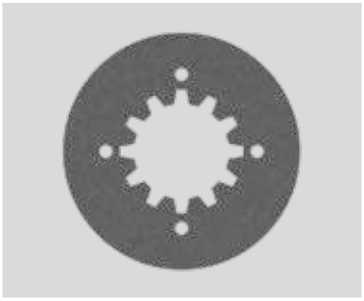
A LTCL4K back-illuminating a mechanical component and interfaced to a TC4K telecentric lens.





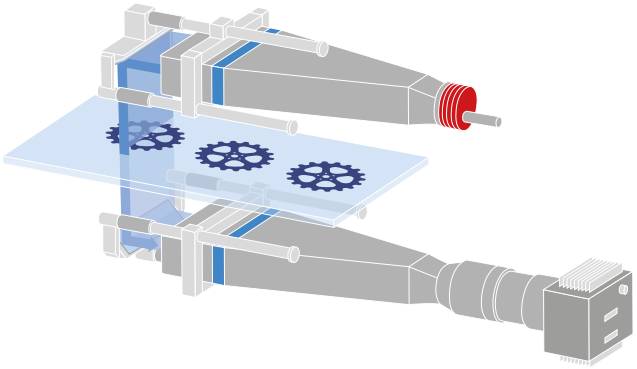
A LTCL4K directly illuminating a sample and serving as a linear telecentric illuminator.

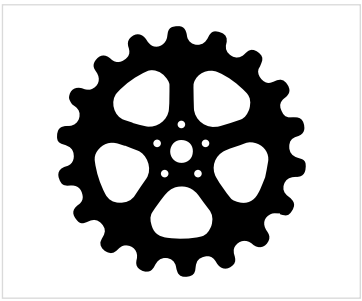




FULL RANGE OF COMPATIBLE IMAGING TELECENTRIC LENSES		
	TC4K series	p. 46
FULL RANGE OF COMPATIBLE ACCESSORIES		
	CMMR4K series	p. 168
	LTDV1CH-17V strobe controller	p. 182

A LTCL4K illuminator coupled with a TC4K lens using a CMMR4K deflecting mirrors to scan samples on a glass surface.





Precise light intensity tuning

Easily and precisely tune the light intensity level thanks to the leadscrew multi-turn trimmer positioned in the back.

Direct LED control

The built-in electronics can be bypassed in order to drive the LED directly for use in continuous or pulsed mode.
When bypassed, built-in electronics behave as an open circuit allowing direct control of the LED source.

Electrical specifications

	Light	Device power ratings				LED power ratings		
Part number	**Light color, wavelength peak**	**DC voltage**		**Power consumption**	**Max LED fwd current**	**Forward voltage**		**Max pulse current**
		min	max			typical	max	
		(V)	(V)	(W)	(mA)	(V)	(V)	(mA)
		1			**2**	**3**		**4**
LTCL4K xxx-G	green, 520 nm	12	24	< 2.5	350	3.3	4.00	2000
LTCL4K xxx-W	white	12	24	< 2.5	350	2.78	n.a.	2000

1 Tolerance ± 10%.
2 Used in continuous (not pulsed) mode.
3 At max forward current. Tolerance is ±0.06V on forward voltage measurements.
4 At pulse width <= 10 ms, duty cycle <= 10% condition.
Built-in electronics board must be bypassed (see tech info online).

	Optical specifications				Mechanical specifications			Compatibility
Part number	**Light color, wavelength peak**	**Beam width**	**Beam height**	**Working distance range**	**Length**	**Width**	**Height**	**Compatible TC4K**
		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	
LTCL4K 060-G	green, 520 nm	71	10	90 - 300	218.3	83	38.5	TC4K060-x
LTCL4K 060-W	white	71	10	90 - 300	218.3	83	38.5	TC4K060-x
LTCL4K 090-G	green, 520 nm	102	10	90 - 300	295.2	114	38.5	TC4K090-x
LTCL4K 090-W	white	102	10	90 - 300	295.2	114	38.5	TC4K090-x
LTCL4K 120-G	green, 520 nm	132	10	90 - 300	306.3	144	38.5	TC4K120-x
LTCL4K 120-W	white	132	10	90 - 300	306.3	144	38.5	TC4K120-x
LTCL4K 180-G	green, 520 nm	187	10	120 - 450	483.5	206	38.5	TC4K180-x
LTCL4K 180-W	white	187	10	120 - 450	483.5	206	38.5	TC4K180-x

LTDM series

High-power strobed LED domes

KEY ADVANTAGES

Ultra-high power light output and strobe mode only operation
For the inspection of fast moving object and extended LED lifetime.

Rugged industrial design with built-in industrial connector
For easy integration into any machine vision system.

Wide selection
Available in three sizes, three colors and two power intensities.

Compatible LTDV strobe controllers available
For easy and appropriate power, control and synchronization of the illuminator.

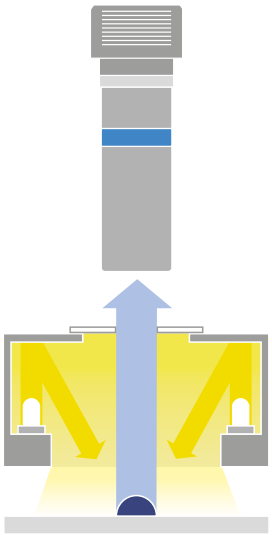
LTDM series are high power diffusive LED strobed dome illuminators designed to provide non-directional diffused light and to effectively eliminate glares and shadows.

LTDM series provides ultra-high power light output and can be used to illuminate complex shapes with curved and shiny surfaces.
LTDM dome illuminators can be exclusively operated in strobe mode, making them the perfect choice to illuminate very fast moving objects while ensuring extended LED lifetime since no heat is generated.

LTDM series can be easily powered, controlled and synchronized by compatible LTDV strobe controllers and is available in:
- **three sizes**: small, medium and large, respectively with illumination area of 40 mm, 60 mm and 100 mm in diameter;
- **two power intensities**: medium power with driving current up to 7.5 A and high power with driving current up to 17 A;
- **three different colors**: white, red and green.

LTDM series feature industry standard connection (M8 or M12 four poles connector) and resizable aperture that can be drilled to increase the diameter and accommodate the optics field of view. Additionally they can be easily integrated into any machine vision system by means of M6 screws.

Lighting structure



FULL RANGE OF COMPATIBLE STROBE CONTROLLERS

LTDV series p. 182

DESIGNED FOR OEM APPLICATIONS

Compatible LTDV strobe controllers available to easily power, control and synchronize LED illuminators.

Part number			LTDMA1-W	LTDMA1-G	LTDMA1-R	LTDMB2-W	LTDMB2-G	LTDMB2-R	LTDMC1-W	LTDMC2-W	LTDMC2-G	LTDMC2-R
Optical specifications												
Number of LEDs			15	15	15	40	40	40	40	80	80	80
Light colour			white, 6000 K	green, 525 nm	red, 625 nm	white, 6500K	green, 528 nm	red, 625 nm	white	white, 6500K	green, 528 nm	red, 625 nm
Spectral FWHM		(nm)	n.a.	50	25	n.a.	35	20	n.a.	n.a.	35	20
Illumination area diameter		(mm)	40	40	40	60	60	60	100	100	100	100
Suggested working distance WD		(mm)	5 - 50	5 - 50	5 - 50	5 - 50	5 - 50	5 - 50	5 - 50	5 - 50	5 - 50	5 - 50
Min estimated illumination 1	At driving current = 3.5 A	(klux)	100	70	40	50	45	35	25	50	45	35
	At driving current = 7.5 A	(klux)	175	125	70	90	80	65	50	100	90	70
	At driving current = 17.0 A	(klux)	n.a.	n.a.	n.a.	160	145	115	70	140	125	100
Aperture range		(mm)	38 (fixed)	38 (fixed)	38 (fixed)	10 - 50	10 - 50	10 - 50	10 - 60	10 - 60	10 - 60	10 - 60
Electrical specifications												
Power supply mode			strobe only, constant current driving			strobe only, constant current driving			strobe only, constant current driving			
Driving current	Min	(A)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
	Max	(A)	7.5	7.5	7.5	17.0	17.0	17.0	7.5	17.0	17.0	17.0
Pulse width 2		(ms)	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
Connection Type 3			M8 industrial male connector			M12 industrial male connector			M12 industrial male connector			
Estimated MTBF 4		(hours)	> 50000	> 50000	> 50000	> 50000	> 50000	> 50000	> 50000	> 50000	> 50000	> 50000
Mechanical specifications												
Dimensions	Length	(mm)	107	107	107	166.5	166.5	166.5	206	206	206	206
	Width	(mm)	84	84	84	133	133	133	206	206	206	206
	Height	(mm)	53	53	53	90	90	90	128	128	128	128
Materials			black anodized aluminum body			black anodized aluminum body			black anodized aluminum body / painted steel reflector			
Clamping system			4 threaded holes for M6 screw			4 holes for M6 screw			4 threaded holes for M6 screw			
Compatibility												
Strobe controllers			LTDV1CH-7, LTDV6CH			LTDV1CH-17, LTDV6CH			LTDV1CH-7, LTDV6CH	LTDV1CH-17, LTDV6CH		
Lenses			TC23007, TC23009, TCLWD series, MC050X, MC033X			TCLWD series, MC033X			TCLWD series, MC4K050X-x, MC4K075X-x			

1 At max Working Distance WD
2 At 25°C. At max pulse width (1 ms), max pulse frequency = 15 Hz.
3 5 m cable with straight female connector included. Optional cable with right angled connector is also available and must be ordered separately (refer to our website for further info and ordering codes).
4 At 25°C.

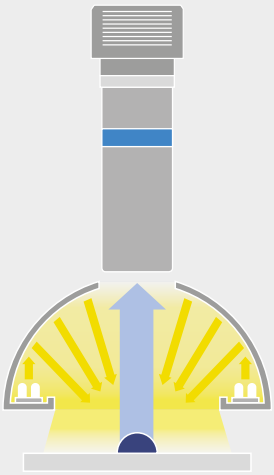
Ordering information

It's easy to select the right illuminator for your application: our part numbers are coded as **LTDM xy-z**, where **x** defines the illuminator size (A = small, B = medium, C = large), **y** refers to the power intensity (1 = medium, 2 = high) and **z** refers to color (W = white, R = red, G = green).
For instance LTDM B2-R is a diffusive strobed dome illuminator - medium size high power red.

LTDMC series

Continuous LED domes

Lighting structure



LTDMC series consists of LED dome illuminators designed to provide uniform illumination of complex surfaces.
Light comes from all angles effectively eliminating glares and shadows. Suggested usage is continuous mode.

FULL RANGE OF COMPATIBLE STROBE CONTROLLERS		
	LTDV1CH-17V strobe controller	p. 182
	PS power supplies	p. 186

	Optical specifications		Electrical specifications					Dimensions		
			Continuous mode			Pulsed mode				
Part number	Light colour, wavelength peak	Illumination area diam. (mm)	Supply voltage (V)	Current (mA)	Power cons. (W)	Supply voltage (V) 1	Max pulse current (mA) 2	Outer diam. (mm)	Aperture (mm)	Height (mm)
RT-IDS4-00-150-2-W-24V-FL	white, 6300K	113	24	240	5.76	36	720	185	40	89.8
RT-IDS4-00-150-2-R-24V-FL	red, 630nm	113	24	252	6.05	36	750	185	40	89.8
RT-IDS4-00-150-2-G-24V-FL	green, 525nm	113	24	240	5.76	36	720	185	40	89.8
RT-IDS4-00-150-2-B-24V-FL	blue, 470nm	113	24	240	5.76	36	720	185	40	89.8
RT-IDS4-00-200-2-W-24V-FL	white, 6300K	160	24	360	8.64	36	1080	232	50	112.8
RT-IDS4-00-200-2-R-24V-FL	red, 630nm	160	24	378	9.07	36	1134	232	50	112.8
RT-IDS4-00-200-2-G-24V-FL	green, 525nm	160	24	360	8.64	36	1080	232	50	112.8
RT-IDS4-00-200-2-B-24V-FL	blue, 470nm	160	24	360	8.64	36	1080	232	50	112.8
RT-IDS4-00-250-2-W-24V-FL	white, 6300K	212	24	520	12.48	36	1560	284	50	139.4
RT-IDS4-00-250-2-R-24V-FL	red, 630nm	212	24	476	11.42	36	1428	284	50	139.4
RT-IDS4-00-250-2-G-24V-FL	green, 525nm	212	24	520	12.48	36	1560	284	50	139.4
RT-IDS4-00-250-2-B-24V-FL	blue, 470nm	212	24	520	12.48	36	1560	284	50	139.4

1 With constant driving voltage (36V recommended, 48V max). Duty cycle = 0-10 %. Max pulse width = 10 ms.
2 With constant driving current. Duty cycle = 0-10 %. Max pulse width = 10 ms.


OPTO ENGINE
THE TELECENTRIC COMPANY
CORE
OPTO EN
THE TELECENTRIC

LTLA series

High-power strobed LED low angle diffused ringlights

KEY ADVANTAGES

Ultra-high power light output and strobe mode only operation
For the inspection of fast moving object and extended LED lifetime.

Rugged industrial design with built-in industrial connector
For easy integration into any machine vision system.

Wide selection
Available in two sizes, three colors and two power intensities.

Compatible LTDV strobe controllers available
For easy and appropriate power, control and synchronization of the illuminator.

Low angle beam shaping diffuser
Highly diffusive material avoids hot spots formation and ensures uniform light intensity.

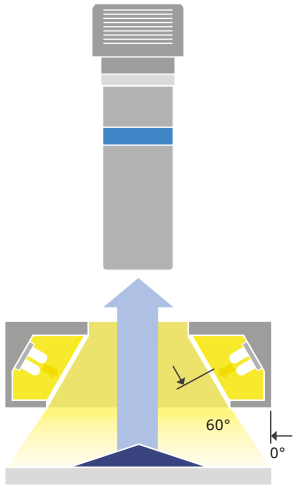
LTLA series are high power diffusive LED strobed low-angle ring light illuminators designed to provide darkfield lightning and to effectively enhance minute surface features or textures.

LTLA series features ultra-high power light output and can be used to cast shadows that emphasize surface irregularities, scratches or special characteristics (such as bar codes) from a close distance.
LTLA low angle ring illuminators can be exclusively operated in strobe mode, making them the perfect choice to illuminate very fast moving objects while ensuring extended LED lifetime since no heat is generated.

LTLA series can be easily powered, controlled and synchronized by compatible LTDV strobe controllers and is available in:
- **two sizes**: medium and large, respectively with illumination area of 60 mm and 100 mm in diameter;
- **two power intensities**: medium power with driving current up to 7.5 A and high power with driving current up to 17 A;
- **three different colors**: white, red and green.

LTLA series feature industry standard connection (M12 four poles connector) and can be easily integrated into any machine vision system by means of M6 screws.

Lighting structure



FULL RANGE OF COMPATIBLE STROBE CONTROLLERS

LTDV series p. 182

DESIGNED FOR OEM APPLICATIONS

Compatible LTDV strobe controllers available to easily power, control and synchronize LED illuminators.

Part number			LTLAB2-W	LTLAB2-G	LTLAB2-R	LTLAC1-W	LTLAC2-W	LTLAC2-G	LTLAC2-R
Optical specifications									
Number of LEDs			40	40	40	40	80	80	80
Light colour			white, 6000 K	green, 525 nm	red, 625 nm	white, 6500K	white, 6500K	green, 528 nm	red, 625 nm
Spectral FWHM		(nm)	n.a.	35	20	n.a.	n.a.	35	20
Diffusive ring			yes	yes	yes	yes	yes	yes	yes
Illumination area diameter		(mm)	60	60	60	100	100	100	100
Suggested working distance WD		(mm)	5 - 50	5 - 50	5 - 50	5 - 50	5 - 50	5 - 50	5 - 50
Emission angle α		(deg)	60	60	60	60	60	60	60
Min estimated illumination 1	At driving current = 3.5 A	(klux)	55	50	40	35	70	60	45
	At driving current = 7.5 A	(klux)	105	90	70	70	140	120	90
	At driving current = 17.0 A	(klux)	210	180	150	125	250	220	170
Aperture range		(mm)	64 (fixed)	64 (fixed)	64 (fixed)	102 (fixed)	102 (fixed)	102 (fixed)	102 (fixed)
Electrical specifications									
Power supply mode			strobe only, constant current driving			strobe only, constant current driving			
Driving current	Min	(A)	3.5	3.5	3.5	3.5	3.5	3.5	3.5
	Max	(A)	17.0	17.0	17.0	7.5	17.0	17.0	17.0
Pulse width 2		(ms)	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
Connection Type 3			M12 industrial male connector			M12 industrial male connector			
Estimated MTBF 4		(hours)	> 50000	> 50000	> 50000	> 50000	> 50000	> 50000	> 50000
Mechanical specifications									
Dimensions	Length	(mm)	166.5	166.5	166.5	206	206	206	206
	Width	(mm)	133	133	133	206	206	206	206
	Height	(mm)	38	38	38	76	76	76	76
Materials			black anodized aluminum body			black anodized aluminum body			
Clamping system			4 holes for M6 screw			8 threaded holes for M6 screw			
Compatibility									
Strobe controllers			LTDV1CH-17, LTDV6CH			LTDV1CH-7, LTDV6CH	LTDV1CH-17, LTDV6CH		
Lenses			TC2300y, TC23012, TC12016, TC23016, TC12024, TC23024, TCxx036, TC2MHR016-x, TC2MHR024-x, TC2MHR036-x, TC4M004-x, TC4M007-x, TC4M009-x, TC4MHR016-x, TC4MHR024-x, TC4MHR036-x, TC16M009-x, TC16M012-x, TC16M018-x, TC16M036-x, TCLWD series, TCZR036, MCZR033-008, MCZR025-006, MCZR018-004, MCZR014-003, MC150X, MC100X, MC075X, MC050X, MC033X, MC4K050X-x, MC4K075X-x, MC4K100X-x, MC4K125X-x, MC4K150X-x, PCHI0xx			TCxx036, TCxx048, TC12056, TC23056, TC13064, TCxx064, TC2MHR036-x, TC2MHR048-x, TC2MHR056-x, TC2MHR064-x, TC4MHR036-x, TC4MHR048-x, TC4MHR056-x, TC4MHR064-x, TC16M036-x, TC16M048-x, TC16M056-x, TC16M064-x, TC12K064, TCLW series, TC4K060-x, TCZR072, MCZR025-006, MCZR018-004, MCZR014-003, MC033X, MC12K200X-x, MC12K150X-x, MC12K100X-x, MC12K067X-x, MC4K050X-x, MC4K075X-x, MC4K100X-x, MC4K125X-x, MC4K150X-x		

1 At max Working Distance WD.
2 At 25°C. At max pulse width (1 ms), max pulse frequency = 15 Hz.
3 5 m cable with straight female connector included. Optional cable with right angled connector is also available and must be ordered separately (refer to our website for further info and ordering codes).
4 At 25°C.

Ordering information

It's easy to select the right illuminator for your application: our part numbers are coded as **LTLA xy-z**, where **x** defines the illuminator size (B = medium, C = large), **y** refers to the power intensity (1 = medium, 2 = high) and **z** refers to color (W = white, R = red, G = green).
For instance LTLA B2-R is a diffusive strobed low angle ring light illuminator - medium size high power red.

LTRNST series

LED ring illuminators - straight type

KEY ADVANTAGES

Mechanically fitting Opto Engineering optics
Each lens integrates specific mechanical interfaces.

Specific illumination geometry
Illumination path matches Opto Engineering lenses viewing angle and numerical aperture.

High performance to price ratio
Cost-effective, without quality compromises.

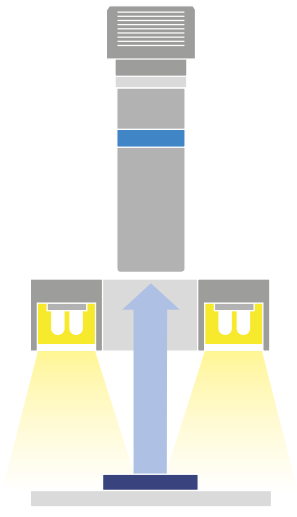
FULL RANGE OF COMPATIBLE PRODUCTS		
	Telecentric lenses	p. 8-48
FULL RANGE OF COMPATIBLE STROBE CONTROLLERS		
	LTDV1CH-17V strobe controller	p. 182
	PS power supplies	p. 186

LTRNST series are LED ring illuminators specifically designed for a wide range of Opto Engineering products.
Especially the straight type models perfectly fit Opto Engineering telecentric lenses.

Every illuminator is equipped with a mechanical interface which makes it very easy to mount it on different lens types.
These products enable the optimal illumination geometry for the most common applications of their matching lens.

LTRN illuminator coupled with TCZR series.

Lighting structure



LTRN - Ring lights / straight illumination

Product overview

LTRN 016 NW

LTRN 120 NW

	Optical specifications				Electrical specifications					Dimensions			Compatibility
					Continuous mode [1]			Pulsed mode					
Part number	**Light colour, peak wavelength**	**Optimal WD**	**Lighting area diam.**		**Supply voltage**	**Current**	**Power cons.**	**Supply voltage**	**Max pulse current**	**Outer diam.**	**Inner diam.**	**Height**	**Compatible OE products**
		(mm)	inner (mm)	outer (mm)	(V)	(mA)	(W)	(V) [2]	(mA) [3]	(mm)	(mm)	(mm)	
Straight illumination													
LTRN 023 RD	red, 630 nm	55-85	32	90	24	200	4.8	24 - 48	600	104	28	40	TC2300y, TC23012, TC4M00y-x, MC3-03X
LTRN 023 GR	green, 525 nm	55-85	32	90	24	220	5.28	24 - 48	660	104	28	40	TC2300y, TC23012, TC4M00y-x, MC3-03X
LTRN 023 BL	blue, 470 nm	55-85	32	90	24	220	5.28	24 - 48	660	104	28	40	TC2300y, TC23012, TC4M00y-x, MC3-03X
LTRN 023 NW	white, 6300K	55-85	32	90	24	480	11.52	24 - 48	1440	104	28	40	TC2300y, TC23012, TC4M00y-x, MC3-03X
LTRN 016 RD	red, 630 nm	85-150	48	107	24	300	7.2	24 - 48	900	120.6	37.7	40	TCxx016, TCxMHR016-x, TCSM016, TCLWD series
LTRN 016 GR	green, 525 nm	85-150	48	107	24	275	6.6	24 - 48	825	120.6	37.7	40	TCxx016, TCxMHR016-x, TCSM016, TCLWD series
LTRN 016 BL	blue, 470 nm	85-150	48	107	24	315	7.56	24 - 48	945	120.6	37.7	40	TCxx016, TCxMHR016-x, TCSM016, TCLWD series
LTRN 016 NW	white, 6300K	85-150	48	107	24	650	15.6	24 - 48	1950	120.6	37.7	40	TCxx016, TCxMHR016-x, TCSM016, TCLWD series
LTRN 024 RD	red, 630 nm	85-150	48	107	24	300	7.2	24 - 48	900	120.6	44	40	TCxx024, TCxMHR024-x, TCSM024
LTRN 024 GR	green, 525 nm	85-150	48	107	24	275	6.6	24 - 48	825	120.6	44	40	TCxx024, TCxMHR024-x, TCSM024
LTRN 024 BL	blue, 470 nm	85-150	48	107	24	315	7.56	24 - 48	945	120.6	44	40	TCxx024, TCxMHR024-x, TCSM024
LTRN 024 NW	white, 6300K	85-150	48	107	24	650	15.6	24 - 48	1950	120.6	44	40	TCxx024, TCxMHR024-x, TCSM024
LTRN 032 RD	red, 630 nm	65-240	84	143	24	400	9.6	24 - 48	1200	157	56	40	TCZR036
LTRN 032 GR	green, 525 nm	65-240	84	143	24	385	9.24	24 - 48	1155	157	56	40	TCZR036
LTRN 032 BL	blue, 470 nm	65-240	84	143	24	434	10.416	24 - 48	1302	157	56	40	TCZR036
LTRN 032 NW	white, 6300K	65-240	84	143	24	840	20.16	24 - 48	2000	157	56	40	TCZR036
LTRN 036 RD	red, 630 nm	65-240	84	143	24	400	9.6	24 - 48	1200	157	61	40	TCxx036, TCxMHR036-x, TC16M036-x, TCSM036, MCZRxxx-yyy
LTRN 036 GR	green, 525 nm	65-240	84	143	24	385	9.24	24 - 48	1155	157	61	40	TCxx036, TCxMHR036-x, TC16M036-x, TCSM036, MCZRxxx-yyy
LTRN 036 BL	blue, 470 nm	65-240	84	143	24	434	10.416	24 - 48	1302	157	61	40	TCxx036, TCxMHR036-x, TC16M036-x, TCSM036, MCZRxxx-yyy
LTRN 036 NW	white, 6300K	65-240	84	143	24	840	20.16	24 - 48	2000	157	61	40	TCxx036, TCxMHR036-x, TC16M036-x, TCSM036, MCZRxxx-yyy
LTRN 048 RD	red, 630 nm	65-240	84	143	24	400	9.6	24 - 48	1200	157	75	40	TCxx048, TCCRxx048, TCxMHR048-x, TC16M048-x, TCSM048
LTRN 048 GR	green, 525 nm	65-240	84	143	24	385	9.24	24 - 48	1155	157	75	40	TCxx048, TCCRxx048, TCxMHR048-x, TC16M048-x, TCSM048
LTRN 048 BL	blue, 470 nm	65-240	84	143	24	434	10.416	24 - 48	1302	157	75	40	TCxx048, TCCRxx048, TCxMHR048-x, TC16M048-x, TCSM048
LTRN 048 NW	white, 6300K	65-240	84	143	24	840	20.16	24 - 48	2000	157	75	40	TCxx048, TCCRxx048, TCxMHR048-x, TC16M048-x, TCSM048
LTRN 056 RD	red, 630 nm	65-240	84	143	24	400	9.6	24 - 48	1200	157	80	40	TCxx056, TCCRxx056, TCxMHR056-x, TC16M056-x, TCSM056
LTRN 056 GR	green, 525 nm	65-240	84	143	24	385	9.24	24 - 48	1155	157	80	40	TCxx056, TCCRxx056, TCxMHR056-x, TC16M056-x, TCSM056
LTRN 056 BL	blue, 470 nm	65-240	84	143	24	434	10.416	24 - 48	1302	157	80	40	TCxx056, TCCRxx056, TCxMHR056-x, TC16M056-x, TCSM056
LTRN 056 NW	white, 6300K	65-240	84	143	24	840	20.16	24 - 48	2000	157	80	40	TCxx056, TCCRxx056, TCxMHR056-x, TC16M056-x, TCSM056
LTRN 064 RD	red, 630 nm	280-365	120	178	24	500	12	24 - 48	1500	192	100	40	TCxx064 , TCCRxx064, TCxMHR064-x, TC16M064-x,TC12K064, TCSM064, TCZR072
LTRN 064 GR	green, 525 nm	280-365	120	178	24	522	12.528	24 - 48	1566	192	100	40	TCxx064 , TCCRxx064, TCxMHR064-x, TC16M064-x,TC12K064, TCSM064, TCZR072
LTRN 064 BL	blue, 470 nm	280-365	120	178	24	567	13.608	24 - 48	1701	192	100	40	TCxx064 , TCCRxx064, TCxMHR064-x, TC16M064-x,TC12K064, TCSM064, TCZR072
LTRN 064 NW	white, 6300K	280-365	120	178	24	960	23.04	24 - 48	2000	192	100	40	TCxx064 , TCCRxx064, TCxMHR064-x, TC16M064-x,TC12K064, TCSM064, TCZR072
LTRN 080 RD	red, 630 nm	280-365	120	178	24	500	12	24 - 48	1500	192	116	40	TCxx080, TC23072, TCxMHR080-x, TC16M080-x, TC12K080, TCSM080
LTRN 080 GR	green, 525 nm	280-365	120	178	24	522	12.528	24 - 48	1566	192	116	40	TCxx080, TCCRxx080, TC23072, TCxMHR080-x, TC16M080-x, TC12K080, TCSM080
LTRN 080 BL	blue, 470 nm	280-365	120	178	24	567	13.608	24 - 48	1701	192	116	40	TCxx080, TCCRxx080, TC23072, TCxMHR080-x, TC16M080-x, TC12K080, TCSM080
LTRN 080 NW	white, 6300K	280-365	120	178	24	1170	28.08	24 - 48	2000	192	116	40	TCxx080, TCCRxx080, TC23072, TCxMHR080-x, TC16M080-x, TC12K080, TCSM080
LTRN 096 RD	red, 630 nm	350-450	148	207	24	600	14.4	24 - 48	1800	221	143	40	TCxx096, TCCRxx096, TC23085, TCxMHR096-x, TC16M096-x, TCSM096
LTRN 096 GR	green, 525 nm	350-450	148	207	24	550	13.2	24 - 48	1650	221	143	40	TCxx096, TCCRxx096, TC23085, TCxMHR096-x, TC16M096-x, TCSM096
LTRN 096 BL	blue, 470 nm	350-450	148	207	24	650	15.6	24 - 48	1950	221	143	40	TCxx096, TCCRxx096, TC23085, TCxMHR096-x, TC16M096-x, TCSM096
LTRN 096 NW	white, 6300K	350-450	148	207	24	1200	28.8	24 - 48	2000	221	143	40	TCxx096, TCCRxx096, TC23085, TCxMHR096-x, TC16M096-x, TCSM096
LTRN 120 RD	red, 630 nm	450-580	204	276	24	875	21	24 - 48	2000	290	180	40	TCxx120, TC23110, TCxMHR120-x, TC16M120-x, TC12K120
LTRN 120 GR	green, 525 nm	450-580	204	276	24	1118	26.832	24 - 48	2000	290	180	40	TCxx120, TC23110, TCxMHR120-x, TC16M120-x, TC12K120
LTRN 120 BL	blue, 470 nm	450-580	204	276	24	1118	26.832	24 - 48	2000	290	180	40	TCxx120, TC23110, TCxMHR120-x, TC16M120-x, TC12K120
LTRN 120 NW	white, 6300K	450-580	204	276	24	1690	40.56	24 - 48	2000	290	180	40	TCxx120, TC23110, TCxMHR120-x, TC16M120-x, TC12K120
LTRN 144 RD	red, 630 nm	450-580	204	276	24	875	21	24 - 48	2000	290	200	40	TCxx144, TC23130, TCxMHR144-x, TC16M144-x, TC12K144
LTRN 144 GR	green, 525 nm	450-580	204	276	24	1118	26.832	24 - 48	2000	290	200	40	TCxx144, TC23130, TCxMHR144-x, C16M144-x, TC12K144
LTRN 144 BL	blue, 470 nm	450-580	204	276	24	1118	26.832	24 - 48	2000	290	200	40	TCxx144, TC23130, TCxMHR144-x, TC16M144-x, TC12K144
LTRN 144 NW	white, 6300K	450-580	204	276	24	1690	40.56	24-48	2000	290	200	40	TCxx144, TC23130, TCxMHR144-x, TC16M144-x, TC12K144

1 Lifespan: 20.000 hours (drop to 50% intensity) at 25 °C.
2 With constant driving voltage (36V recommended, 48V max). Duty cycle = 0-10 %. Max pulse width = 10 ms.
3 With constant driving current. Duty cycle = 0-10 %. Max pulse width = 10 ms.

LTRNOB series

LED ring illuminators - oblique type

KEY ADVANTAGES

Mechanically fitting Opto Engineering optics
Each lens integrates specific mechanical interfaces.

Specific illumination geometry
Illumination path matches Opto Engineering lenses viewing angle and numerical aperture.

High performance to price ratio
Cost-effective, without quality compromises.

FULL RANGE OF COMPATIBLE PRODUCTS		
	360° view optics	p. 52-66
FULL RANGE OF COMPATIBLE STROBE CONTROLLERS		
	LTDV1CH-17V strobe controller	p. 182
	PS power supplies	p. 186

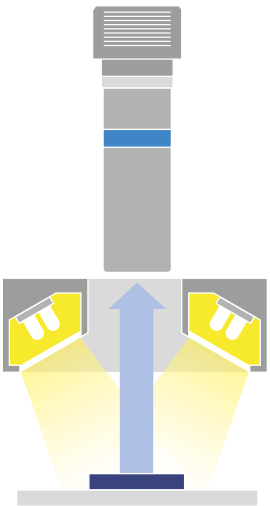
LTRNOB series are LED ring illuminators specifically designed for a wide range of Opto Engineering products. Especially the oblique type models perfectly fit Opto Engineering 360° view optics.

Every illuminator is equipped with a mechanical interface which makes it very easy to mount it on different lens types.

These products enable the optimal illumination geometry for the most common applications of their matching lens.

LTRN 050 W 45 mounted on PCPW series.

Lighting structure



LTRN - Ring lights / oblique illumination

Product overview

LTRN 050 W45

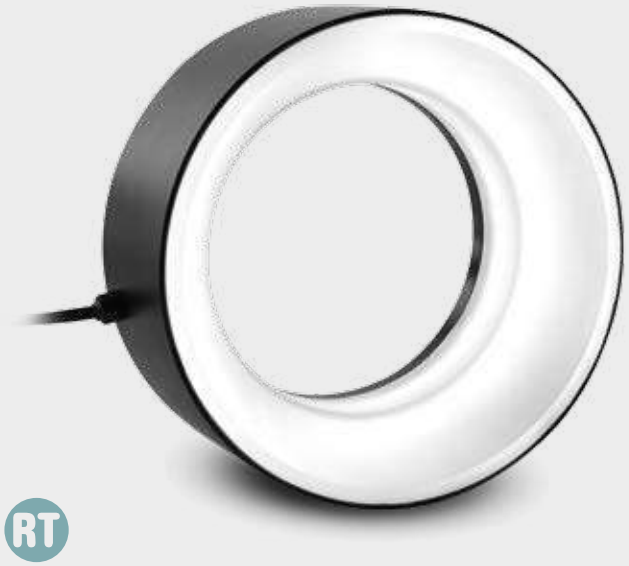
LTRN 245 W45

	Optical specifications				Electrical specifications					Dimensions			Compatibility
					Continuous mode 1			Pulsed mode					
Part number	Light colour, peak wavelength	Optimal WD	Lighting area diam.		Supply voltage	Current	Power cons.	Supply voltage	Max pulse current	Outer diam.	Inner diam.	Height	Compatible OE products
			inner	outer									
		(mm)	(mm)	(mm)	(V)	(mA)	(W)	(V) 2	(mA) 3	(mm)	(mm)	(mm)	
Oblique illumination													
LTRN 050 R45	red, 630 nm	20-80	19	49	24	60	1.44	24-48	180	53.5	15.2	22	PCPW0xx, MCxxxX, TCCAGExx048
LTRN 050 G45	green, 525 nm	20-80	19	49	24	70	1.68	24-48	210	53.5	15.2	22	PCPW0xx, MCxxxX, TCCAGExx048
LTRN 050 B45	blue, 470 nm	20-80	19	49	24	105	2.52	24-48	315	53.5	15.2	22	PCPW0xx, MCxxxX, TCCAGExx048
LTRN 050 W45	white, 6300K	20-80	19	49	24	105	2.52	24-48	700	53.5	15.2	22	PCPW0xx, MCxxxX, TCCAGExx048
LTRN 075 R45	red, 630 nm	20-50	43.8	65.4	24	75	1.8	24-48	225	75.4	28	32	TC2300y, TC23012, TC4M00y-x, PCHI0xx, TCCAGExx096, MC3-03X
LTRN 075 G45	green, 525 nm	20-50	43.8	65.4	24	60	1.44	24-48	180	75.4	28	32	TC2300y, TC23012, TC4M00y-x, PCHI0xx, TCCAGExx096, MC3-03X
LTRN 075 B45	blue, 470 nm	20-50	43.8	65.4	24	60	1.44	24-48	180	75.4	28	32	TC2300y, TC23012, TC4M00y-x, PCHI0xx, TCCAGExx096, MC3-03X
LTRN 075 W45	white, 6300K	20-50	43.8	65.4	24	90	2.16	24-48	270	75.4	28	32	TC2300y, TC23012, TC4M00y-x, PCHI0xx, TCCAGExx096, MC3-03X
LTRN 165 R45	red, 630 nm	30-50	134.5	164.5	24	500	12	24-48	1500	175	132.5	36.5	PCCD0xx
LTRN 165 G45	green, 525 nm	30-50	134.5	164.5	24	400	9.6	24-48	1200	175	132.5	36.5	PCCD0xx
LTRN 165 B45	blue, 470 nm	30-50	134.5	164.5	24	480	11.52	24-48	1440	175	132.5	36.5	PCCD0xx
LTRN 165 W45	white, 6300K	30-50	134.5	164.5	24	800	19.2	24-48	2400	175	132	36.5	PCCD0xx
LTRN 210 R20	red, 630 nm	55-95	195.6	116.5	24	600	14.4	24-48	1800	210	116.5	40	PCxx030XS
LTRN 210 G20	green, 525 nm	55-95	195.6	116.5	24	560	13.44	24-48	1580	210	116.5	40	PCxx030XS
LTRN 210 B20	blue, 470 nm	55-95	195.6	116.5	24	630	15.12	24-48	1890	210	116.5	40	PCxx030XS
LTRN 210 W20	white, 6300K	55-95	195.6	116.5	24	840	20.16	24-48	2000	210	116.5	40	PCxx030XS
LTRN 245 R25	red, 630 nm	20-80	160	225	24	750	18	24-48	2000	245	157	48	PCxx030HP
LTRN 245 G25	green, 525 nm	20-80	160	225	24	850	20.4	24-48	2000	245	157	48	PCxx030HP
LTRN 245 B25	blue, 470 nm	20-80	160	225	24	650	15.6	24-48	1950	245	157	48	PCxx030HP
LTRN 245 W25	white, 6300K	20-80	160	225	24	1120	26.88	24-48	2000	245	157	48	PCxx030HP
LTRN 245 R35	red, 630 nm	20-80	160	225	24	750	18	24-48	2000	245	143	48	PCCD0xx
LTRN 245 G35	green, 525 nm	20-80	160	225	24	850	20.4	24-48	2000	245	143	48	PCCD0xx
LTRN 245 B35	blue, 470 nm	20-80	160	225	24	650	15.6	24-48	1950	245	143	48	PCCD0xx
LTRN 245 W35	white, 6300K	20-80	160	225	24	1120	26.88	24-48	2000	245	143	48	PCCD0xx
LTRN 245 R45	red, 630 nm	20-80	160	225	24	750	18	24-48	2000	245	117	48	PCPW0xx
LTRN 245 G45	green, 525 nm	20-80	160	225	24	850	20.4	24-48	2000	245	117	48	PCPW0xx
LTRN 245 B45	blue, 470 nm	20-80	160	225	24	650	15.6	24-48	1950	245	117	48	PCPW0xx
LTRN 245 W45	white, 6300K	20-80	160	225	24	1120	26.88	24-48	2000	245	117	48	PCPW0xx

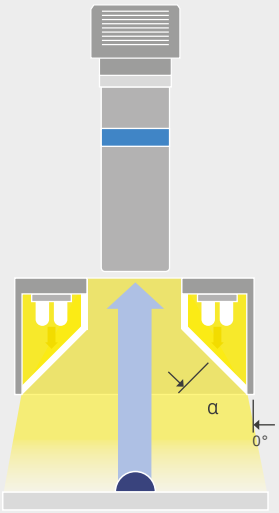
1 Lifespan: 20.000 hours (drop to 50% intensity) at 25 °C.
2 With constant driving voltage (36V recommended, 48V max). Duty cycle = 0-10 %. Max pulse width = 10 ms.
3 With constant driving current. Duty cycle = 0-10 %. Max pulse width = 10 ms.

LTLAIC series

Continuous LED low angle diffused ringlights



Lighting structure



LTLAIC series LTLAIC series consists of LED low angle diffused ringlights that provide diffused even illumination ever a surface effectively preventing glaring when inspecting shining surfaces. Suggested usage is continuous mode.

FULL RANGE OF COMPATIBLE STROBE CONTROLLERS		
	LTDV1CH-17V strobe controller	p. 182
	PS power supplies	p. 186

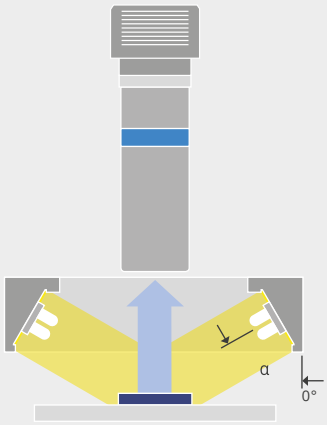
	Optical specifications					Electrical specifications					Dimensions		
			Lighting area			Continuous mode			Pulsed mode				
Part number	Light colour, wavelength peak	Optimal WD	inner diam.	outer diam.	Emission angle α	Supply voltage	Current	Power cons.	Supply voltage	Max pulse current	Outer diam.	Inner diam.	Height
		(mm)	(mm)	(mm)	(deg)	(V)	(mA)	(W)	(V) 1	(mA) 2	(mm)	(mm)	(mm)
RT-DLR2-60-050-2-W-24V-FL	white, 6300K	5 - 15	18	42.1	60	24	75	1.80	36	225	51	18	42
RT-DLR2-60-050-2-R-24V-FL	red, 630nm	5 - 15	18	42.1	60	24	60	1.44	36	180	51	18	42
RT-DLR2-60-050-2-G-24V-FL	green, 525nm	5 - 15	18	42.1	60	24	75	1.80	36	225	51	18	42
RT-DLR2-60-050-2-B-24V-FL	blue, 470nm	5 - 15	18	42.1	60	24	75	1.80	36	225	51	18	42
RT-DLR2-60-070-2-W-24V-FL	white, 6300K	5 - 15	43	67.1	60	24	150	3.60	36	450	76	43	42
RT-DLR2-60-070-2-R-24V-FL	red, 630nm	5 - 15	43	67.1	60	24	120	2.88	36	360	76	43	42
RT-DLR2-60-070-2-G-24V-FL	green, 525nm	5 - 15	43	67.1	60	24	150	3.60	36	450	76	43	42
RT-DLR2-60-070-2-B-24V-FL	blue, 470nm	5 - 15	43	67.1	60	24	150	3.60	36	450	76	43	42
RT-DLR2-60-100-2-W-24V-FL	white, 6300K	13	68	91.1	60	24	195	4.68	36	585	100	68	42
RT-DLR2-60-100-2-R-24V-FL	red, 630nm	13	68	91.1	60	24	150	3.60	36	450	100	68	42
RT-DLR2-60-100-2-G-24V-FL	green, 525nm	13	68	91.1	60	24	195	4.68	36	585	100	68	42
RT-DLR2-60-100-2-B-24V-FL	blue, 470nm	13	68	91.1	60	24	195	4.68	36	585	100	68	42
RT-DLR2-60-120-2-W-24V-FL	white, 6300K	20	93	117.4	60	24	255	6.12	36	765	126.5	93	42
RT-DLR2-60-120-2-R-24V-FL	red, 630nm	20	93	117.4	60	24	195	4.68	36	585	126.5	93	42
RT-DLR2-60-120-2-G-24V-FL	green, 525nm	20	93	117.4	60	24	255	6.12	36	765	126.5	93	42
RT-DLR2-60-120-2-B-24V-FL	blue, 470nm	20	93	117.4	60	24	255	6.12	36	765	126.5	93	42

1 With constant driving voltage (36V recommended, 48V max). Duty cycle = 0-10 %. Max pulse width = 10 ms.
2 With constant driving current. Duty cycle = 0-10 %. Max pulse width = 10 ms.

LTLADC series

Continuous LED low angle direct ringlights

Lighting structure



LTLADC series consists of low angle direct ringlights that provide direct side illumination from a low angle to emphasize the surface features of the workpiece, such as scratches or textures. Suggested usage is continuous mode.

FULL RANGE OF COMPATIBLE STROBE CONTROLLERS		
	LTDV1CH-17V strobe controller	p. 182
	PS power supplies	p. 186

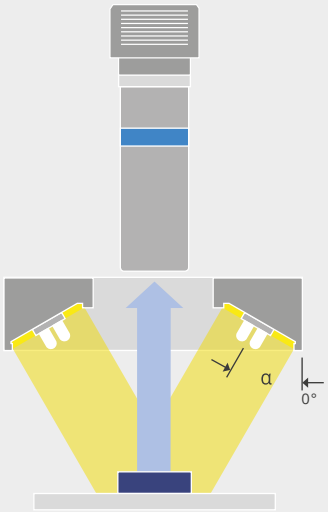
	Optical specifications					Electrical specifications					Dimensions		
						Continuous mode			Pulsed mode				
Part number	Light colour, wavelength peak	Optimal WD	Lighting area inner diam.	Lighting area outer diam.	Emission angle α	Supply voltage	Current	Power cons.	Supply voltage	Max pulse current	Outer diam.	Inner diam.	Height
		(mm)	(mm)	(mm)	(deg)	(V)	(mA)	(W)	(V) 1	(mA) 2	(mm)	(mm)	(mm)
RT-LLA-75-130-3-W-24V-FL	white, 6300K	5 - 15	111	126	75	24	540	12.96	36	225	131	94	24.5
RT-LLA-75-130-3-R-24V-FL	red, 630nm	5 - 15	111	126	75	24	420	10.08	36	180	131	94	24.5
RT-LLA-75-130-3-G-24V-FL	green, 525nm	5 - 15	111	126	75	24	540	12.96	36	225	131	94	24.5
RT-LLA-75-130-3-B-24V-FL	blue, 470nm	5 - 15	111	126	75	24	540	12.96	36	225	131	94	24.5
RT-LLA-75-170-3-W-24V-FL	white, 6300K	5 - 15	154	170	75	24	735	17.64	36	450	175	136	24.5
RT-LLA-75-170-3-R-24V-FL	red, 630nm	5 - 15	154	170	75	24	570	13.68	36	360	175	136	24.5
RT-LLA-75-170-3-G-24V-FL	green, 525nm	5 - 15	154	170	75	24	735	17.64	36	450	175	136	24.5
RT-LLA-75-170-3-B-24V-FL	blue, 470nm	5 - 15	154	170	75	24	735	17.64	36	450	175	136	24.5

1 With constant driving voltage (36V recommended, 48V max). Duty cycle = 0-10 %. Max pulse width = 10 ms.
2 With constant driving current. Duty cycle = 0-10 %. Max pulse width = 10 ms.

LTRNDC series

Continuous LED direct ringlights

Lighting structure



LTRNDC series consists of LED direct ringlights that provide direct side illumination from different angles.
These ringlights reduce shadows and provide even illumination to non-reflective objects. Suggested usage is continuous mode.

FULL RANGE OF COMPATIBLE STROBE CONTROLLERS


LTDV1CH-17V strobe controller p. 182


PS power supplies p. 186

	Optical specifications				Electrical specifications					Dimensions		
					Continuous mode			Pulsed mode				
Part number	Light colour, wavelength peak	Optimal WD	Lighting area inner diam.	Lighting area outer diam.	Emission angle α	Supply voltage	Current	Power cons.	Supply voltage	Max pulse current	Outer diam.	Inner diam.	Height
		(mm)	(mm)	(mm)	(deg)	(V)	(mA)	(W)	(V) 1	(mA) 2	(mm)	(mm)	(mm)
RT-LSW-15-050-2-W-24V-FL	white, 6300K	64	30	49.6	15	24	105	2.52	36	315	50	28	16
RT-LSW-15-050-2-R-24V-FL	red, 630nm	64	30	49.6	15	24	90	2.16	36	270	50	28	16
RT-LSW-15-050-2-G-24V-FL	green, 525nm	64	30	49.6	15	24	105	2.52	36	315	50	28	16
RT-LSW-15-050-2-B-24V-FL	blue, 470nm	64	30	49.6	15	24	105	2.52	36	315	50	28	16
RT-LSW-15-070-3-W-24V-FL	white, 6300K	85	37	67	15	24	240	5.76	36	720	70	32	20.5
RT-LSW-15-070-3-R-24V-FL	red, 630nm	85	37	67	15	24	180	4.32	36	540	70	32	20.5
RT-LSW-15-070-3-G-24V-FL	green, 525nm	85	37	67	15	24	240	5.76	36	720	70	32	20.5
RT-LSW-15-070-3-B-24V-FL	blue, 470nm	85	37	67	15	24	240	5.76	36	720	70	32	20.5
RT-LSW-15-100-5-W-24V-FL	white, 6300K	128	53	99	15	24	570	13.68	36	1710	103	48	24
RT-LSW-15-100-5-R-24V-FL	red, 630nm	128	53	99	15	24	450	10.80	36	1350	103	48	24
RT-LSW-15-100-5-G-24V-FL	green, 525nm	128	53	99	15	24	570	13.68	36	1710	103	48	24
RT-LSW-15-100-5-B-24V-FL	blue, 470nm	128	53	99	15	24	570	13.68	36	1710	103	48	24
RT-LSW-45-070-3-W-24V-FL	white, 6300K	18	40.5	62.5	45	24	240	5.76	36	720	70	35	21
RT-LSW-45-070-3-R-24V-FL	red, 630nm	18	40.5	62.5	45	24	195	4.68	36	585	70	35	21
RT-LSW-45-070-3-G-24V-FL	green, 525nm	18	40.5	62.5	45	24	240	5.76	36	720	70	35	21
RT-LSW-45-070-3-B-24V-FL	blue, 470nm	18	40.5	62.5	45	24	240	5.76	36	720	70	35	21
RT-LSW-45-100-5-W-24V-FL	white, 6300K	24	58	95	45	24	600	14.40	36	1800	100	48	30
RT-LSW-45-100-5-R-24V-FL	red, 630nm	24	58	95	45	24	465	11.16	36	1395	100	48	30
RT-LSW-45-100-5-G-24V-FL	green, 525nm	24	58	95	45	24	600	14.40	36	1800	100	48	30
RT-LSW-45-100-5-B-24V-FL	blue, 470nm	24	58	95	45	24	600	14.40	36	1800	100	48	30

1 With constant driving voltage (36V recommended, 48V max). Duty cycle = 0-10 %. Max pulse width = 10 ms.

2 With constant driving current. Duty cycle = 0-10 %. Max pulse width = 10 ms.

LTDMLA series

High power strobed dome + low angle illumination systems

KEY ADVANTAGES

Two independent illumination units in one single solution
Dome unit for homogeneous illuminations and low angle unit for dark field lightning can be independently operated.

Ultra-high power light output and strobe mode only operation
For the inspection of fast moving object and extended LED lifetime.

Rugged industrial design with built-in industrial connector
For easy integration into any machine vision system.

Wide selection
Available in two sizes and two power intensities.

Compatible LTDV strobe controllers available
For easy and appropriate power, control and synchronization of the illuminator.

LTDMLA series are ultra-high power diffusive LED strobed integrated illumination systems comprising a dome and a low angle ring light illuminator.

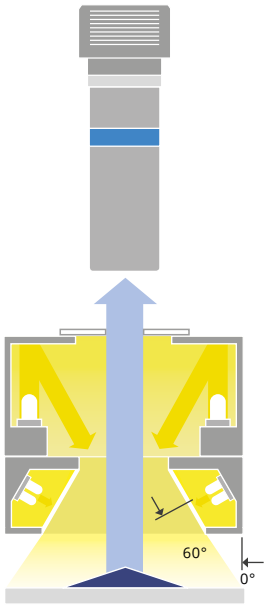
This solution provides two different illumination types in a single, compact, easy-to-integrate system: the dome unit provides non-directional diffused light that can be used to homogeneously illuminate complex shapes with curved and shiny surfaces, effectively eliminating glares and shadows. The low angle ring light unit provides darkfield lightning that can be used to cast shadows, greatly emphasizing surface irregularities, scratches and other details.

LTDMLA illuminators operate exclusively in strobe mode: the reduced heat generation guarantees extended LED lifetime and makes LTDMLA the perfect choice to illuminate very fast moving objects.

The two illumination units can be operated independently and easily powered, controlled and synchronized by compatible LTDV strobe controllers. LTDMLA series is available in:
- **two sizes**: medium and large, respectively with illumination area of 60 mm and 100 mm in diameter;
- **two power intensities**: medium power with driving current up to 7.5 A and high power with driving current up to 17 A.

LTDMLA series features industry standard connection (M12 four poles connector), resizable aperture for the dome unit that can be drilled to increase the diameter and accommodate the optics field of view and effective diffuser for the ring light unit to avoid hot spots formation. Additionally LTDMLA series can be easily mounted and integrated into any machine vision system by means of M6 screws.

Lighting structure

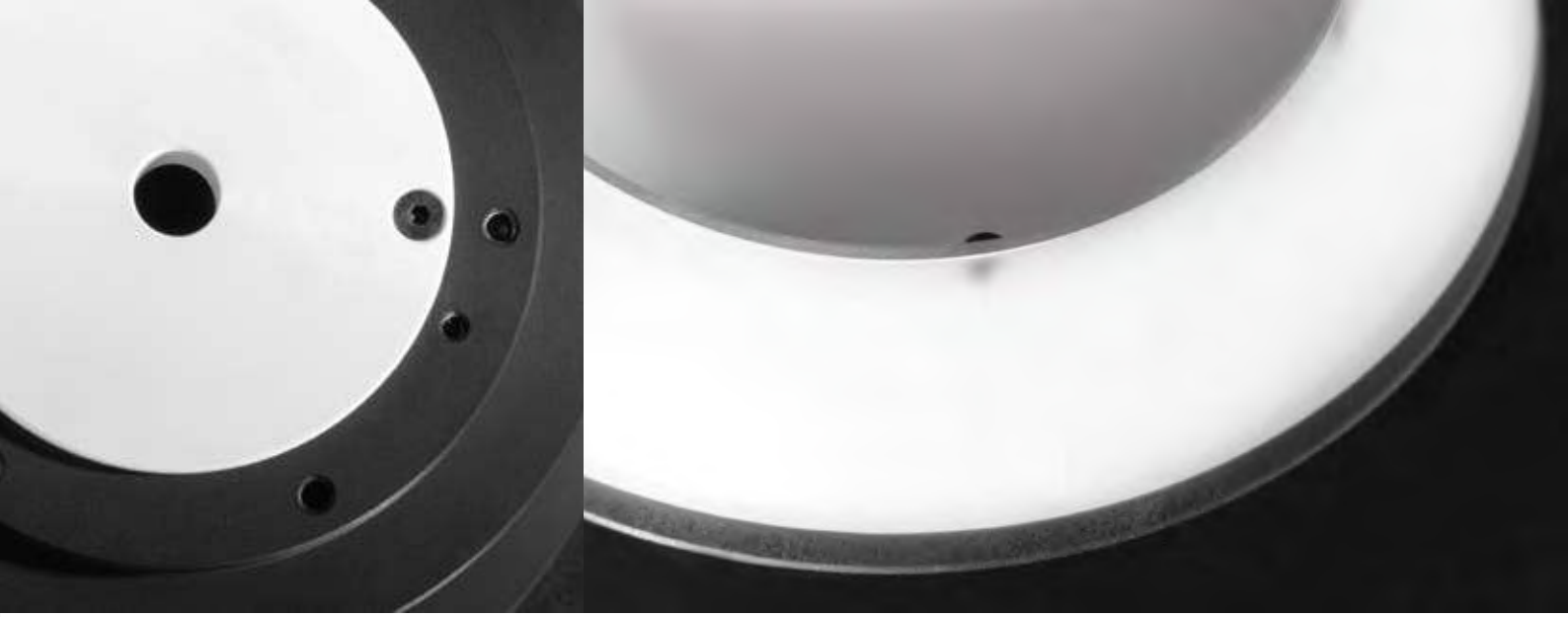


FULL RANGE OF COMPATIBLE STROBE CONTROLLERS

LTDV series p. 182

DESIGNED FOR OEM APPLICATIONS

Compatible LTDV strobe controllers available to easily power, control and synchronize LED illuminators.



Part number			LTDMLAB2-WW	LTDMLAC1-WW	LTDMLAC2-WW
Optical specifications					
Dome unit					
Number of LEDs			40	40	80
Light colour			white, 6500K	white	white, 6500K
Spectral FWHM		(nm)	n.a.	n.a.	n.a.
Illumination area diameter		(mm)	60	100	100
Suggested working distance WD		(mm)	5 - 50	5 - 50	5 - 50
Min estimated illumination 1	At driving current = 3.5 A	(klux)	50	15	35
	At driving current = 7.5 A	(klux)	90	30	65
	At driving current = 17.0 A	(klux)	160	50	100
Aperture range		(mm)	10 - 50	10 - 60	10 - 60
Low angle ringlight unit					
Number of LEDs			40	40	80
Light colour			white, 6000K	white, 6500K	white, 6500K
Spectral FWHM		(nm)	n.a.	n.a.	n.a.
Diffusive ring			yes	yes	yes
Illumination area diameter		(mm)	60	100	100
Suggested working distance WD		(mm)	5 - 50	5 - 50	5 - 50
Min estimated illumination 1	At driving current = 3.5 A	(klux)	55	35	70
	At driving current = 7.5 A	(klux)	105	70	140
	At driving current = 17.0 A	(klux)	210	125	250
Electrical specifications					
Power supply mode			strobe only, constant current driving	strobe only, constant current driving	
Driving current	Min	(A)	3.5	3.5	3.5
	Max	(A)	17.0	7.5	17.0
Pulse width 2		(ms)	≤ 1	≤ 1	≤ 1
Connection Type 3			M12 industrial male connector	M12 industrial male connector	
Estimated MTBF 4		(hours)	> 50000	> 50000	> 50000
Mechanical specifications					
Dimensions	Length	(mm)	166.5	206	206
	Width	(mm)	133	206	206
	Height	(mm)	104	147	147
Materials			black anodized aluminum body	black anodized aluminum body / Painted steel reflector	
Clamping system			4 holes for M6 screw	8 threaded holes for M6 screw	
Compatibility					
Strobe controllers			LTDV1CH-17 (2 units), LTDV6CH	LTDV1CH-7 (2 units), LTDV6CH	LTDV1CH-17 (2 units), LTDV6CH
Lenses			TCLWD series	MC4K050X	

1 At max Working Distance WD.
2 At 25°C. At max pulse width (1 ms), max pulse frequency = 15 Hz.
3 PIN 1 and PIN 2 for the dome unit, PIN 3 and PIN 4 for the ringlight unit.
5 m cable with straight female connector included. Optional cable with right angled connector is also available and must be ordered separately (refer to our website for further info and ordering codes).
4 At 25 °C.

Ordering information

It's easy to select the right illuminator for your application: our part numbers are coded as **LTDMLA xy-WW** where **x** defines the illuminator size (B = medium, C = large), **y** refers to the power intensity (1 = medium, 2 = high). For instance LTDMLA B2-WW is a diffusive strobed dome + low angle illumination system - medium size, high power, dome white, ringlight white.

View-through system

Vision Systems Design 2015 Innovators Awards SILVER

Space saving illumination system for double-side object inspection

KEY ADVANTAGES

Compact space-saving solution for inspection of fast moving object
Illuminates two sides of an object almost simultaneously.

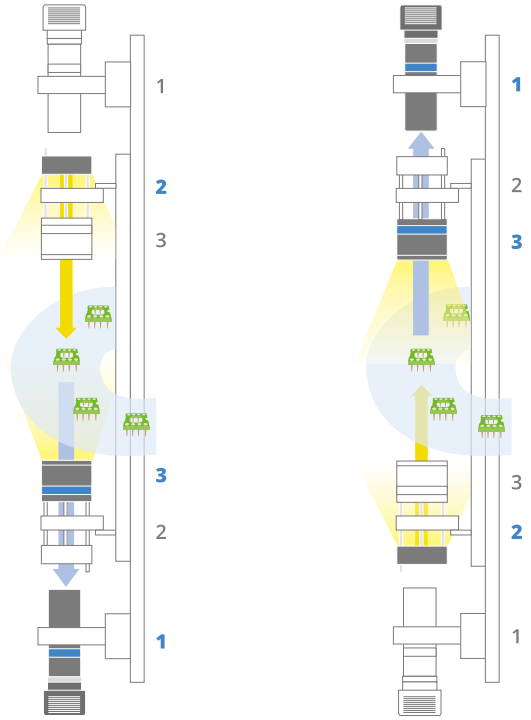
Ultra-high power light output and strobe mode only operation
For the inspection of fast moving object and extended LED lifetime.

Rugged industrial design with built-in industrial connector
For easy integration with any machine vision system.

Modular configuration.

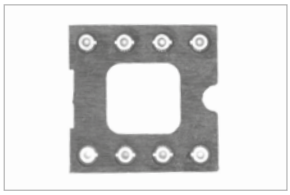
View-through system is a compact space-saving unique illumination solution designed to illuminate two sides of an object. It consists of two symmetrical modules, each one made of two illumination units:
• A diffusive strobed dome illuminator (white color)
• A special active "view-through" backlight unit (white color)
View-through system is designed to create very compact inline inspection solutions that illuminate and image both sides of fast-moving objects. While one camera acquires the image of one side of an object, the corresponding dome and special backlight units emit light simultaneously so that one side of the object can be inspected. Subsequently the dome and the backlight units are turned off so that the second camera can acquire the image of the other side of the object while its corresponding dome and special backlight units are now switched on.
Such innovative and unique approach can be achieved thanks to the special backlight units which act either as transparent windows (when turned off) or as backlights (when turned on) and enables to quickly and accurately inspect fast-moving objects almost simultaneously, in a very compact solution. View-through system can be used for many different inspections, especially for identification of surface defects/features with applications spanning from automotive to pharmaceutical. View-through system is available as LTVTA1-W, which consists of two dome units and two active backlight "view-through" units (white color) or as LTVTBENCH, a complete bench solution which additionally includes a base plate with two right-angle brackets, the LTDV6CH compatible strobe controller (programmable) and the ADPT001 RS485-USB adapter.

Lighting structure

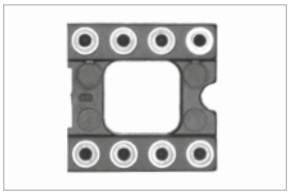


DESIGNED FOR OEM APPLICATIONS

Compatible LTDV6CH strobe controllers available to easily power, control and synchronize the View-through system.



DIL socket, bottom side



DIL socket, top side

FULL RANGE OF COMPATIBLE TELECENTRIC LENSES

TCLWD series p. 18

COMPATIBLE STROBE CONTROLLER AVAILABLE

LTDV6CH p. 182

Part number			LTVTA1-W	LTVTBENCH
Optical specifications				
Dome unit				
Number of LEDs			15	
Light colour			white, 6000K	
Spectral FWHM		(nm)	n.a.	
Illumination area diameter		(mm)	40	
Suggested working distance WD		(mm)	5 - 25	
Min estimated illumination 1	At driving current = 3.5 A	(klux)	290	
	At driving current = 7.5 A	(klux)	490	
Aperture range		(mm)	48 (fixed)	
Active backlight view-through unit				
Number of LEDs			18	
Light colour			white, 6000K	
Spectral FWHM		(nm)	n.a.	
Diffusive material			yes	
Illumination area diameter		(mm)	40	
Suggested working distance WD		(mm)	n.a.	
Min estimated illumination 1	At driving current = 17.0 A	(klux)	5	
Electrical specifications				
Power supply mode			strobe only, constant current driving	
Pulse width 2		(ms)	≤ 1	
Connection Type 3			M8 industrial male connector	
Dome unit				
Driving current	Min - Max	(A)	3.5 - 7.5	
Active backlight view-through unit				
Driving current	Min - Max	(A)	3.5 - 17.0	
Estimated MTBF 4		(hours)	> 50000	
Mechanical specifications				
Dimensions	Length	(mm)	107	600
	Width	(mm)	84	100
	Height	(mm)	125	155.5
Materials			black anodized aluminum body	
Clamping system			4 threaded holes for M6 screw	
Compatibility				
Lenses			TCLWD series	

Items included	LTVTA1-W		LTVTBENCH	
	Description	**Qty**	**Description**	**Qty**
	Dome unit 5	2	Dome unit 5	2
	Active backlight view-through unit 5	2	Active backlight view-through unit 5	2
			Base plate with two right-angle brackets	1
			LTDV6CH strobe controller	1
			ADPT001 adapter RS485-USB	1

1 At max Working Distance WD.
2 At 25°C. At max pulse width (1 ms), max pulse frequency = 15 Hz.
3 PIN 1 and PIN 2 for the dome unit, PIN 3 and PIN 4 for the ringlight unit.
4 At 25 °C.
5 Cables included.

LTBP series

High-power strobed LED backlights

NEW

KEY ADVANTAGES

Excellent uniformity (down to ±10 %).

Ultra high-power light output and strobe mode operation
For inspection and measurement of fast moving objects and an extended LED lifetime.

Suitable for frequent cleaning
Thanks to the optical grade and scratch resistant protective cover.

Wide selection and modular design
Size options range from 48 x 36 to 288 x 216 mm available in red, white, green and blue.

Compact design with reduced thickness (26 mm).

Special continuous alignment mode.

Compatible LTDV1CH-17V strobe controller.

LTBP series are high power LED backlights designed to provide exceptional illumination performances and excellent uniformity. Their special design provides both powerful and homogeneous lighting that perfectly fits confined spaces thanks to a special beam shaping diffuser, new high efficiency LEDs and reduced thickness.

LTBP series innovative optical layout has been designed to emit directional light beams and achieve accurate results even when used in combination with telecentric lenses for measurement applications.

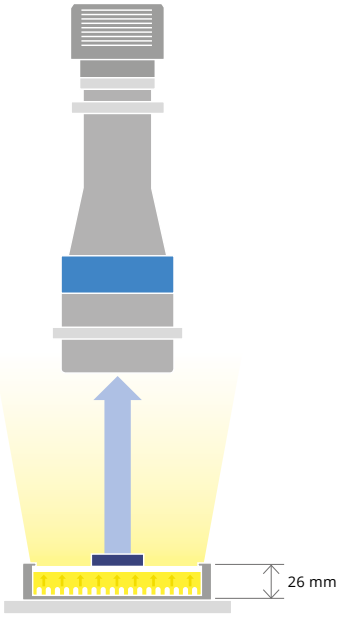
When positioned behind the objects to be inspected, LTBP series highlight the silhouette of the objects providing excellent image contrast and high illuminance for the most demanding high speed applications (down to exposure times of tens of µs).

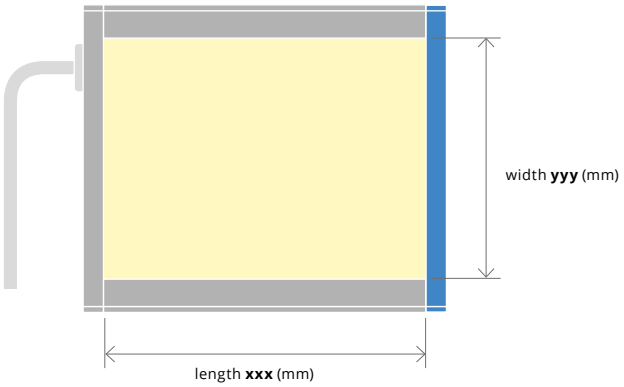
These backlights work in strobe mode only but they also feature a special continuous mode to be used for alignment/setting purpose (when used with LTDV1CH-17V controller).

Their robust and modular design featuring M8/M12 connectors and scratch resistant protective cover is conceived for demanding industrial automation environments and to provide you a great choice of sizes, colors and aspect ratios for many diverse applications (from 4:3 to 16:9 and bar lights).

Furthermore, LTBP series can be easily installed into any machine vision system thanks to the lateral M6 threads and their slick design, suitable for environments with space constrains.

Lighting structure





Optical specifications

Available light colours	red, green, blue, **white**

Electrical specifications

Power supply mode		strobe only, constant current driving
Pulse width 1	(ms)	≤ 1
Estimated MTBF 2	(h)	> 50000

Mechanical specification

Materials	Black&Blue anodized Aluminum

1 At 25°C. At max pulse width (1 ms), max pulse frequency = 15 Hz.
2 At 25°C.

		Optical specifications			Electrical specifications					Mechanical specifications			
Part number 1	Modules	Number of LEDs	Lighting area dim. Length xxx (mm)	Lighting area dim. Width yyy (mm)	Max Driving Current -R (red) (A)	Max Driving Current -G (green) (A)	Max Driving Current -B (blue) (A)	Max Driving Current -W (white) (A)	Connection type 2	Dimensions Length (mm)	Dimensions Width (mm)	Dimensions Thickness (mm)	Clamping system
LTBP048036-z	1 x 1	48	48	36	1.8	1.8	1.8	1.8	M8	60	56	26	4x M6 threaded holes
LTBP096036-z	2 x 1	96	96	36	3.6	3.6	3.6	3.6	M8	108	56	26	4x M6 threaded holes
LTBP144036-z	3 x 1	144	144	36	5.4	5.4	5.4	5.4	M8	156	56	26	4x M6 threaded holes
LTBP192036-z	4 x 1	192	192	36	7.2	7.2	7.2	7.2	M8	204	56	26	8x M6 threaded holes
LTBP240036-z	5 x 1	240	240	36	9	9	9	9	M8	252	56	26	8x M6 threaded holes
LTBP288036-z	6 x 1	288	288	36	10.8	10.8	10.8	10.8	M8	300	56	26	8x M6 threaded holes
LTBP048072-z	1 x 2	96	48	72	3.6	3.6	3.6	3.6	M8	60	92	26	4x M6 threaded holes
LTBP096072-z	2 x 2	192	96	72	7.2	7.2	7.2	7.2	M8	108	92	26	4x M6 threaded holes
LTBP144072-z	3 x 2	288	144	72	10.8	10.8	10.8	10.8	M8	156	92	26	4x M6 threaded holes
LTBP192072-z	4 x 2	384	192	72	14.4	14.4	14.4	14.4	M8	204	92	26	8x M6 threaded holes
LTBP240072-z	5 x 2	480	240	72	8.4	8.4	4.9	4.8	M8	252	92	26	8x M6 threaded holes
LTBP288072-z	6 x 2	576	288	72	10.1	10.1	5.8	5.8	M8	300	92	26	8x M6 threaded holes
LTBP048108-z	1 x 3	144	48	108	5.4	5.4	5.4	5.4	M8	60	128	26	4x M6 threaded holes
LTBP096108-z	2 x 3	288	96	108	10.8	10.8	10.8	10.8	M8	108	128	26	4x M6 threaded holes
LTBP144108-z	3 x 3	432	144	108	16.2	16.2	16.2	16.2	M8	156	128	26	4x M6 threaded holes
LTBP192108-z	4 x 3	576	192	108	10.1	10.1	5.8	5.8	M8	204	128	26	8x M6 threaded holes
LTBP240108-z	5 x 3	720	240	108	12.6	12.6	7.3	7.2	M8	252	128	26	8x M6 threaded holes
LTBP288108-z	6 x 3	864	288	108	15.1	15.1	8.7	8.6	M8	300	128	26	8x M6 threaded holes
LTBP048144-z	1 x 4	192	48	144	7.2	7.2	7.2	7.2	M8	60	164	26	4x M6 threaded holes
LTBP096144-z	2 x 4	384	96	144	14.4	14.4	14.4	14.4	M8	108	164	26	4x M6 threaded holes
LTBP144144-z	3 x 4	576	144	144	10.1	10.1	5.8	5.8	M8	156	164	26	4x M6 threaded holes
LTBP192144-z	4 x 4	768	192	144	13.4	13.4	7.8	7.7	M8	204	164	26	8x M6 threaded holes
LTBP240144-z	5 x 4	960	240	144	16.8	16.8	9.7	9.6	M8	252	164	26	8x M6 threaded holes
LTBP288144-z	6 x 4	1152	288	144	20.2	20.2	11.7	11.5	M8	300	164	26	8x M6 threaded holes
LTBP048180-z	1 x 5	240	48	180	9	9	9	9	M8	60	200	26	4x M6 threaded holes
LTBP096180-z	2 x 5	480	96	180	8.4	8.4	4.9	4.8	M8	108	200	26	4x M6 threaded holes
LTBP144180-z	3 x 5	720	144	180	12.6	12.6	7.3	7.2	M8	156	200	26	4x M6 threaded holes
LTBP192180-z	4 x 5	960	192	180	16.8	16.8	9.7	9.6	M8	204	200	26	8x M6 threaded holes
LTBP240180-z 3	5 x 5	1200	240	180	10.5 + 10.5	10.5 + 10.5	12.2	12	M12	252	200	26	8x M6 threaded holes
LTBP288180-z 3	6 x 5	1440	288	180	12.6 + 12.6	12.6 + 12.6	14.6	14.4	M12	300	200	26	8x M6 threaded holes
LTBP048216-z	1 x 6	288	48	216	10.8	10.8	10.8	10.8	M8	60	236	26	4x M6 threaded holes
LTBP096216-z	2 x 6	576	96	216	10.1	10.1	5.8	5.8	M8	108	236	26	4x M6 threaded holes
LTBP144216-z	3 x 6	864	144	216	15.1	15.1	8.7	8.6	M8	156	236	26	4x M6 threaded holes
LTBP192216-z	4 x 6	1152	192	216	20.2	20.2	11.7	11.5	M8	204	236	26	8x M6 threaded holes
LTBP240216-z 3	5 x 6	1440	240	216	12.6 + 12.6	12.6 +12.6	14.6	14.4	M12	252	236	26	8x M6 threaded holes
LTBP288216-z 3	6 x 6	1728	288	216	15.1 + 15.1	15.1 + 15.1	17.5	17.3	M12	300	236	26	8x M6 threaded holes

1 The last digit of the part number (-z) refers to the color (R = red, G = green, B = blue, W = white).
2 5 m cable with straight female connector included. Optional cable with right angled connector is also available and must be ordered separately (refer to our website for further info and ordering codes).
3 Red and Green versions of these models feature 2 separate channels.

Ordering information

Our part numbers are coded as **LTBP xxx yyy - z**, where **xxx** defines the illumination area length (in mm), **yyy** defines the illumination area width (in mm) and **z** refers to the color (W = white, R = red, G = green, B = blue). For instance LTBP048036-R is a high power strobed LED backlight, 48 x 36 mm lighting area, red.

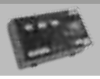
LTBP series

High-power strobed LED backlights

LTBP096072-W

LTBP048036-G

FULL RANGE OF COMPATIBLE STROBE CONTROLLERS



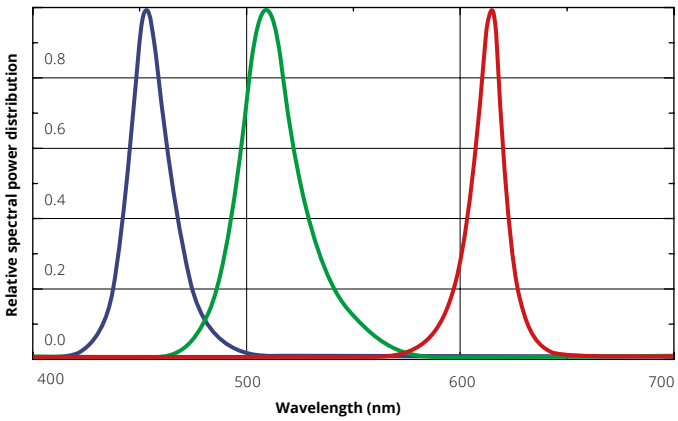
LTDV series p. 182

Light colour			-R (red)	-G (green)	-B (blue)	-W (white)
		LED Type				
Wavelength	(nm)	A	620	522	465	cool white, > 4500 K
		B	625	525	470	cool white, > 4500 K
Spectral FWHM	(nm)	A	20	30	20	cool white, > 4500 K
		B	20	30	25	cool white, > 4500 K
Min estimated illumination	(klux)	A 1	70	150	30	200
		B 2	n.a.	n.a.	n.a.	n.a.

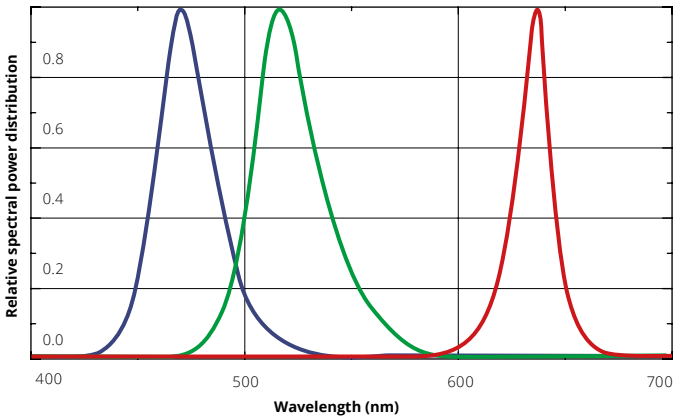
1 At max driving current, on emitting surface.
2 Available upon request.

Part number	Module	LED type
LTBP 048036-z	1 x 1	A
LTBP 096036-z	2 x 1	A
LTBP 144036-z	3 x 1	A
LTBP 192036-z	4 x 1	A
LTBP 240036-z	5 x 1	A
LTBP 288036-z	6 x 1	A
LTBP 048072-z	1 x 2	A
LTBP 096072-z	2 x 2	A
LTBP 144072-z	3 x 2	A
LTBP 192072-z	4 x 2	A
LTBP 240072-z	5 x 2	B
LTBP 288072-z	6 x 2	B
LTBP 048108-z	1 x 3	A
LTBP 096108-z	2 x 3	A
LTBP 144108-z	3 x 3	A
LTBP192108-z	4 x 3	B
LTBP 240108-z	5 x 3	B
LTBP 288108-z	6 x 3	B
LTBP 048144-z	1 x 4	A
LTBP 096144-z	2 x 4	A
LTBP 144144-z	3 x 4	B
LTBP 192144-z	4 x 4	B
LTBP 240144-z	5 x 4	B
LTBP 288144-z	6 x 4	B
LTBP 048180-z	1 x 5	A
LTBP 096180-z	2 x 5	B
LTBP 144180-z	3 x 5	B
LTBP 192180-z	4 x 5	B
LTBP 240180-z	5 x 5	B
LTBP 288180-z	6 x 5	B
LTBP 048216-z	1 x 6	A
LTBP 096216-z	2 x 6	B
LTBP 144216-z	3 x 6	B
LTBP 192216-z	4 x 6	B
LTBP 240216-z	5 x 6	B
LTBP 288216-z	6 x 6	B

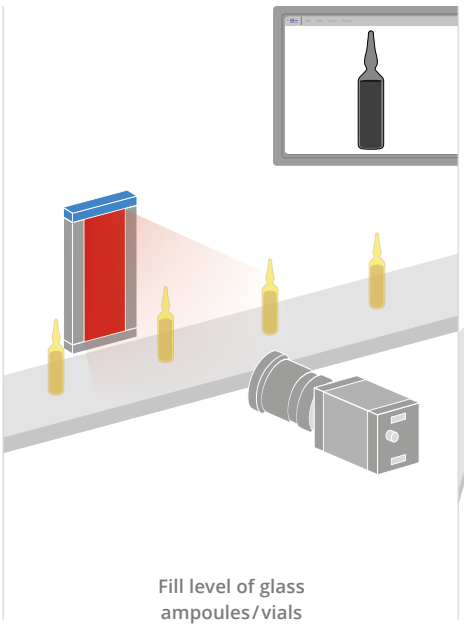
Typical emission spectrum of type A LEDs (R, G, B)



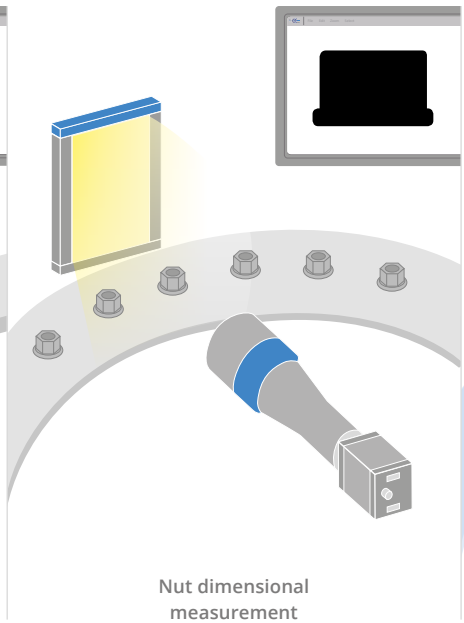
Typical emission spectrum of type B LEDs (R, G, B)



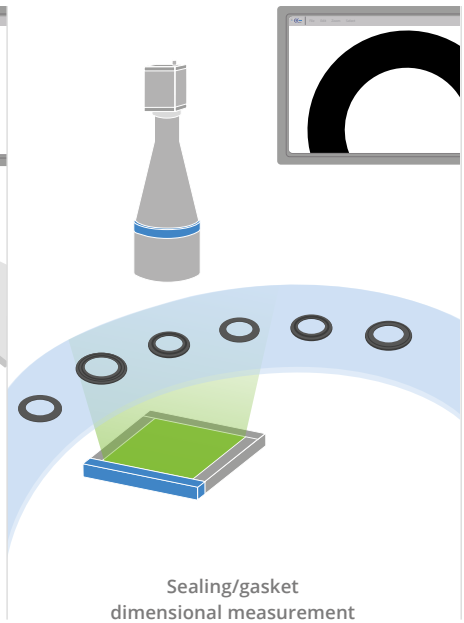
Application examples



Fill level of glass ampoules/vials



Nut dimensional measurement



Sealing/gasket dimensional measurement

LTBC series

Continuous LED backlights

NEW

KEY ADVANTAGES

Cost-effective homogeneous illumination
Densely packed LED arrays with matt diffuser eliminating hot spots and glare.

Robust industrial Design
M8 connector for easy connection to power supplies.

Easy integration
M6 nut channels for easy mounting.

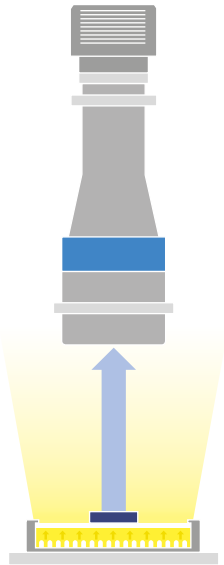
LTBC series are LED backlights designed to be employed in a wide variety of applications such as shape and size inspection of workpieces.

These backlights are a cost-effective solution without quality compromise: they feature a robust design and provide diffused homogeneous illumination without hotspot formation.

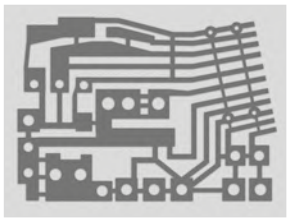
When installed behind the workpiece LTBC series effectively emphasize its silhouette providing excellent optical contrast in combination with many different lenses.

FULL RANGE OF COMPATIBLE STROBE CONTROLLERS		
	LTDV1CH-17V strobe controller	p. 182
	PS power supplies	p. 186

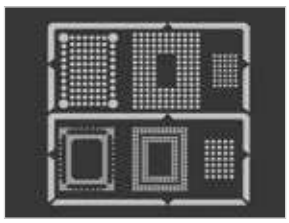
Lighting structure



Application examples



Shape inspection



Detection of patterns/holes

LTBC114114-G

LTBC054054 with M6 threaded hole for easy mounting.

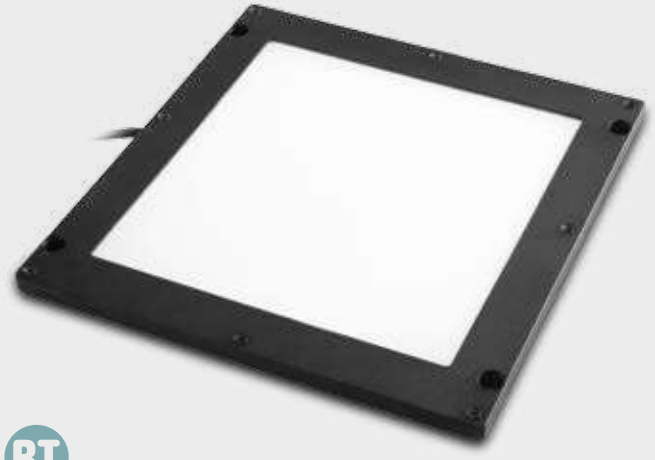
	Optical specifications			Electrical specifications					Dimensions			Compatibility
Part number	Colour, peak wavelength	Lighting area Lenght (mm)	Width (mm)	Continuous mode Supply Voltage (V)	Current (mA)	Power cons. (W)	Pulsed mode Supply Voltage (V) 1	Max pulse Current (mA) 2	Length (mm)	Width (mm)	Height (mm)	Opto Engineering optics
LTBC 054 054-W	white, 6300K	54.5	54.5	24	54	1.30	36	162	99	99	35.6	TC2300y, TC23012, TCxx016, TCxx024, TCxx036, TCLWD series, TCxMHR016-x,TCxMHR024-x, TCxMHR036-x, TC4M00y-x, TC16M009-x, TC16M012-x, TC16M018-x, TC16M036-x, TCZR036, MC series, MC4K050X-x, MC4K100X-x, MC4K125X-x, MC4K150X-x, MC4K175X-x, MC4K200X-x, MC12K200X-x, MC12K150X-x, MC12K100X-x
LTBC 054 054-G	green, 525nm	54.5	54.5	24	54	1.30	36	162	99	99	35.6	
LTBC 114 114-W	white, 6300K	114.5	114.5	24	216	5.18	36	648	159	159	35.6	TCxx048, TCxx056, TCxx085, TCxMHR048-x, TCxMHR056-x, TCxMHR064-x, TCxMHR080-x, TC16M048-x, TC16M056-x, TC16M064-x, TC16M080-x, TCZR072, MC4K025X-x, MC12K067X-x,MC12K050X-x
LTBC 114 114-G	green, 525nm	114.5	114.5	24	216	5.18	36	648	159	159	35.6	
LTBC 174 174-W	white, 6300K	174.5	174.5	24	486	11.66	36	1458	219	219	35.6	TCxx096, TCxx130, TCxMHR096-x,TCxMHR120-x, TC16M096-x, TC16M0120-x, TCDPxX096, TCDPxX120, MCZR033-008, MC12K025X-x
LTBC 174 174-G	green, 525nm	174.5	174.5	24	486	11.66	36	1458	219	219	35.6	
LTBC 234 234-W	white, 6300K	234.5	234.5	24	864	20.74	36	2592	279	279	35.6	TCxx144, TC23172, TCxMHR144-x, TC16M144-x, TC16M192-x, TCDPxX144, MCZR025-006, MCZR018-004
LTBC 234 234-G	green, 525nm	234.5	234.5	24	864	20.74	36	2592	279	279	35.6	

1 With constant driving voltage (36V recommended, 48V max). Duty cycle = 0-10 %. Max pulse width = 10 ms.

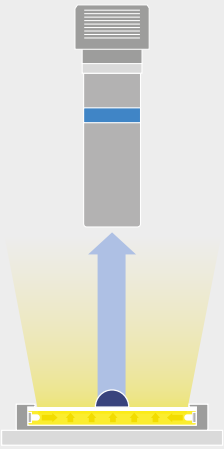
2 With constant driving current. Duty cycle = 0-10 %. Max pulse width = 10 ms.

LTBFC series

Continuous flat side-emitting LED backlights



Lighting structure



LTBFC series consists of flat side-emitting LED backlights: two types are available either with four borders or with three borders and one side “edge to edge”. Suggested usage is continuous mode.

FULL RANGE OF COMPATIBLE STROBE CONTROLLERS		
	LTDV1CH-17V strobe controller	p. 182
	PS power supplies	p. 186

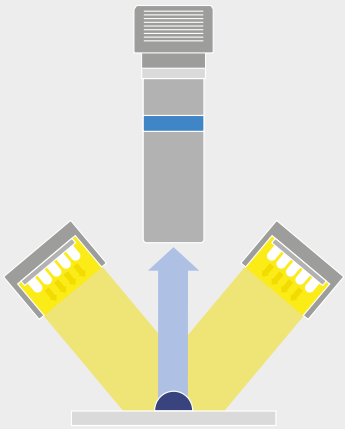
	Optical specifications				Electrical specifications					Dimensions		
					Continuous mode			Pulsed mode				
Part number	Light colour, wavelength peak	Lighting area Width (mm)	Lighting area Length (mm)	Sides type	Supply voltage (V)	Current (mA)	Power cons. (W)	Supply voltage (V) 1	Max pulse current (mA) 2	Length (mm)	Width (mm)	Height (mm)
RT-BHD-00-070-1-W-24V-FL	white, 6300K	70	70	4 borders	24	120	2.88	36	360	98.5	98.5	5.30
RT-BHD-00-070-1-R-24V-FL	red, 630nm	70	70	4 borders	24	120	2.88	36	360	98.5	98.5	5.30
RT-BHD-00-070-1-G-24V-FL	green, 525nm	70	70	4 borders	24	120	2.88	36	360	98.5	98.5	5.30
RT-BHD-00-070-1-B-24V-FL	blue, 470nm	70	70	4 borders	24	120	2.88	36	360	98.5	98.5	5.30
RT-BHD-00-100-1-W-24V-FL	white, 6300K	100	100	4 borders	24	160	3.84	36	480	128.5	128.5	5.30
RT-BHD-00-100-1-R-24V-FL	red, 630nm	100	100	4 borders	24	180	4.32	36	540	128.5	128.5	5.30
RT-BHD-00-100-1-G-24V-FL	green, 525nm	100	100	4 borders	24	160	3.84	36	480	128.5	128.5	5.30
RT-BHD-00-100-1-B-24V-FL	blue, 470nm	100	100	4 borders	24	160	3.84	36	480	128.5	128.5	5.30
RT-BHDS-25X36-1-W-24V-FL	white, 6300K	25	36	3 borders and 1 edge to edge	24	20	0.48	36	60	38.5	43.5	5.30
RT-BHDS-25X36-1-R-24V-FL	red, 630nm	25	36	3 borders and 1 edge to edge	24	15	0.36	36	45	38.5	43.5	5.30
RT-BHDS-25X36-1-G-24V-FL	green, 525nm	25	36	3 borders and 1 edge to edge	24	20	0.48	36	60	38.5	43.5	5.30
RT-BHDS-25X36-1-B-24V-FL	blue, 470nm	25	36	3 borders and 1 edge to edge	24	20	0.48	36	60	38.5	43.5	5.30
RT-BHDS-31X58-1-W-24V-FL	white, 6300K	31	58	3 borders and 1 edge to edge	24	30	0.72	36	90	60	43.5	5.30
RT-BHDS-31X58-1-R-24V-FL	red, 630nm	31	58	3 borders and 1 edge to edge	24	30	0.72	36	90	60	43.5	5.30
RT-BHDS-31X58-1-G-24V-FL	green, 525nm	31	58	3 borders and 1 edge to edge	24	30	0.72	36	90	60	43.5	5.30
RT-BHDS-31X58-1-B-24V-FL	blue, 470nm	31	58	3 borders and 1 edge to edge	24	30	0.72	36	90	60	43.5	5.30
RT-BHDS-00-070-1-W-24V-FL	white, 6300K	70	70	3 borders and 1 edge to edge	24	90	2.16	36	270	98.5	84.5	4.30
RT-BHDS-00-070-1-R-24V-FL	red, 630nm	70	70	3 borders and 1 edge to edge	24	90	2.16	36	270	98.5	84.5	4.30
RT-BHDS-00-070-1-G-24V-FL	green, 525nm	70	70	3 borders and 1 edge to edge	24	90	2.16	36	270	98.5	84.5	4.30
RT-BHDS-00-070-1-B-24V-FL	blue, 470nm	70	70	3 borders and 1 edge to edge	24	90	2.16	36	270	98.5	84.5	4.30

1 With constant driving voltage (36V recommended, 48V max). Duty cycle = 0-10 %. Max pulse width = 10 ms.
2 With constant driving current. Duty cycle = 0-10 %. Max pulse width = 10 ms.

LTBRDC series

Continuous LED bar lights

Lighting structure



LTBRDC series LTBRDC series consists of LED bar lights that can be used in a wide variety of applications such as text reading on flat surfaces.
They provide rectangular illumination on the workpiece and the installation angle is set freely. Suggested usage is continuous mode.

FULL RANGE OF COMPATIBLE STROBE CONTROLLERS

LTDV1CH-17V strobe controller p. 182

PS power supplies p. 186

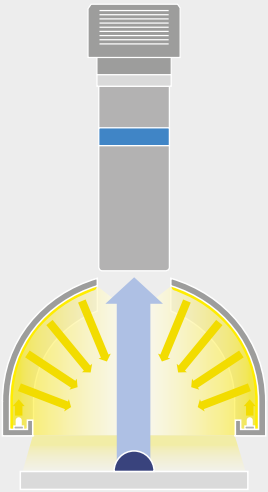
	Optical specifications			Electrical specifications					Dimensions		
				Continuous mode			Pulsed mode				
Part number	Light colour, wavelength peak	Lighting area Width (mm)	Lighting area Length (mm)	Supply voltage (V)	Current (mA)	Power cons. (W)	Supply voltage (V) 1	Max pulse current (mA) 2	Length (mm)	Width (mm)	Height (mm)
RT-LBRX-00-040-6-W-24V-FL	white, 6300K	26.3	40	24	72	1.73	36	216	52	31.5	22
RT-LBRX-00-040-6-R-24V-FL	red, 630nm	26.3	40	24	78	1.87	36	234	52	31.5	22
RT-LBRX-00-040-6-G-24V-FL	green, 525nm	26.3	40	24	72	1.73	36	216	52	31.5	22
RT-LBRX-00-040-6-B-24V-FL	blue, 470nm	26.3	40	24	72	1.73	36	216	52	31.5	22
RT-LBRX-00-080-6-W-24V-FL	white, 6300K	26.3	80	24	144	3.46	36	432	92	31.5	22
RT-LBRX-00-080-6-R-24V-FL	red, 630nm	26.3	80	24	156	3.74	36	468	92	31.5	22
RT-LBRX-00-080-6-G-24V-FL	green, 525nm	26.3	80	24	144	3.46	36	432	92	31.5	22
RT-LBRX-00-080-6-B-24V-FL	blue, 470nm	26.3	80	24	144	3.46	36	432	92	31.5	22
RT-LBRX-00-120-6-W-24V-FL	white, 6300K	26.3	120	24	216	5.18	36	648	132	31.5	22
RT-LBRX-00-120-6-R-24V-FL	red, 630nm	26.3	120	24	234	5.62	36	702	132	31.5	22
RT-LBRX-00-120-6-G-24V-FL	green, 525nm	26.3	120	24	216	5.18	36	648	132	31.5	22
RT-LBRX-00-120-6-B-24V-FL	blue, 470nm	26.3	120	24	216	5.18	36	648	132	31.5	22
RT-LBRX-00-160-6-W-24V-FL	white, 6300K	26.3	160	24	288	6.91	36	864	172	31.5	22
RT-LBRX-00-160-6-R-24V-FL	red, 630nm	26.3	160	24	312	7.49	36	936	172	31.5	22
RT-LBRX-00-160-6-G-24V-FL	green, 525nm	26.3	160	24	288	6.91	36	864	172	31.5	22
RT-LBRX-00-160-6-B-24V-FL	blue, 470nm	26.3	160	24	288	6.91	36	864	172	31.5	22
RT-LBRX-00-200-6-W-24V-FL	white, 6300K	26.3	200	24	360	8.64	36	1080	212	31.5	22
RT-LBRX-00-200-6-R-24V-FL	red, 630nm	26.3	200	24	390	9.36	36	1170	212	31.5	22
RT-LBRX-00-200-6-G-24V-FL	green, 525nm	26.3	200	24	360	8.64	36	1080	212	31.5	22
RT-LBRX-00-200-6-B-24V-FL	blue, 470nm	26.3	200	24	360	8.64	36	1080	212	31.5	22

1 With constant driving voltage (36V recommended, 48V max). Duty cycle = 0-10 %. Max pulse width = 10 ms.
2 With constant driving current. Duty cycle = 0-10 %. Max pulse width = 10 ms.

LTTNC series

Continuous LED tunnel lights

Lighting structure



LTTNC series LTTNC series consists of LED tunnel lights designed to provide even illumination on long cylindrical surfaces or shafts. Suggested usage is continuous mode.

FULL RANGE OF COMPATIBLE STROBE CONTROLLERS		
	LTDV1CH-17V strobe controller	p. 182
	PS power supplies	p. 186

	Optical specifications				Electrical specifications					Dimensions		
					Continuous mode			Pulsed mode				
Part number	Light colour, wavelength peak	Optimal WD	Lighting area inner diam.	Lighting area Width	Supply voltage	Current	Power cons.	Supply voltage	Max pulse current	Width x lenght	Aperture	Height
		(mm)	(mm)	(mm)	(V)	(mA)	(W)	(V) 1	(mA) 2	(mm)	(mm)	(mm)
RT-IDT2-00-150-1-W-24V-FL	white, 6300K	40 - 60	90	183	24	400	9.60	36	1200	36	25	96
RT-IDT2-00-150-1-R-24V-FL	red, 630nm	40 - 60	90	183	24	400	9.60	36	1200	36	25	96
RT-IDT2-00-150-1-G-24V-FL	green, 525nm	40 - 60	90	183	24	400	9.60	36	1200	36	25	96
RT-IDT2-00-150-1-B-24V-FL	blue, 470nm	40 - 60	90	183	24	400	9.60	36	1200	36	25	96
RT-IDT2-00-200-1-W-24V-FL	white, 6300K	40 - 60	126	183	24	400	9.60	36	1200	36	25	121
RT-IDT2-00-200-1-R-24V-FL	red, 630nm	40 - 60	126	183	24	400	9.60	36	1200	36	25	121
RT-IDT2-00-200-1-G-24V-FL	green, 525nm	40 - 60	126	183	24	400	9.60	36	1200	36	25	121
RT-IDT2-00-200-1-B-24V-FL	blue, 470nm	40 - 60	126	183	24	400	9.60	36	1200	36	25	121

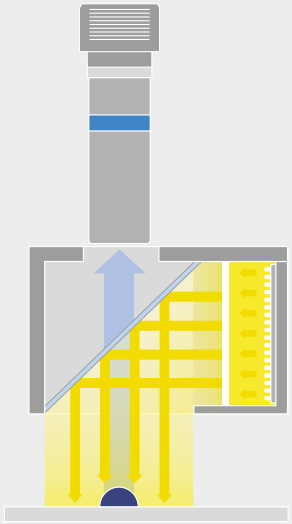
1 With constant driving voltage (36V recommended, 48V max). Duty cycle = 0-10 %. Max pulse width = 10 ms.
2 With constant driving current. Duty cycle = 0-10 %. Max pulse width = 10 ms.

LTCXC series

Continuous LED coaxial lights

RT

Lighting structure



LTCXC series consists of LED coaxial lights that provide coaxial illumination ideal for inspection of scratches/dents on glossy surfaces or pattern inspection on PCB to be used in combination with telecentric lenses.
Light is reflected by a 45° beam splitter so that it is projected on the same axis as the camera. Suggested usage is continuous mode.

FULL RANGE OF COMPATIBLE STROBE CONTROLLERS		
	LTDV1CH-17V strobe controller	p. 182
	PS power supplies	p. 186

	Optical specifications			Electrical specifications					Dimensions		
				Continuous mode			Pulsed mode				
Part number	Light colour, wavelength peak	Lighting area Width (mm)	Lighting area Lenght (mm)	Supply voltage (V)	Current (mA)	Power cons. (W)	Supply voltage (V) 1	Max pulse current (mA) 2	Lenght (mm)	Width (mm)	Height (mm)
RT-CAS2-00-025-X-W-24V-FL	white, 6300K	27	27	24	160	3,84	36	480	54	33	33
RT-CAS2-00-025-X-R-24V-FL	red, 630nm	27	27	24	150	3,60	36	450	54	33	33
RT-CAS2-00-025-X-G-24V-FL	green, 525nm	27	27	24	160	3,84	36	480	54	33	33
RT-CAS2-00-025-X-B-24V-FL	blue, 470nm	27	27	24	160	3,84	36	480	54	33	33
RT-CAS2-00-040-X-W-24V-FL	white, 6300K	48	48	24	350	8,40	36	1050	107.5	60	66
RT-CAS2-00-040-X-R-24V-FL	red, 630nm	48	48	24	146	3,50	36	438	107.5	60	66
RT-CAS2-00-040-X-G-24V-FL	green, 525nm	48	48	24	350	8,40	36	1050	107.5	60	66
RT-CAS2-00-040-X-B-24V-FL	blue, 470nm	48	48	24	350	8,40	36	1050	107.5	60	66
RT-CAS2-00-070-X-W-24V-FL	white, 6300K	70	70	24	560	13,44	36	1680	139.6	89	95
RT-CAS2-00-070-X-R-24V-FL	red, 630nm	70	70	24	525	12,60	36	1575	139.6	89	95
RT-CAS2-00-070-X-G-24V-FL	green, 525nm	70	70	24	560	13,44	36	1680	139.6	89	95
RT-CAS2-00-070-X-B-24V-FL	blue, 470nm	70	70	24	560	13,44	36	1680	139.6	89	95
RT-CAS2-00-100-X-W-24V-FL	white, 6300K	100	100	24	781	18,74	36	2000	166.5	120	123.8
RT-CAS2-00-100-X-R-24V-FL	red, 630nm	100	100	24	450	10,80	36	1350	166.5	120	123.8
RT-CAS2-00-100-X-G-24V-FL	green, 525nm	100	100	24	781	18,74	36	2000	166.5	120	123.8
RT-CAS2-00-100-X-B-24V-FL	blue, 470nm	100	100	24	781	18,74	36	2000	166.5	120	123.8

1 With constant driving voltage (36V recommended, 48V max). Duty cycle = 0-10 %. Max pulse width = 10 ms.
2 With constant driving current. Duty cycle = 0-10 %. Max pulse width = 10 ms.

LED PATTERN PROJECTORS

Advanced structured lighting.

Opto Engineering LED pattern projectors have been designed for 3D profiling/reconstruction and for the measurement of objects with complex structures or inclined planes.
They are successfully used in a variety of applications like quality control in food and packaging to check for correct volume, reverse engineering, dimensional measurement of electronic components, planarity control of products, robot guidance for pick and place and alignment applications.

When compared to laser emitters, LED technology ensures more homogeneous illumination in addition to sharp edges and no speckle effect.

Many 3D machine vision applications require structured light to be projected onto inclined surfaces, i.e. at a certain angle from the vertical axis. In such cases, the focus is maintained only within a small area close to the center of the field of view and the rest of the image shows relevant defocusing thus making 3D measurement inaccurate.
For this reason, our family of pattern projectors includes special projectors equipped with a high-precision tilting mechanism that allows the pattern of the light source to meet the Scheimpflug condition so that the projected light is properly and evenly focused across the entire sample surface.

All Opto Engineering LED projectors feature a wide selection of interchangeable patterns.
Furthermore, the size of the projection area can be easily modified by interchanging compatible projection optics: our projectors can be used with different C-mount lenses.
To achieve the best results we suggest to use bi-telecentric lenses or zero distortion macro lenses.

CE REACH COMPLIANT RoHS

Refer to specific datasheets available at **www.opto-engineering.com** for product compliancy with regulations, certifications and safety labels.

LTPRHP3W series

3W 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.

LTPRHP3W series are the most advanced and efficient devices for pattern projection and structured light applications, such as 3D reconstruction.

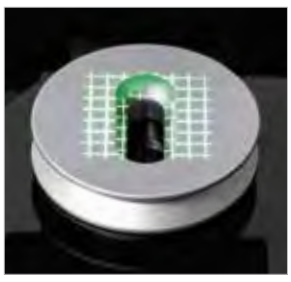
Unlike laser sources, which typically show poor line sharpness and power distribution inhomogeneity as well as scattering and diffraction effects, LTPR pattern projectors overcome all of these problems by integrating LED sources and precisely engraved masks. Any kind of pattern shape can be easily supplied, integrated and projected by these devices.

Different colors are available and the size of the projection area can be easily modified by interchanging the projection optics.

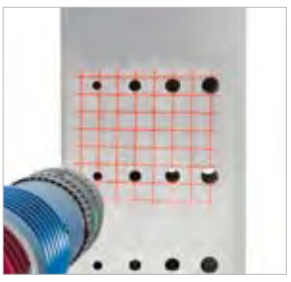
LIGHT SOURCE

- **Higher efficiency**
- **Precise light intensity adjustment**
- **Easy LED source replacement**

Application examples



3D reconstruction



Mechanical alignment

Visualization & mapping

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

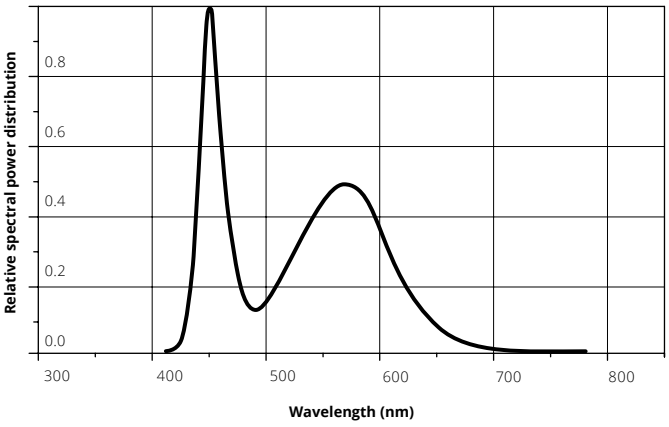
Line 0.5 mm line thickness

Custom patterns

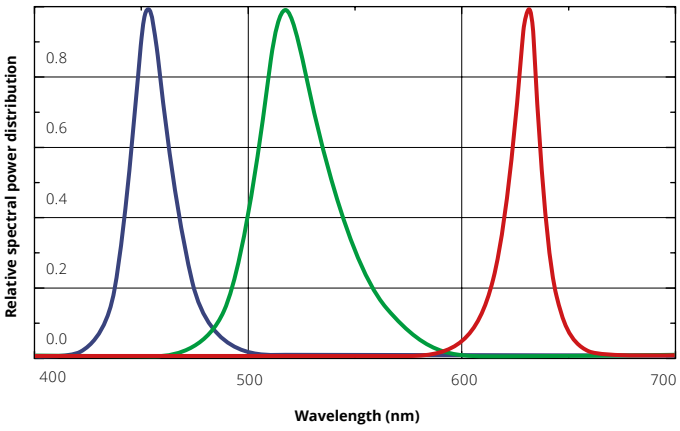
Electrical features

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



	Light	Device power ratings				LED power ratings		
Part number	**Light color, wavelength peak**	**DC Voltage**		**Power consumption**	**Max LED forward current**	**Forward voltage**		**Max pulse current**
		Minimum (V)	Maximum (V)	(W)	(mA)	Typical (V)	Maximum (V)	(mA)
		1			2		3,4	5
LTPRHP3W-R	red, 630 nm	12	24	< 4.5	720	2.4	3.00	2000
LTPRHP3W-G	green, 520 nm	12	24	< 4.5	720	3.3	4.00	2000
LTPRHP3W-B	blue, 460 nm	12	24	< 4.5	720	3.3	4.00	2000
LTPRHP3W-W	white	12	24	< 4.5	720	2.78	n.a.	2000

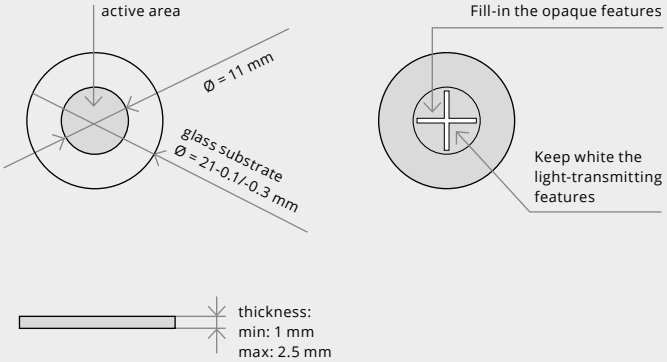
1 Tolerance ± 10%.
2 Used in continuous (not pulsed) mode.
3 At max forward current.
4 Tolerance is ±0.06V on forward voltage measurements.
5 At pulse width <= 10 ms, duty cycle <= 10% condition.
Built-in electronics board must be bypassed (see tech info online).

LTPRHP3W series

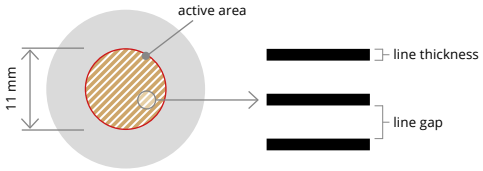
Product insight

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).

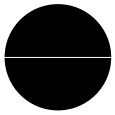


Pattern selection

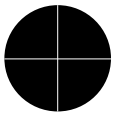


The projection pattern can be easily integrated into the LTPR projection unit by unscrewing the retaining ring that holds the pattern itself.
This simple procedure makes it easy to interchange different patterns on the same projection unit. The pattern outer diameter is 21 mm, while the active projection area is a circle of Ø 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.

Photolithography patterns

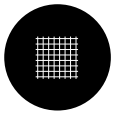


PT 0000 0100 P
format: line
line thickness 0.05 mm

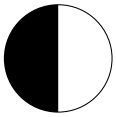


PT 0000 0200 P
format: cross
line thickness 0.05 mm

PT 0000 0300 P
format: stripe
line gap 0.95 mm
line thickness 0.05 mm
line length 7.78 mm



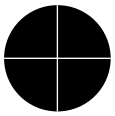
PT 0000 0400 P
format: grid
line gap 0.95 mm
line thickness 0.05 mm
line length 7.78 mm



PT 0000 0500 P
format: edge
line gap 0.10 mm
line thickness 0.05 mm

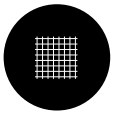
Laser engraved patterns

PT 0000 0100 L
format: line
line thickness 0.5 mm

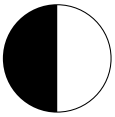


PT 0000 0200 L
format: cross
line thickness 0.5 mm

PT 0000 0300 L
format: stripe
line gap 0.5 mm
line thickness 0.5 mm
line length 7.78 mm



PT 0000 0400 L
format: grid
line gap 0.8 mm
line thickness 0.2 mm
line length 7.78 mm



PT 0000 0500 L
format: edge
line gap 0.10 mm
line thickness 0.5 mm

Pattern specifications

Photolithography patterns	
Substrate	Soda lime grass
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

FULL RANGE OF COMPATIBLE PROJECTION OPTICS

ENHR series p. 90

FULL RANGE OF PROJECTION PATTERNS

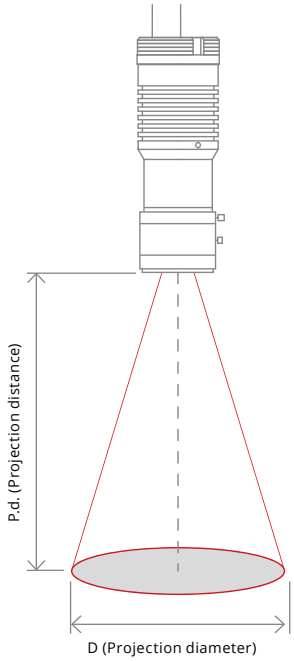
PTPR series p. 178

FULL RANGE OF COMPATIBLE POWER SUPPLIES

PS power supplies p. 186

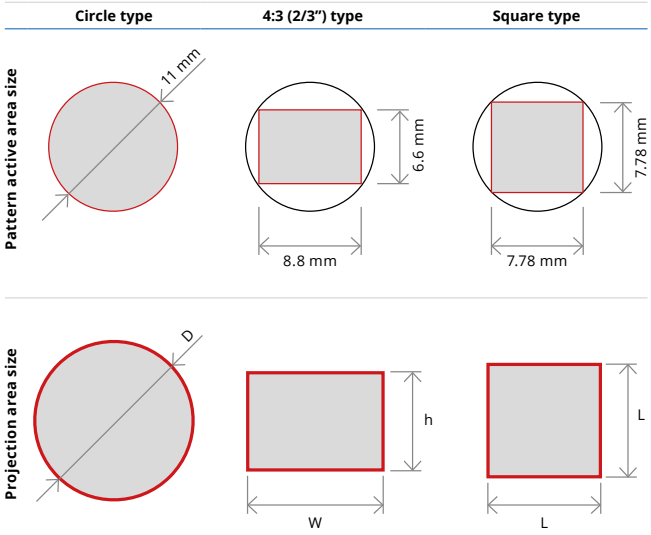
Projection lens selection

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.

Pattern drawing and projection area



LTPR series can integrate most types of high resolution lenses: any high resolution C-mount lens for 2/3" detectors (11 mm image diagonal) can be used such as the ones included in our ENHR series. 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 is a list of the projection diameters and the recommended projection distances with different types of optics.

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

Bi-telecentric lenses

2 / 3" C-mount lenses

P.d.	@50 mm	@75 mm	@100 mm	@150 mm	@200 mm	@250 mm	@300 mm	@400 mm	@500 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

Standard C-mount lenses

LTPRSMHP3W series

3W tilting LED pattern projectors

KEY ADVANTAGES

Scheimpflug tilt adjustment
For homogeneous focusing of the pattern features.

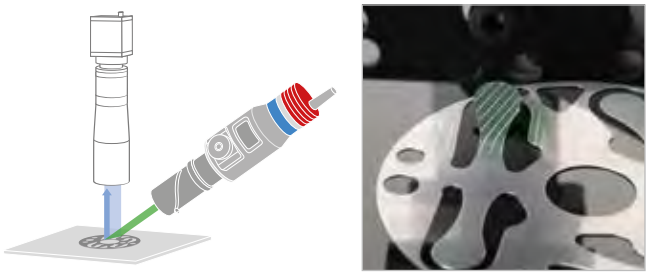
Tilt adjustment compatible with C-mount optics
Focus is maintained even when the pattern is tilted.

Light condenser focusing mechanism
For excellent optical coupling and light throughput.

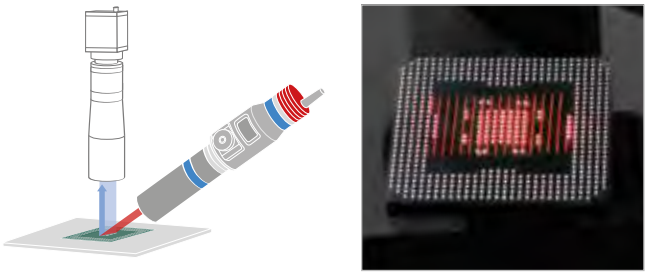
Enhanced optical power
Due to the high numerical aperture condenser lens.

LTPRSMHP3W series are LED pattern projectors specifically designed for the most demanding 3D profiling and measurement applications. Triangulation techniques require that structured light is 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. LTPRSMHP3W 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.

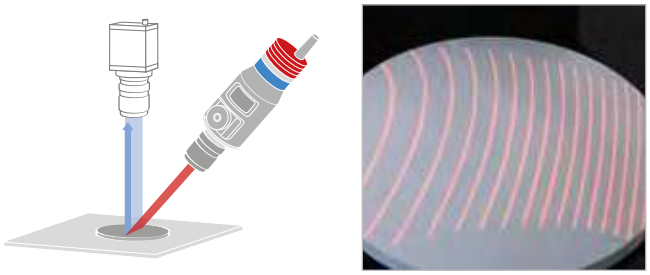
Examples of setup and applications



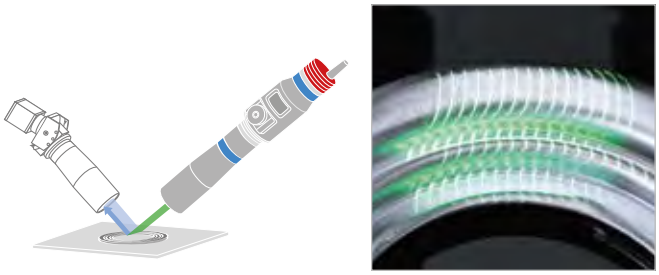
Configuration with zero distortion macro lenses.



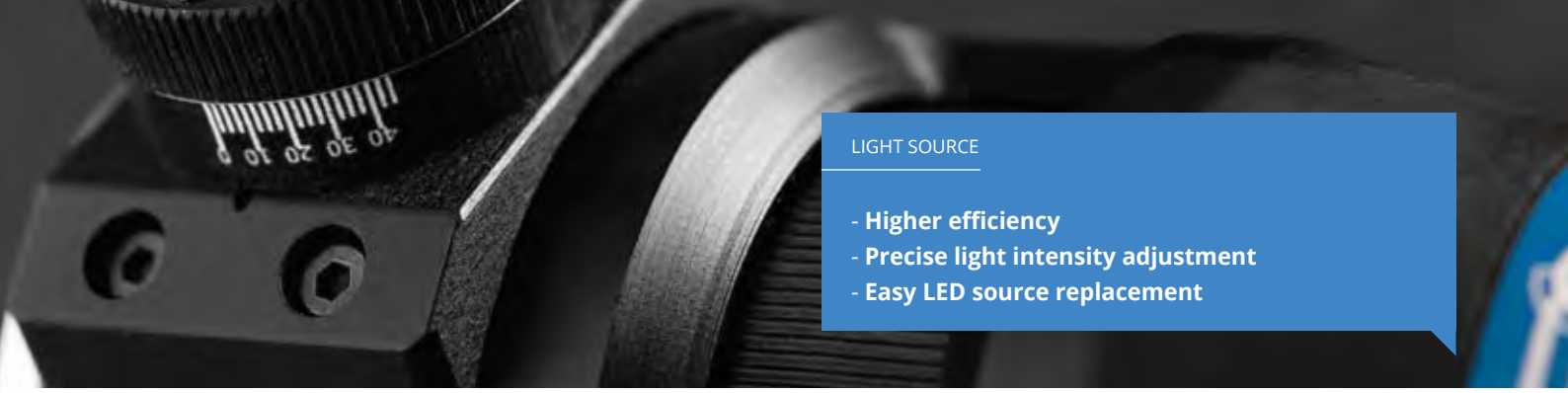
Configuration with bi-telecentric lenses.



LTPRSM pattern projector with a standard C-mount lens.

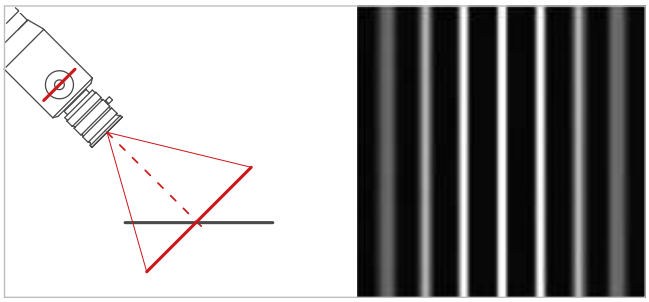


Scheimpflug telecentric optics for both projection and imaging at 90°.

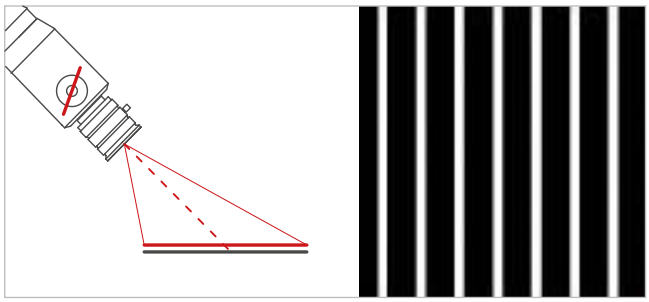


LIGHT SOURCE

- **Higher efficiency**
- **Precise light intensity adjustment**
- **Easy LED source replacement**



Without tilt adjustment the pattern features are only partly focused.

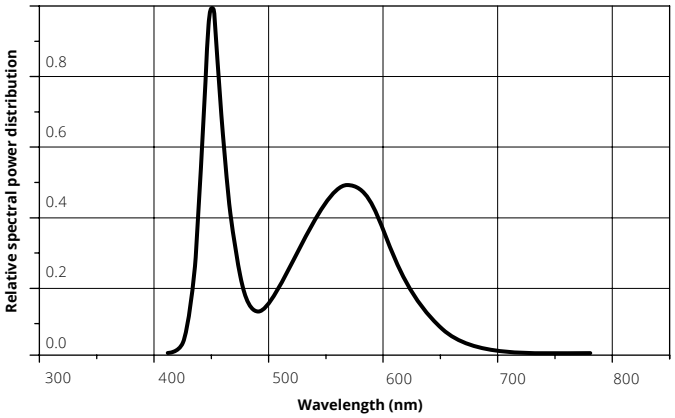


With the Scheimpflug adjustment focus is maintained across the entire plane.

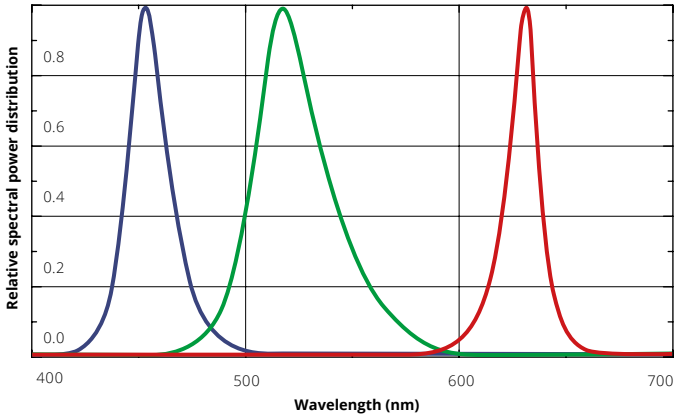
Electrical features

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



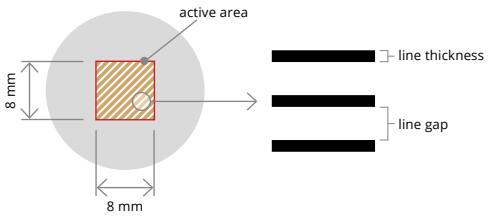
	Light	Device power ratings				LED power ratings		
Part number	**Light color, wavelength peak**	**DC Voltage**		**Power consumption**	**Max LED forward current**	**Forward voltage**		**Max pulse current**
		Minimum (V)	Maximum (V)	(W)	(mA)	Typical (V)	Maximum (V)	(mA)
		1			**2**		**3,4**	**5**
LTPRSMHP 3W-R	red, 630 nm	12	24	< 4.5	720	2.4	3.00	2000
LTPRSMHP 3W-G	green, 520 nm	12	24	< 4.5	720	3.3	4.00	2000
LTPRSMHP 3W-B	blue, 460 nm	12	24	< 4.5	720	3.3	4.00	2000
LTPRSMHP 3W-W	white	12	24	< 4.5	720	2.78	n.a.	2000

1 Tolerance ± 10%.
2 Used in continuous (not pulsed) mode.
3 At max forward current.
4 Tolerance is ±0.06V on forward voltage measurements.
5 At pulse width <= 10 ms, duty cycle <= 10% condition.
Built-in electronics board must be bypassed (see tech info online).

LTPRSMHP3W series

Product insight

Pattern selection



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.

Photolithography stripe patterns

PT 0000 0300 P
8 lines in projection area

line gap	0.95 mm
line thickness	0.05 mm
line length	7.78 mm

PTST 050 450 P
16 lines in projection area

line gap	0.45 mm
line thickness	0.05 mm

PTST 050 200 P
32 lines in projection area

line gap	0.20 mm
line thickness	0.05 mm

PTST 050 100 P
53 lines in projection area

line gap	0.10 mm
line thickness	0.05 mm

PTST 050 050 P
80 lines in projection area

line gap	0.05 mm
line thickness	0.05 mm

Photolithography grid patterns

PT 0000 0400 P
8 x 8 lines in projection area

line gap	0.95 mm
line thickness	0.05 mm
line length	7.78 mm

PTGR 050 450 P
16 x 16 lines in projection area

line gap	0.45 mm
line thickness	0.05 mm

PTGR 050 200 P
32 x 32 lines in projection area

line gap	0.20 mm
line thickness	0.05 mm

PTGR 050 100 P
53 x 53 lines in projection area

line gap	0.10 mm
line thickness	0.05 mm

PTGR 050 050 P
80 x 80 lines in projection area

line gap	0.05 mm
line thickness	0.05 mm

Pattern specifications

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

FULL RANGE OF COMPATIBLE PROJECTION OPTICS

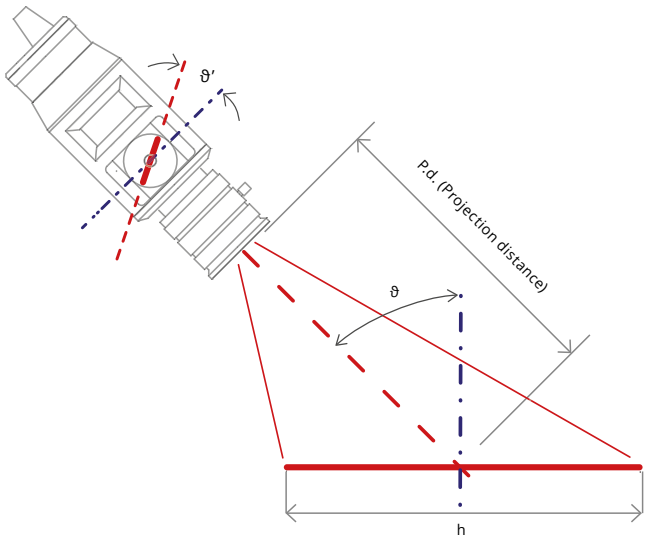

TC series p. 8


MC series p. 70

FULL RANGE OF PROJECTION PATTERNS


PTPR series p. 178

Projection lens selection

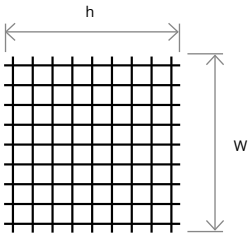


LTPRSMHP3W series units can be interfaced with any type of optics, but the best results are achieved with bi-telecentric lenses. The projection area is undistorted since tilting the pattern causes a linear extension along only one direction.

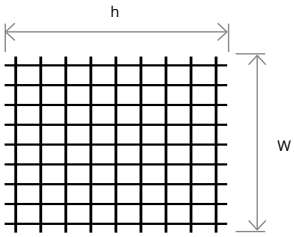
Excellent results can also be obtained with zero distortion macro lenses; here, the magnification changes along both axes, but image resolution and distortion still easily allows 3D reconstruction.

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.

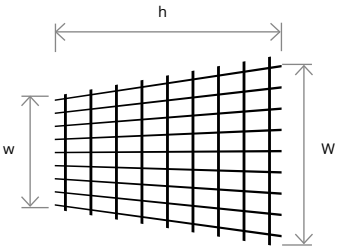
The projection area shown in the chart are also a good approximation for standard C-mount lenses used as macro lenses (eventually equipped with spacers).



Original pattern features



Projection area with a bi-telecentric lens



Projection area with a macro lens

Projection area with bi-telecentric lenses (TC series)

		ϑ = 0°		ϑ = 15°		ϑ = 30°		ϑ = 45°	
Part number	**Projection distance P.d.** (mm)	**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

Bi-telecentric lenses

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

		ϑ = 0°			ϑ = 15°			ϑ = 30°			ϑ = 45°		
Mag.	**Projection distance P.d.**	**Projection area w**	**(W) x h**	**Pattern tilt ϑ'**	**Projection area w**	**(W) x h**	**Pattern tilt ϑ'**	**Projection area w**	**(W) x h**	**Pattern tilt ϑ'**	**Projection area w**	**(W) x h**	**Pattern tilt ϑ'**
(x)	(mm)	(mm)	(mm x mm)	(deg)	(mm)	(mm x mm)	(deg)	(mm)	(mm x mm)	(deg)	(mm)	(mm x mm)	(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

Standard C-mount lenses

Macro lenses

LTPRXP series

10W continuous LED pattern projector

KEY ADVANTAGES

Superior optical throughput
For large targets illumination and fast 3D scanning; minimal sensitivity to ambient light.

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.

Easy LED source replacement.

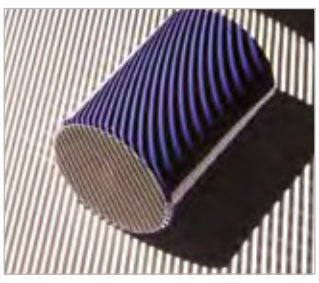
LTPRXP series pushes the light output of LTPR LED pattern projectors to extremely high values, making these products the solution of choice for 3D measurement of large objects.

Thanks to the illuminance these projectors can be used as a viable alternative to laser line generators in high-speed, on-line, linescan camera-based applications.

The high power can also be used in order to decrease system sensitivity to ambient light, for example, to perform 3D mapping of objects with illumination levels found in typical working environments.

Examples of setup and applications

3D reconstruction



Visualization & mapping

Every kind of shape can be projected

Standard patterns

Stripe 0.5 mm line thickness

Edge

Grid 0.05 mm line thickness

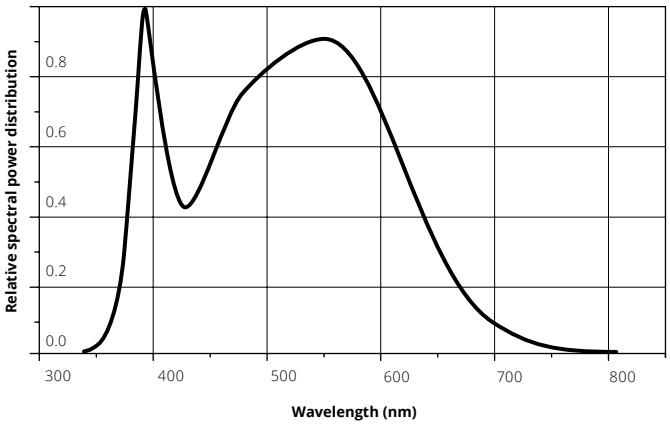
Line 0.5 mm line thickness

Custom patterns

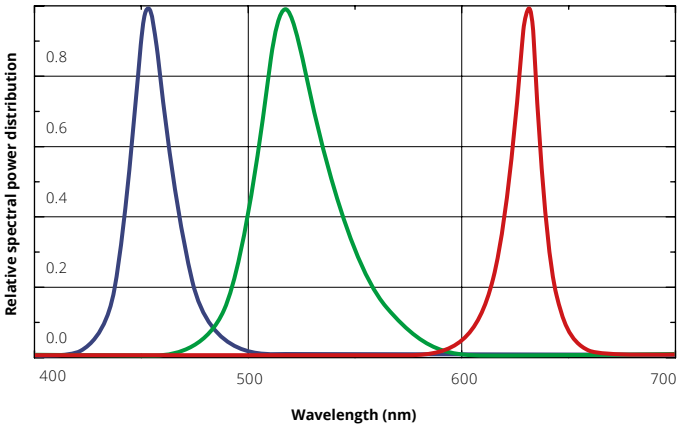
Electrical features

These LED projectors integrate built-in switching electronics that control the current flow though the LED source.
The large heat sink ensures long lifetime at the highest power rates for the LED module and driving electronics.

Typical emission spectrum of white LEDs



Typical emission spectrum of R,G,B LEDs



	Light	Device power ratings			Compatible products
Part number	**Light color, wavelength peak**	**DC Voltage** (V)	**Power consumption** (W)	**Illuminance** (kLux) 1	
LTPRXP-R	red, 630 nm	24	< 13	40	ENHR series
LTPRXP-G	green, 520 nm	24	< 13	68	ENHR series
LTPRXP-B	blue, 460 nm	24	< 13	9	ENHR series
LTPRXP-W	white	24	< 13	85	ENHR series

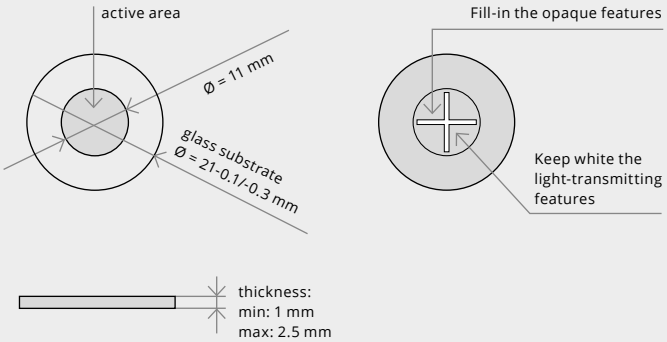
1 With a 35 mm lens, F/# 1.4 at 100 mm working distance without projection pattern.

LTPRXP series

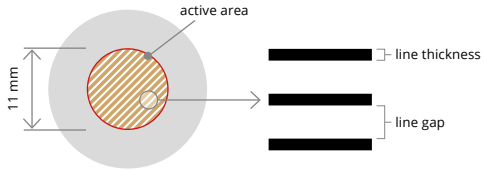
Product insight

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).

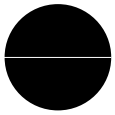


Pattern selection

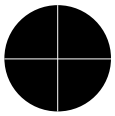


The projection pattern can be easily integrated into the LTPR projection unit by unscrewing the retaining ring that holds the pattern itself.
This simple procedure makes it easy to interchange different patterns on the same projection unit. The pattern outer diameter is 21 mm, while the active projection area is a circle of Ø 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.

Photolithography patterns

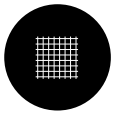


PT 0000 0100 P
format: line
line thickness 0.05 mm

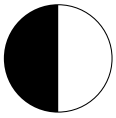


PT 0000 0200 P
format: cross
line thickness 0.05 mm

PT 0000 0300 P
format: stripe
line gap 0.95 mm
line thickness 0.05 mm
line length 7.78 mm



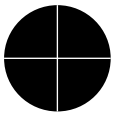
PT 0000 0400 P
format: grid
line gap 0.95 mm
line thickness 0.05 mm
line length 7.78 mm



PT 0000 0500 P
format: edge
line gap 0.10 mm
line thickness 0.05 mm

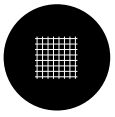
Laser engraved patterns

PT 0000 0100 L
format: line
line thickness 0.5 mm

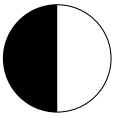


PT 0000 0200 L
format: cross
line thickness 0.5 mm

PT 0000 0300 L
format: stripe
line gap 0.5 mm
line thickness 0.5 mm
line length 7.78 mm



PT 0000 0400 L
format: grid
line gap 0.8 mm
line thickness 0.2 mm
line length 7.78 mm



PT 0000 0500 L
format: edge
line gap 0.10 mm
line thickness 0.5 mm

Pattern specifications

Photolithography patterns	
Substrate	Soda lime grass
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

FULL RANGE OF COMPATIBLE PROJECTION OPTICS

ENHR series p. 90

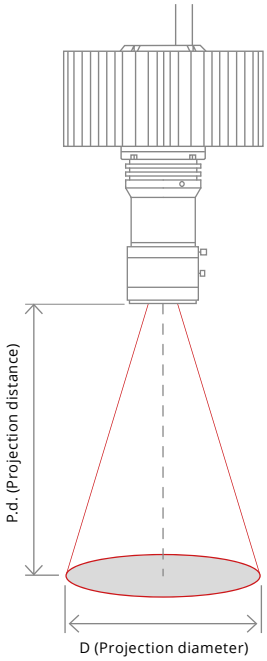
FULL RANGE OF PROJECTION PATTERNS

PTPR series p. 178

Projection lens selection

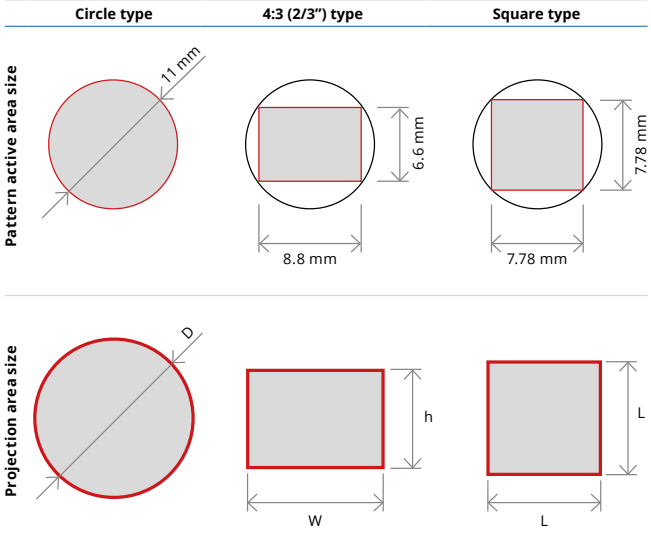
The pattern drawing must be inscribed in a 11 mm diameter circle, same diagonal of a 2/3" detector. For example, the pattern drawing could cover the entire 11 mm diameter area or be shaped as a 8.8 x 6.6 mm rectangle or also a square of 7.78 mm side length.

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 size will be equal to 1/M, where "M" stands for the magnification factor of the lens when used as a standard viewing objective.
LTPRXP series can integrate high resolution C-mount lenses for 2/3" detectors (11 mm image diagonal), using the mount adaptor included in the product package. Here is a list of the projection diameters and the recommended projection distances with different types of optics.

Pattern drawing and projection area



2 / 3" C-mount lenses

P.d.	@50 mm	@75 mm	@100 mm	@150 mm	@200 mm	@250 mm	@300 mm	@400 mm	@500 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

Standard C-mount lenses

LTPRUP series

90W strobed LED pattern projectors

NEW

KEY ADVANTAGES

Ultra high-power light output and strobe mode only operation
Low sensitivity to ambient light for the inspection of fast moving objects and an extended LED lifetime.

LED technology
Thinner lines, sharper edges and more even illumination than lasers.

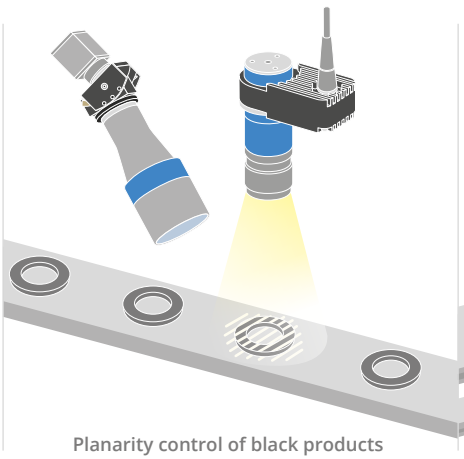
Repeatable results with dedicated strobe controllers
Compatible LTDV series ensures very stable illumination intensity.

Wide selection of projection patterns available
Chrome-on-glass patterns with geometrical accuracy down to 2 µm.

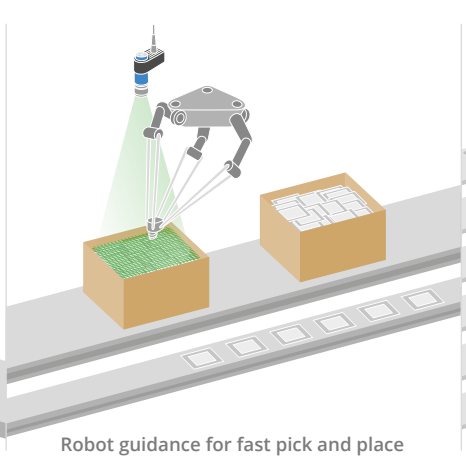
Compatible with any C-mount optics.

LTPRUP series are the most powerful LED pattern projectors designed for fast image acquisition in high speed applications where camera exposure time must be set to the minimum, including planarity control of opaque products, robot guidance for fast pick and place and 3D profiling.
LTPRUP are strobe only and provide ultra-high intensity while ensuring extended LED lifetime and reduced heat generation. LTPRUP series are current driven and can be precisely controlled using compatible LTDV strobe controllers series.
LTDV series is designed to drive the LED of LTPRUP pattern projectors with extremely constant current ensuring repeatable results even in applications where low exposure time is required minimizing illumination intensity variations down to ± 1%, leading to accurate and repeatable results when compared to models offered by major competitors.
Additionally rise and fall time are kept to the minimum: this ensures repeatable results specifically in applications where light intensity is controlled through time-dimming.
Multiple interchangeable patterns, either stripe or grid styles, are available along with optional custom patterns. LTPRUP is easily integrated into any system thanks to its compact design, multiple threaded holes positioned in the rear part, and compatibility with CMHO016 clamping mechanics. Additionally the phase-adjustment design allows for easy pattern alignment.

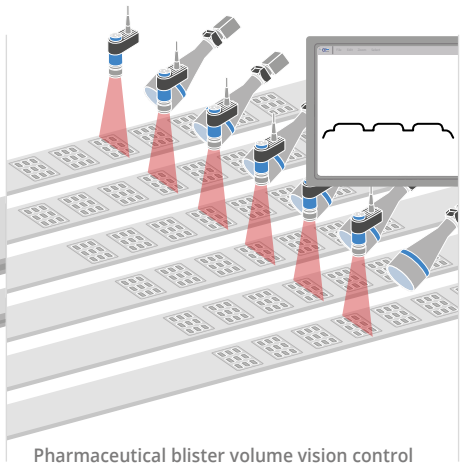
Application examples



Planarity control of black products



Robot guidance for fast pick and place



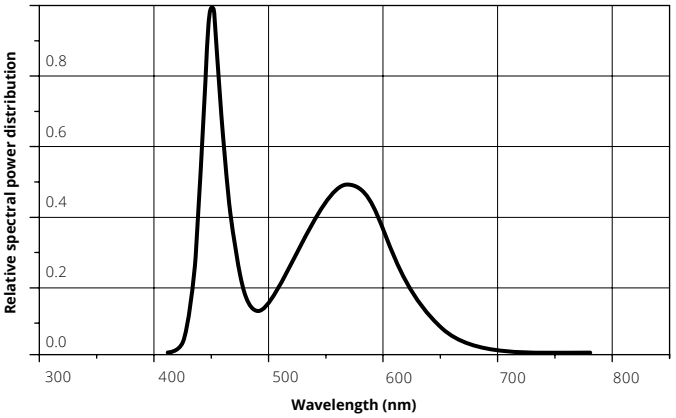
Pharmaceutical blister volume vision control

LTPRUP-x + CMHO016 clamping mechanics.

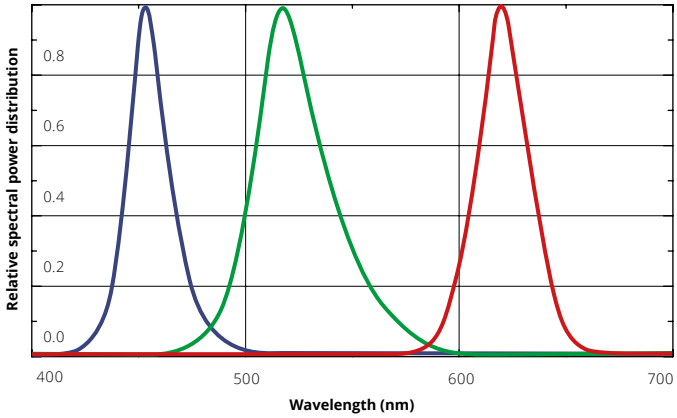
Three M4 and one M6 threads for additional fixing options.

FULL RANGE OF COMPATIBLE PROJECTION OPTICS		
	ENHR series	p. 90
FULL RANGE OF COMPATIBLE ACCESSORIES		
	Projection patterns PTPR series	p. 178
	Strobe controllers LTDV series	p. 182
	Clamping mechanics CMHO016	p. 162

Typical emission spectrum of white LEDs



Typical emission spectrum of R,G,B LEDs

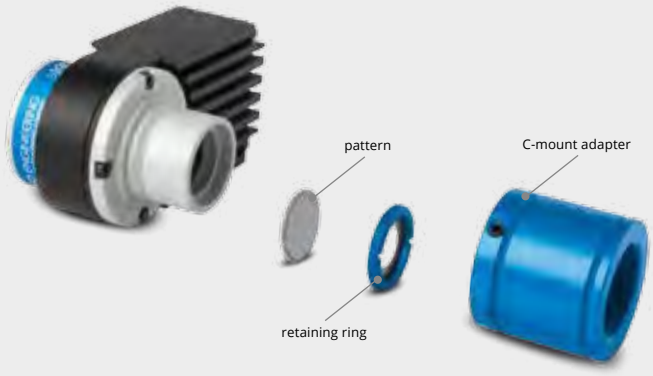


Part Number		LTPRUP-W	LTPRUP-R	LTPRUP-G	LTPRUP-B
Optical specifications					
Light color		White	Red, 618 nm	Green, 525 nm	Blue, 460 nm
Spectral FWHM	(nm)	n.a.	20	40	30
Illuminance 1	(klux)	170	65	220	20
Electrical specifications					
Power supply mode		strobe only, constant current driving			
Driving current, max	(A)	17	17	17	17
Pulse width 2	(ms)	<= 1	<= 1	<= 1	<= 1
Connection Type 3		M12 industrial male connector			
Estimated MTBF 4	(h)	> 50000	> 50000	> 50000	> 50000
Strobe peak LED source power	(W)	90	90	90	90
Mechanical specifications					
Length 5	(mm)	108,9	108,9	108,9	108,9
Width	(mm)	46	46	46	46
Height	(mm)	93	93	93	93
Materials		anodized aluminum body			
Clamping system		3 Holes for M4 screw or 37.7mm diameter clamp			
Compatibility					
Strobe controllers		LTDV1CH-17, LTDV1CH-17V, LTDV6CH			
Lenses		ENMP series, ENHR series, ENVF series, TC series, TCLWD series, TCHM series			
Cable		CBLT001, CBLT002			
Clamping mechanics		CMHO016			
Projection patterns		PTPR series			

1 With a 35 mm lens, F/N 1.4 at 100 mm working distance without projection pattern at driving current = 17A. Estimated value.
2 At 25°C. At max pulse width (1 ms), max pulse frequency = 15 Hz. Contact us to check other allowable combinations of duty cycle-frequency-temperature.
3 5 m cable with straight female connector included. Optional cable with right angled connector is also available and must be ordered separately (refer to our website for further info and ordering codes.
4 At 25° C.
5 Including connector.

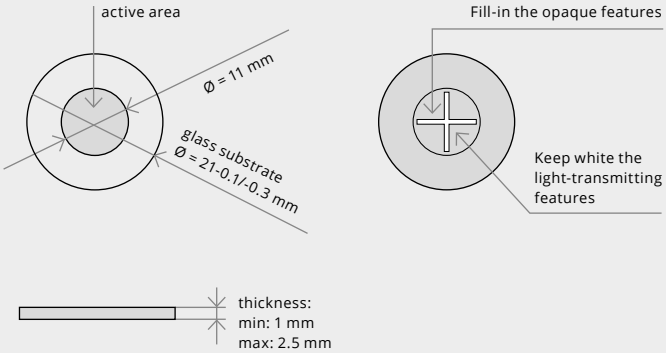
LTPRUP series

Product insight

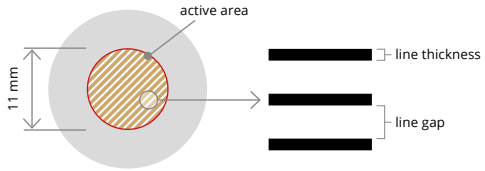


Custom-made pattern

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

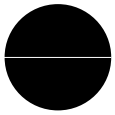


Pattern selection

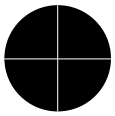


The projection pattern can be easily integrated into the LTPR projection unit by unscrewing the retaining ring that holds the pattern itself.
This simple procedure makes it easy to interchange different patterns on the same projection unit. The pattern outer diameter is 21 mm, while the active projection area is a circle of Ø 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.

Photolithography patterns

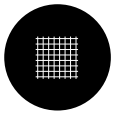


PT 0000 0100 P
format: line
line thickness 0.05 mm

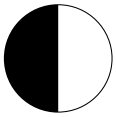


PT 0000 0200 P
format: cross
line thickness 0.05 mm

PT 0000 0300 P
format: stripe
line gap 0.95 mm
line thickness 0.05 mm
line length 7.78 mm



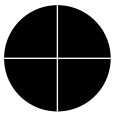
PT 0000 0400 P
format: grid
line gap 0.95 mm
line thickness 0.05 mm
line length 7.78 mm



PT 0000 0500 P
format: edge
line gap 0.10 mm
line thickness 0.05 mm

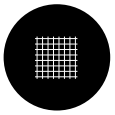
Laser engraved patterns

PT 0000 0100 L
format: line
line thickness 0.5 mm

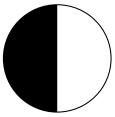


PT 0000 0200 L
format: cross
line thickness 0.5 mm

PT 0000 0300 L
format: stripe
line gap 0.5 mm
line thickness 0.5 mm
line length 7.78 mm



PT 0000 0400 L
format: grid
line gap 0.8 mm
line thickness 0.2 mm
line length 7.78 mm



PT 0000 0500 L
format: edge
line gap 0.10 mm
line thickness 0.5 mm

Pattern specifications

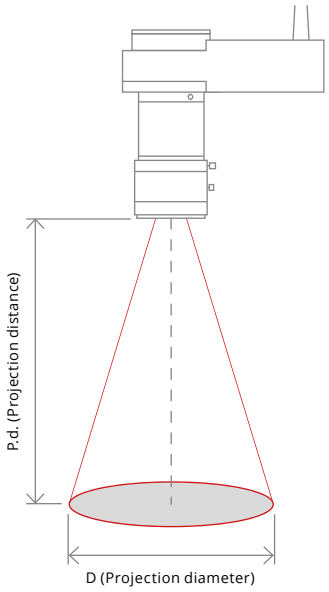
Photolithography patterns	
Substrate	Soda lime grass
Coating	Chrome
Geometrical accuracy	2 µm
Edge sharpness	1.4 µm

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

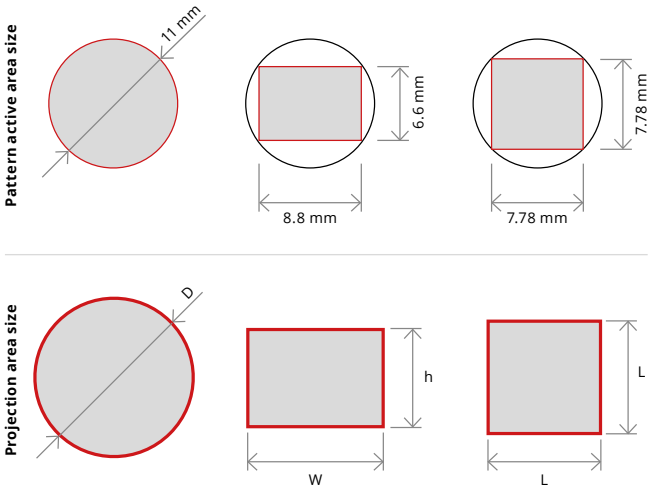
Projection lens selection

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: any high resolution C-mount lens for 2/3" detectors (11 mm image diagonal) can be used such as the ones included in our ENHR series. 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 is a list of the projection diameters and the recommended projection distances with different types of optics.



Pattern drawing and projection area



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

LTPRUP+TC

2 / 3" C-mount lenses

P.d.	@50 mm	@75 mm	@100 mm	@150 mm	@200 mm	@250 mm	@300 mm	@400 mm	@500 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

LTPRIP+C Mount Standard

Accessories

Refer to specific datasheets available at **www.opto-engineering.com**
for product compliancy with regulations, certifications and safety labels.

Although accessories are often considered as an "optional", in many applications they are essential to properly use the product or even to enhance its performance.

Opto Engineering extensive range of accessories has been designed and selected to ensure hassle-free and quick integration of our vision components.

Our accessories perfectly complement our product range and have been specifically tested in combination with our products to ensure correct usage and smooth integration into your vision system.

The selection of accessories that we offer includes mounting mechanics, filters, protective windows, first surface mirrors and beam splitters, calibration patterns, projection patterns in addition to strobe controllers for our LED lighting and stepper motor controller.

Please check our website to view the entire range and get the most updated information.

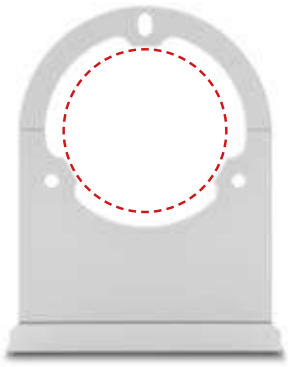
CMHO series

Clamping mechanics

The accurate alignment of optical components is crucial when designing measurement systems. Besides optical components stability, the mechanical system layout should assure that the optical axis is orthonormal to the measurement plane.

For this purpose Opto Engineering supplies **CMHO series** clamping mechanics, compatible with our lenses and telecentric illuminators.

Three-point mounting grants a very precise and stable alignment of the optical components, also making the assembling procedure quick and simple.



Assembling a TC lens on a CMHO clamping support

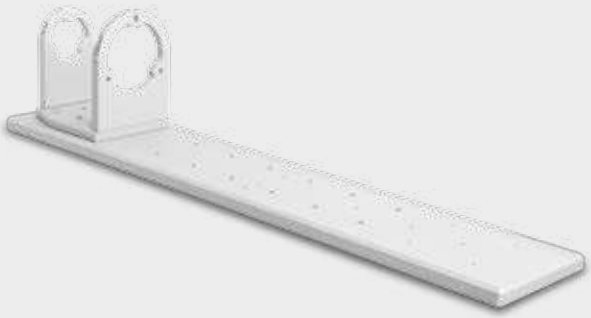
	Compatibility		Mechanical specifications			
Part number	**Opto Engineering optics**	**CMPT plates**	**Length** (mm)	**Width** (mm)	**Height** (mm)	**Optical axis height** (mm)
CMHO 023	TC2300y, TC23012, TC4M00y-x, LTCLHP023-x	004-009	20.0	53.0	66.5	40.0
CMHO 016	TCxx016, TCxMHR016-x, LTCLHP016-x, LTPRUP-x, TCLWD series	016-024	20.0	62.5	71.2	40.0
CMHO 024	TCxx024, TCxMHR024-x, LTCLHP024-x	016-024	20.0	62.5	71.2	40.0
CMHO 036	TCxx036, TCxMHR036-x, TC16M036-x, LTCLHP036-x	036	110.0	97.0	125.5	80.0
CMHO 048	TCxx048, TCxMHR048-x, TC16M048-x, LTCLHP048-x	048	140.0	111.0	132.5	80.0
CMHO 056	TCxx056, TCxMHR056-x, TC16M056-x, LTCLHP056-x	056	162.0	116.0	135.0	80.0
CMHO 064	TCxx064, TCxMHR064-x, TC16M064-x, LTCLHP064-x	064	175.0	137.0	145.0	80.0
CMHO 080	TC23072, TCxx080, TCxMHR080-x, TC16M080-x, LTCLHP080-x, PCxx030XS	080	230.0	153.0	152.0	80.0
CMHO 096	TC23085, TCxx096, TCxMHR096-x, TC16M096-x, LTCLHP096-x	096	265.0	179.0	186.5	100.0
CMHO 120	TC23110, TCxx120, TCxMHR120-x, TC16M120-x, LTCLHP120-x	-	204.0	220.0	240.0	130.0
CMHO 144	TC23130, TCxx144, TCxMHR144-x, TC16M144-x, LTCLHP144-x	-	204.0	232.0	247.0	130.0
CMHO 192	TC23172, TCxx192, TCxMHR192-x, TC16M192-x, TC12K192, LTCLHP192-x	-	255.0	330.0	303.1	173.0
CMHO 240	TC23200, TC23240, TCxMHR240-x, TC16M240-x, LTCLHP240-x, TC12K240	-	170.0	410.0	377.2	216.2
	TC12K					
CMHO TC12K 064	TC12K064	-	486.0	152.0	150.0	85.0
CMHO TC12K 080	TC12K080	-	486.0	152.0	158.0	85.0
	TC16M					
CMHO TC16M 009	TC16M009-x	-	143.0	66.5	81.3	50.0
CMHO TC16M 012	TC16M012-x	-	143.0	66.5	81.3	50.0
CMHO TC16M 018	TC16M018-x	-	143.0	66.5	81.3	50.0
	MC12K					
CMHO MC12K 025	MC12K008-025	-	140.0	111.0	132.5	80.0
CMHO MC12K 067	MC12K050-067	-	140.0	111.0	132.5	80.0
CMHO MC12K 200	MC12K100-200	-	140.0	111.0	132.5	80.0
	TCZR					
CMHO TCZR	TCZR036, TCZR072	-	138.0	93.6	113.3	66.5
	PCCD					
CMHO PCCD	PCCDxxx	-	139.0	76.0	20.0	92.0

CMPT series

Mounting plates

CMPT plates are mechanical components designed to build up optical benches for measurement applications. Most Opto Engineering telecentric lenses and illuminators can be mounted on these plates using CMHO clamping mechanics.
For very accurate measurement applications, calibration patterns can be precisely positioned in front of the lens with the CMPH pattern holders, enabling a perfect calibration of the optical system.

	Compatibility		Mechanical specifications			
Part number	Clamping mechanics CMHO	Pattern holders CMPH	Length	Width	Thickness	Weight
			(mm)	(mm)	(mm)	(g)
CMPT 004-009	023	004-024	199.6	56.0	10.0	286
CMPT 016-024	016, 024	004-024	226.8	66.5	10.0	385
CMPT 036	036	036-056	477.0	103.0	15.0	1950
CMPT 048	048	036-056	596.0	117.0	15.0	2770
CMPT 056	056	036-056	631.0	122.0	15.0	3060
CMPT 064	064	064-096	783.0	143.0	15.0	4460
CMPT 080	080	064-096	868.0	158.0	15.0	5470
CMPT 096	096	064-096	1005.0	185.0	20.0	9940



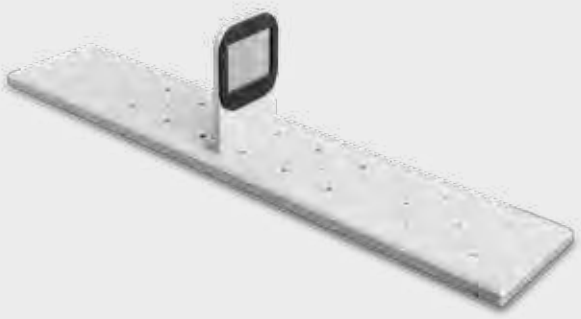
CMPH series

Pattern holders

Software calibration is accurate if **pattern placement** is accurate too. To do so, Opto Engineering offers **specific CMPH pattern holders** to easily and precisely mount each calibration pattern on its holding mechanics. The pattern is assembled on a frame held by three magnets: this floating system allows pattern phase adjustment and proper centering.

FULL RANGE OF COMPATIBLE CALIBRATION PATTERNS

PTTC series p. 177



	Compatibility	Mechanical specifications			
Part number	Patterns PTTC	Width	Height	Thickness	Weight
		(mm)	(mm)	(mm)	(g)
CMPH 004-024	004-009, 016-024	45.0	68.5	18.0	78
CMPH 036-056	036-056	81.0	123.1	22.5	257
CMPH 064-096	064-096	129.0	145.5	25.0	611

CMHOCR series

Clamping mechanics CORE series

NEW

CMHOCR series are special mounting clamps for CORE telecentric lenses and illuminators. CMHOCR mounting clamps have been designed to give even more flexibility for integration of CORE lenses and illuminators.

	Compatibility		Mechanical specifications			
Part number	**Opto Engineering optics**	**Compatible Illuminator**	**Depth** (mm)	**Width** (mm)	**Height** (mm)	**Optical axis height** (mm)
CMHOCR 048	TCCR12048, TCCR23048, TCCR2M048-x, TCCR4M048-x, LTCLCR048-x	LTRN048-x	80	130.0	195.0	130.0
CMHOCR 056	TCCR12056, TCCR23056, TCCR2M056-x, TCCR4M056-x, LTCLCR056-x	LTRN056-x	80	130.0	180.0	115.0
CMHOCR 064	TCCR12064, TCCR23064, TCCR2M064-x, TCCR4M064-x, LTCLCR064-x	LTRN064-x	80	150.0	200.0	125.0
CMHOCR 080	TCCR12080, TCCR23080, TCCR2M080-x, TCCR4M080-x, LTCLCR080-x	LTRN080-x	80	160.0	210.0	130.0
CMHOCR 096	TCCR12096, TCCR23096, TCCR2M096-x, TCCR4M096-x, LTCLCR096-x	LTRN096-x	84	200.0	240.0	140.0

CMPTCR series

Mounting plates CORE series

NEW

CMPTCR series are mechanical components designed for CORE Series telecentric lenses and illuminators. These precision mounting plates have a special design to integrate telecentric lenses and telecentric illuminators from CORE Series directly without any need of mounting clamps.

	Compatible products	Mechanical specifications			
Part number	**Clamping mechanics CMHO**	**Length** (mm)	**Width** (mm)	**Thickness** (mm)	**Weight** (g)
CMPTCR 048	TCCR12048, TCCR23048, TCCR2M048-x, TCCR4M048-x, LTCLCR048-x	352.0	130.0	15.0	1722
CMPTCR 056	TCCR12056, TCCR23056, TCCR2M056-x, TCCR4M056-x, LTCLCR056-x	424.0	135.0	15.0	2156
CMPTCR 064	TCCR12064, TCCR23064, TCCR2M064-x, TCCR4M064-x, LTCLCR064-x	474.0	140.0	15.0	2485
CMPTCR 080	TCCR12080, TCCR23080, TCCR2M080-x, TCCR4M080-x, LTCLCR080-x	578.0	170.0	20.0	5017
CMPTCR 096	TCCR12096, TCCR23096, TCCR2M096-x, TCCR4M096-x, LTCLCR096-x	696.0	190.0	20.0	6735

CMBS series

45° beam splitter

KEY ADVANTAGES

Ready to use and easy to setup.

Ideal to create **coaxial illumination solutions**.

50% transmission and 50% reflection.

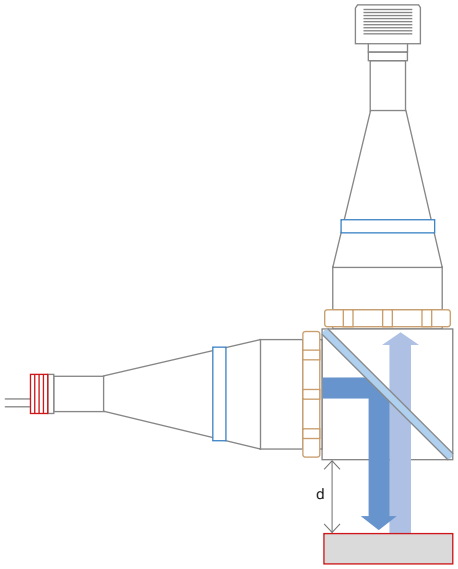
Easy and secure clamping system.

Compatible with telecentric lenses and illuminators.

CMBS series is a collection of **45° plate beam splitters** designed to easily create coaxial illumination solutions with Opto Engineering telecentric lenses and collimated illuminators. Using these 45° plate beam splitters, an incoming light beam can be divided into two separate beams with a 50% reflection / 50% transmission ratio.

CMBS series is designed for 45° angle of incidence in the 430 - 670 nm waveband: one surface is beam-splitter coated while the second one features an anti-reflective coating.
CMBS series enhances Opto Engineering telecentric lenses and collimated illuminators to create the perfect coaxial illumination setup: simply position the telecentric lens and the collimated illuminator in the appropriate port.
Each of the two ports feature a tightening knob that allows for easy and secure clamping. In addition, compatible protective windows are available.

Coaxial illumination is especially used to illuminate plain reflective objects and effectively highlight flaws or dents (which appear in the image as dark features). Whenever you are looking for a precise and easy way to setup a coaxial illumination solution, CMBS series is the ideal choice.



CMBS object distances (d) in mm

Compatible products	TC series						TCLWD series	TC2MHR-4MHR series					TC16M series					TC12K series	
	036	048	056	064	072	080	xxx	036	048	056	064	080	036	048	056	064	080	064	080
CMBS 016							82.8												
CMBS 036	20.1							20.1					19.6						
CMBS 048		37.0							37.0					29.4					
CMBS 056			50.7							50.7					41.4				
CMBS 064				63.8							63.8					52.5		44.3	
CMBS 080					90.1	90.1						90.1					60.4		19.8

Product combinations examples

TC23 036 + CMBS 036 + LTCLHP 036-G

TC2MHR 036-F + CMBS 036 + LTCLHP 036-G

TCLWD 066 + CMBS 016 + LTCLHP 016-G

SETUP

Refer to the mechanical layouts available online to check compatibility with CMHO and other mount systems.

	Optical specifications			Mechanical specifications					Compatible products	
Part number	**Coating** (front) [1]	**Coating** (back) [2]	**Deviation angle** (deg)	**Clamping diameter** (mm)	**Clamping system**	**Length** (mm)	**Width** (mm)	**Height** (mm)	**Telecentric lenses**	**Telecentric illuminators**
CMBS 016	VIS Coating: Beam splitter 50/50 @ 45°	AR Vis Coating: normal reflectance <0.5% bandwidth	90	37.7	lockring	85.8	85.8	64	TCLWD series	LTCLHP016-x
CMBS 036	VIS Coating: Beam splitter 50/50 @ 45°	AR Vis Coating: normal reflectance <0.5% bandwidth	90	61	lockring	104.4	104.4	88	TCxx036, TC2MHR036-x, TC4MHR036-x, TC16M036-x	LTCLHP036-x
CMBS 048	VIS Coating: Beam splitter 50/50 @ 45°	AR Vis Coating: normal reflectance <0.5% bandwidth	90	75	lockring	119	119	102	TCxx048, TC2MHR048-x, TC4MHR048-x, TC16M048-x	LTCLHP048-x
CMBS 056	VIS Coating: Beam splitter 50/50 @ 45°	AR Vis Coating: normal reflectance <0.5% bandwidth	90	80	lockring	129.3	129.3	108	TCxx056, TC2MHR056-x, TC4MHR056-x, TC16M056-x	LTCLHP056-x
CMBS 064	VIS Coating: Beam splitter 50/50 @ 45°	AR Vis Coating: normal reflectance <0.5% bandwidth	90	100	lockring	139.2	139.2	128	TCxx064, TC2MHR064-x, TC4MHR064-x, TC16M064-x, TC12K064	LTCLHP064-x
CMBS 080	VIS Coating: Beam splitter 50/50 @ 45°	AR Vis Coating: normal reflectance <0.5% bandwidth	90	116	lockring	158.9	158.9	144	TC23072, TCxx080, TC2MHR080-x, TC4MHR080-x, TC16M08-x, TC12K080	LTCLHP080-x

1 Tolerance +/- 5%
2 Bandwidth: 430-670 nm.

CMMR series

45° first surface mirrors

KEY ADVANTAGES

Reflect light at 90°.

Ideal for **limited spaces**.

Easy and secure clamping system.

Compatible with telecentric lenses and illuminators.

Optional **protective windows** available.

FULL RANGE OF COMPATIBLE PRODUCTS

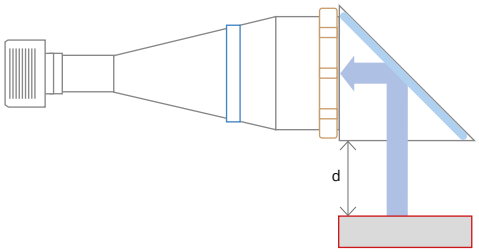
Protective windows WI series p. 172

Production environments often present size constraints, limiting the choice of optics and sometimes sacrificing optical performance for size compatibility. **CMMR series** is the Opto Engineering answer, producing a 90° bend in the light path and opening new installation options for your application.

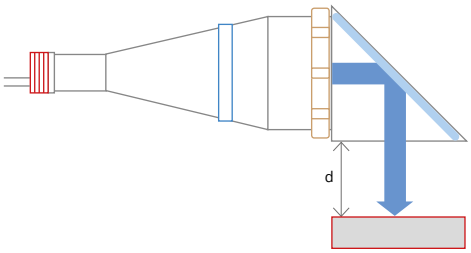
CMMR series is a family of first surface mirrors designed for our telecentric lenses and illuminators which enables viewing at 90° to the optical axis of your telecentric lens and camera.

These right-angle mirrors can also be used together with collimated illuminators, reflecting incident rays coming from the light source at 90° angle.

CMMR series feature a precise tightening knob that allows for easy and secure clamping. In addition, compatible protective windows are available. Whenever overall system dimension and precision alignment are critical factors for your application, CMMR series is the ideal choice.



CMMR first surface mirror combined with a telecentric lens.

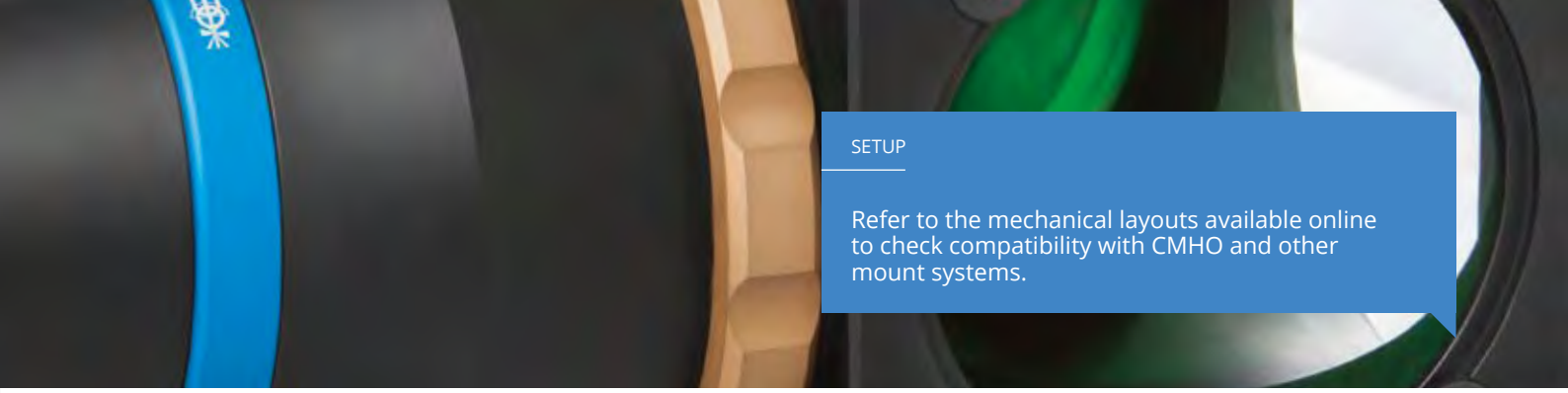


CMMR first surface mirror combined with a telecentric illuminator.

CMMR object distances (d) in mm*

Compatible products	TC series									TC2MHR-4MHR series						TC16M series						TC12K series	
	036	048	056	064	072	080	085	13096	xx96	036	048	056	064	080	096	036	048	056	064	080	096	064	080
CMMR 036	20.1									20.1						19.6							
CMMR 048		37.0									37.0						29.4						
CMMR 056			50.7									50.7						41.4					
CMMR 064				63.8									63.8						52.5			44.3	
CMMR 080					90.1	90.1								90.1						60.4			19.8
CMMR 096							124.0	124.0	123.0						123.0						106.4		

(*) When placing WI0xx protective windows in front of CMMR 45° mirrors, working distance increases of approximately one third of the window thickness (t)
$WD_{new} \approx WD_{lens} + t/3$



SETUP

Refer to the mechanical layouts available online to check compatibility with CMHO and other mount systems.

Application example

LTCLHP080-x + CMMR080 and TC23080 + CMMR080 imaging a screw in a collimated setup.

Product combinations examples

CMMR 080 combined with TC23 080

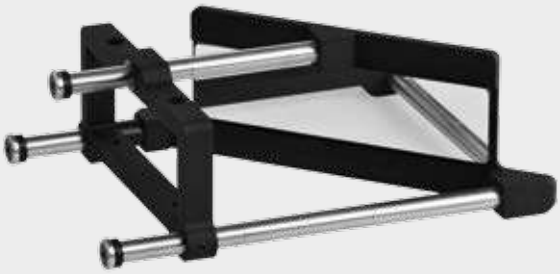
CMMR 056 combined with LTCLHP 056-G

	Optical specifications		Mechanical specifications						Compatible products		Optional accessories
Part number	**Coating** [1]	**Deviation angle** (deg)	**Clamping diameter** (mm)	**Clamping system**	**Length** (mm)	**Width** (mm)	**Height** (mm)	**Weight** (g)	**Telecentric lenses**	**Telecentric illuminators**	**Protective windows** [2]
CMMR 036	Aluminum reflective coating	90	61	lockring	88.0	88.0	107.2	595	TCxx036, TC2MHR036-x, TC4MHR036-x, TC16M036-x	LTCLHP036-x	WI 036
CMMR 048	Aluminum reflective coating	90	75	lockring	102.0	102.0	121.1	508	TCxx048, TC2MHR048-x, TC4MHR048-x, TC16M048-x	LTCLHP048-x	WI 048
CMMR 056	Aluminum reflective coating	90	80	lockring	108.0	108.0	131.3	586	TCxx056, TC2MHR056-x, TC4MHR056-x, TC16M056-x	LTCLHP056-x	WI 056
CMMR 064	Aluminum reflective coating	90	100	lockring	128.0	128.0	141.3	779	TCxx064, TC2MHR064-x, TC4MHR064-x, TC16M064-x, TC12K064	LTCLHP064-x	WI 064
CMMR 080	Aluminum reflective coating	90	116	lockring	144.0	144.0	160.9	1605	TC23072, TCxx080, TC2MHR080-x, TC4MHR080-x, TC16M080-x, TC12K080	LTCLHP080-x	WI 080

1 Normal reflectance > 98% - bandwidth: 430-670 nm.
2 To be ordered separately.

CMMR series

CMMR4K models



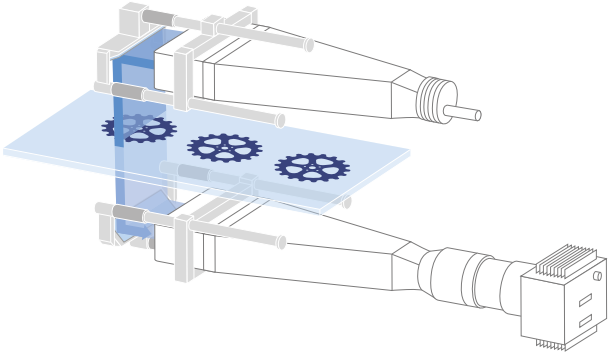
CMMR4K-L

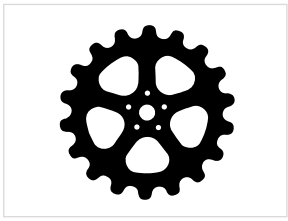
CMMR4K-V

CMMR4K are 45° first surface mirrors that produce a right angle bend in the light path.
CMMR4K are available in two versions: -V and -L, respectively bending the light rays vertically (either upwards or downwards) or laterally (either to the left or the right).
Additionally, length of CMMR4K mirrors can be varied to precisely adjust the distance of the mirror from the front lens of TC4K/ LTCL4K. Refer to the schematics for further details.

FULL RANGE OF COMPATIBLE IMAGING TELECENTRIC LENSES	
	TC4K series p. 46
FULL RANGE OF COMPATIBLE ILLUMINATORS	
	LTCL4K series p. 112

Application examples





A LTCL4K illuminator coupled to a TC4K lens with CMMR4K deflecting mirrors to scan samples on a glass surface.

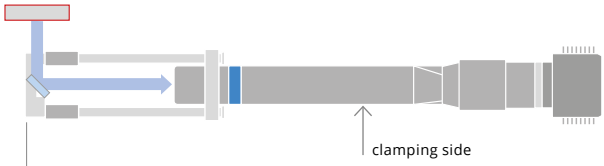
	Optical specifications		Mechanical specifications					Compatible products	
Part number [1]	Coating [2]	Deviation angle (deg)	Clamping system	Length (mm)	Width (mm)	Height (mm)	Weight (g)	Telecentric lenses	Telecentric illuminators
CMMR4K 060-V	Aluminum reflective coating	90	mounting screws	199.0	116.0	72.0	556	TC4K060-x	LTCL4K060-x
CMMR4K 060-L	Aluminum reflective coating	90	mounting screws	208.2	118.4	72.0	504	TC4K060-x	LTCL4K060-x
CMMR4K 090-V	Aluminum reflective coating	90	mounting screws	206.0	147.0	72.0	615	TC4K090-x	LTCL4K090-x
CMMR4K 090-L	Aluminum reflective coating	90	mounting screws	214.0	150.3	72.0	553	TC4K090-x	LTCL4K090-x
CMMR4K 120-V	Aluminum reflective coating	90	mounting screws	199.0	177.0	72.0	783	TC4K120-x	LTCL4K120-x
CMMR4K 120-L	Aluminum reflective coating	90	mounting screws	241.7	187.6	72.0	645	TC4K120-x	LTCL4K120-x
CMMR4K 180-V	Aluminum reflective coating	90	mounting screws	267.0	241.0	72.0	866	TC4K180-x	LTCL4K180-x
CMMR4K 180-L	Aluminum reflective coating	90	mounting screws	326.7	253.6	72.0	885	TC4K180-x	LTCL4K180-x

1 -V stands for Vertical bend, -L stands for Lateral bend.
See drawings for details about deviation axis orientation.
2 Normal reflectance > 98% - bandwidth: 430-670 nm.

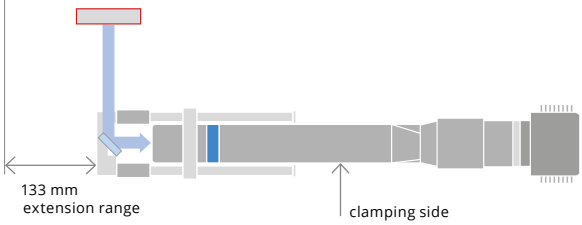
CMMR4K-V schematics

CMMR4K-V bends the light rays vertically.

UPWARD BEND

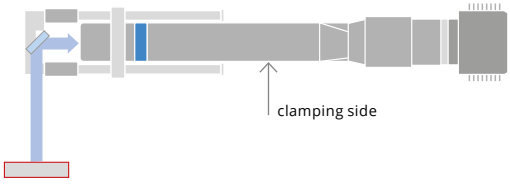


Configuration with CMMR4K at maximum extension.

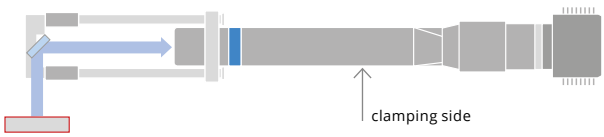


Configuration with CMMR4K at minimum extension.

DOWNWARD BEND



Configuration with CMMR4K at minimum extension.

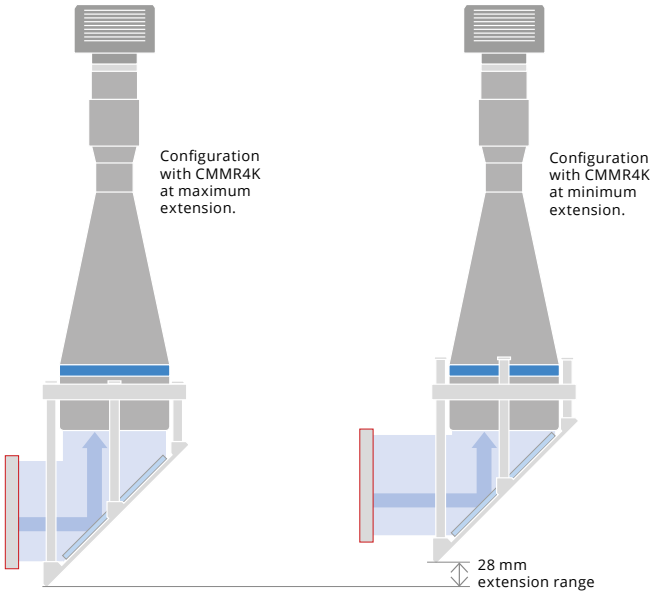


Configuration with CMMR4K at maximum extension.

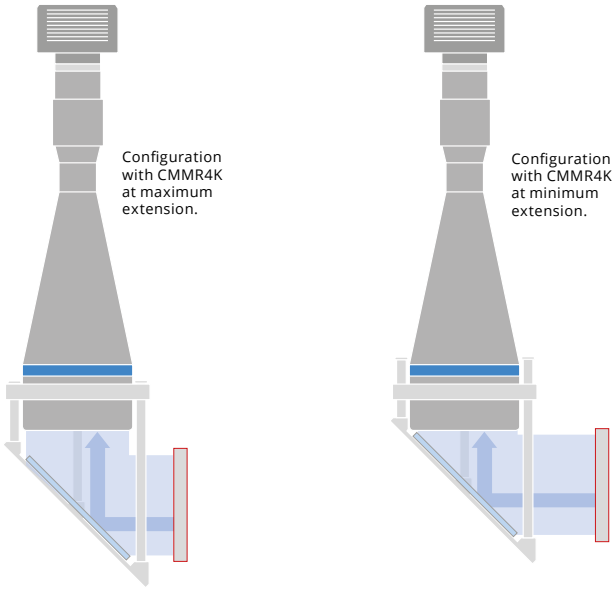
CMMR4K-L schematics

CMMR4K-L bends the light rays laterally.

LEFT BEND



RIGHT BEND



WI series

Protective windows

KEY ADVANTAGES

Protection from dust / debris or other hazardous particles.

No change in optical magnification.

Compatible with telecentric lenses, LTCLHP illuminators and CMMR mirrors.

WI series is a range of optical windows designed to protect telecentric lenses and collimated illuminators.
Material spatter and other hazards such as dust or debris might in fact damage the lens or result in optical performance degradation.

These plano-plano windows effectively shield telecentric lenses from the outside environment without affecting the quality of your imaging system because they do not cause changes in optical magnification.

WI series is also compatible with CMMR mirrors, preserving their delicate optical surfaces from dust or other hazardous particles.

Each window is complemented by its own CMWF holder which features a precise tightening knob that allows for easy and secure clamping. CMWF holders are required to mount WI protective windows in front of telecentric lenses and must be ordered separately.

Product combinations examples

WI080 + CMWF080 + TC23080

WI056 + CMWF056 + LTCLHP056-G

WI windows	Optical specifications	Mechanical specifications			Compatible products		
Part number	**Transmittance band** (nm)	**Substrate**	**Diameter** (mm)	**Thickness**	**Telecentric lenses** (mm) 1	**Telecentric illuminators** 1	**CMMR**
WI 036	450-710	N-BK7	61	3	TCxx036, TC2MHR036-x, TC4MHR036-x, TC16M036-x	LTCLHP036-x	CMMR036
WI 048	450-710	N-BK7	75	3	TCxx048, TC2MHR048-x, TC4MHR048-x, TC16M048-x	LTCLHP048-x	CMMR048
WI 056	450-710	N-BK7	80	3	TCxx056, TC2MHR056-x, TC4MHR056-x, TC16M056-x	LTCLHP056-x	CMMR056
WI 064	450-710	N-BK7	100	3	TCxx064, TC2MHR064-x; TC4MHR064-x, TC16M064-x	LTCLHP064-x	CMMR064
WI 080	450-710	N-BK7	116	3	TC23072, TCxx080; TC2MHR080-x, TC4MHR080-x, TC16M080-x	LTCLHP080-x	CMMR080
WI 096	450-710	N-BK7	143	3	TC23085, TCxx096, TC2MHR096-x, TC4MHR096-x, TC16M096-x	LTCLHP096-x	CMMR096

1 CMWF0xx mounting mechanics required. When WI0xx is placed in front of a lens, its working distance increases of approximately $^1/_3$ of the window thickness.

CMWF holders	Technical details	Optical spec	Mechanical specifications			Compatibility
Part number	**Description**	**Active area diameter** (mm)	**Clamping diameter** (mm)	**Height** (mm)	**Weight** (g)	**WI series**
CMWF 036	Holder for WI series, clamping diameter = 61 mm	51	61	22	108	WI036
CMWF 048	Holder for WI series, clamping diameter = 75 mm	65	75	27	132	WI048
CMWF 056	Holder for WI series, clamping diameter = 80 mm	70	80	27	151	WI056
CMWF 064	Holder for WI series, clamping diameter = 100 mm	90	100	27	181	WI064
CMWF 080	Holder for WI series, clamping diameter = 116 mm	106	116	27	210	WI080
CMWF 096	Holder for WI series, clamping diameter = 143 mm	133	143	27	258	WI096

Ordering information

When ordering, include the following two items:
- **WIxxx** protective window
- **CMWFxxx** holder

For example, if you need a protective window for a **TC 12036** telecentric lens, you have to order both the following items:
- **WI036** protective window
- **CMWF036** holder

The CMWF holder is not required when interfacing WI windows with CMMR.

Optical filters

Lens filters and mounting accessory

Light filtering is a typical need in machine vision measurement applications. For instance, you may need to avoid possible interactions between your LED illuminator and other light sources in an industrial environment.
Moreover, sun light is very frequently causing errors in imaging systems due to unexpected reflections from the surface of the parts being measured.
In these cases, a band-pass or long-pass filter that matches the emission wavelength of the illuminator is usually integrated in front of the objective: this way, only the light coming from the illuminator is collected while the rest of the spectrum is cut out.

Furthermore, many machine vision applications require monochromatic illumination in order to enhance or suppress particular object features: under these conditions, only the features with a certain color are imaged and can be measured.

Part number	Description	Matching products			Diameter	Weight
Filter mount		**Telecentric lenses**			(mm)	(g)
TCFILTER	Filter mount for telecentric lenses	TC 12yyy, TCCR 12yyy, TCCR 23yyy	TC 23yyy [1]	TC2MHRyyy-C, TC4MHRyyy-C, TCCR2Myyy-C, TCCR4Myyy-C [2]	-	10
Filters		**Collimated illuminators**				
COBP470D17.5	Blue (470 nm) bandpass filter	B LED sources			17.5	5
COBP525D17.5	Green (525 nm) bandpass filter	G LED sources			17.5	5
COBP635D17.5	Red (635 nm) bandpass filter	R LED sources			17.5	5
COBP850D17.5	IR (850 nm) bandpass filter	-			17.5	5
COBP880D17.5	IR (880 nm) bandpass filter	-			17.5	5
COLP920D17.5	IR (920 nm) longpass filter	-			17.5	5
COPR032D17.5	Linear polarizer	-			17.5	5

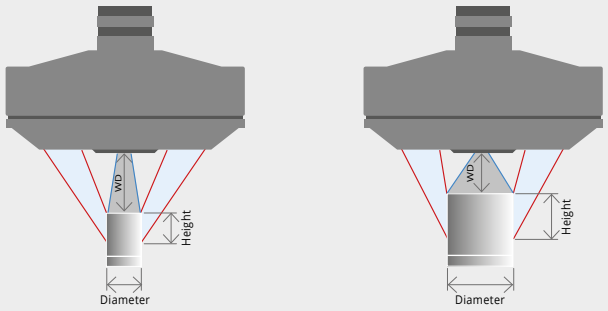
1 Except TC 23 004, TC 23 007, TC 23 009, TC 23 012.
2 Some vignetting may occur, depending on sensor size.

Ordering information

When ordering a filter for a C-mount telecentric lens insert both the filter mount (P/N: TCFILTER) and the optical filter in your order.
For example: if you need a green filter to be mounted onto TC23036 telecentric lens, order both the following items:
- **TCFILTER** - Filter mount for telecentric lenses
- **COBP525D17.5** - Green (525 nm) bandpass filter, 17.5 mm diameter

PCCDLFAT

Interchangeable attachment for extra-wide PCCD field of view



PCCD optics | PCCD optics with PCCDFLAT

Schematics showing the FOVs of PCCD Optics with and without PCCDLFAT. PCCDLFAT extends the central field of view of PCCD optics to image objects with even larger diameters (beyond 25 mm).

PCCDLFAT is an accessory designed to increase the central Field of View of PCCD optics.

By replacing the pre-assembled protective window with PCCDLFAT, PCCD optics increase its central viewing angle, allowing for the inspection of objects with even larger diameters (beyond 25 mm).

As depicted in the schematics, PCCDLFAT enables PCCD optics to inspect the TOP and SIDES of objects with even larger diameters (beyond 25 mm).

Field of view selection chart

PCCD 013 + PCCDLFAT

Diameter (mm)	Height (mm)	WD (mm)	F/#	c (%)
30	22	11	8	36
35	26	5	8	37

PCCD 012 + PCCDLFAT

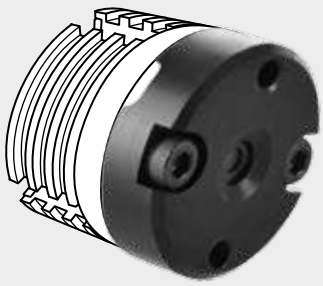
Diameter (mm)	Height (mm)	WD (mm)	F/#	c (%)
30	22	11	8	37
35	26	5	8	37

PCCD 023 + PCCDLFAT

Diameter (mm)	Height (mm)	WD (mm)	F/#	c (%)
30	22	14	8	37
35	25	10	8	45

CPDPH01

Diffuser cap for LTCLHP illuminators



In certain cases telecentric illuminators projecting a quasi-monochromatic light source (such as an LED) can give rise to diffraction effects.

CPDPH01 is an optional diffuser cap designed to be positioned in front of LTSCHP1W modules and into any LTCLHP telecentric illuminator (CPDPH01 is not compatible with LTCLHP023-x) to effectively minimize such diffraction effects; note that CPDPH01 may affect the level of LTCLHP illumination homogeneity.

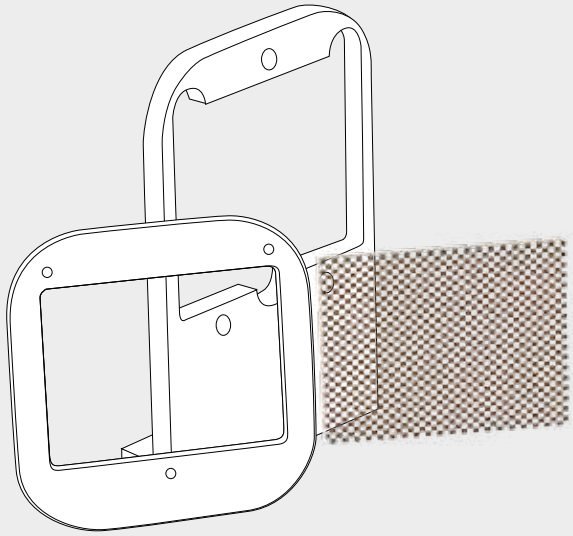
EXT series

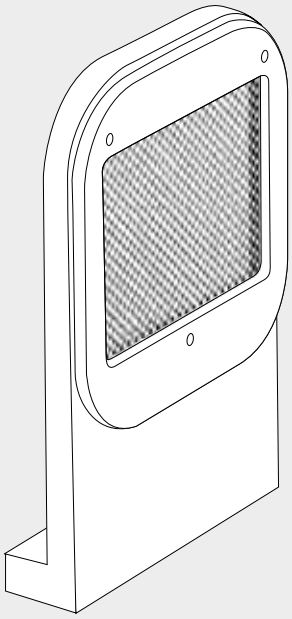
Extenders and adapters

Part number	Description
RT-VM100	Extension tube kit 40, 20, 10, 5, 1, 0.5 mm
RT-VM400	C- to CS-mount 5mm adapter ring
RT-EX15CS	1.5X extender for CS-mount
RT-EX15C	1.5X extender for C-mount
RT-EX2CS	2X extender for CS-mount
RT-EX2C	2X extender for C-mount

PTTC series

Calibration patterns



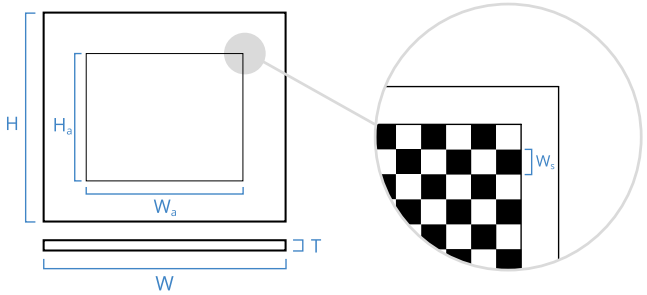


Any machine vision lens (either telecentric or not) shows some amount of distortion. In addition to *barrel* or *pincushion* distortion, changes in the view angle or misaligned components will affect the image symmetry and generate the so-called *thin prism* or *keystone* effect.

Imaging and metrology applications often require to minimize distortion, which can be software-corrected by analyzing the image of a precision pattern whose geometrical features are well known.

For this reason Opto Engineering offers chrome-on-glass patterns optimized for software calibration, featuring extremely high geometrical accuracy thanks to photolithography techniques.

The range of available chessboard patterns is compatible with most Opto Engineering telecentric lenses.



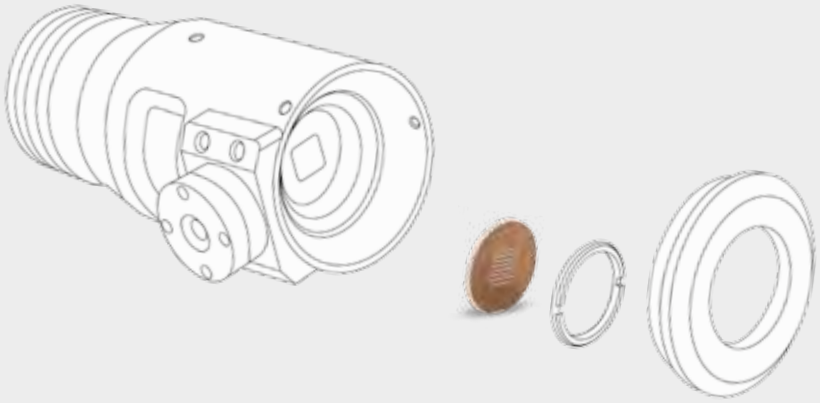
FULL RANGE OF COMPATIBLE PATTERN HOLDERS

CMPH series p. 164

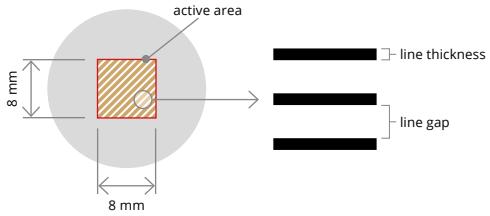
	Compatibility		Mechanical specifications				
Part number	**Telecentric lenses** (Part numbers ending in)	**Pattern mounts CMPH**	**Dimensions W x H** (mm x mm)	**Thickness T** (mm)	**Active area W_a x H_a** (mm x mm)	**Squares W_s** (mm)	**Dimensional accuracy** (µm)
PT 004-009	004, 007, 009	004-024	33.0 x 26.0	3.0	15.0 x 13.0	0.20	1.3
PT 016-024	016, 024	004-024	33.0 x 26.0	3.0	31.0 x 24.0	0.60	1.5
PT 036-056	036, 048, 056	036-056	66.0 x 52.0	3.0	64.0 x 51.0	1.35	1.9
PT 064-096	064, 072, 080, 085, 096	064-096	107.0 x 83.0	3.0	105.0 x 79.0	2.20	2.4
PT 120-240	110, 120, 130, 144, 172, 192, 200, 240	n.a.	229.0 x 229.0	3.0	208.0 x 208.0	4.00	3.7

PTPR series

Patterns for LTPRSM series



Pattern selection



LTPRSMHP3W pattern projector for machine vision

Photolitography pattern

Photolithography stripe patterns

PT 0000 0300 P
8 lines in projection area

line gap	0.95 mm
line thickness	0.05 mm
line length	7.78 mm

PTST 050 450 P
16 lines in projection area

line gap	0.45 mm
line thickness	0.05 mm

PTST 050 200 P
32 lines in projection area

line gap	0.20 mm
line thickness	0.05 mm

PTST 050 100 P
53 lines in projection area

line gap	0.10 mm
line thickness	0.05 mm

PTST 050 050 P
80 lines in projection area

line gap	0.05 mm
line thickness	0.05 mm

Photolithography grid patterns

PT 0000 0400 P
8 x 8 lines in projection area

line gap	0.95 mm
line thickness	0.05 mm
line length	7.78 mm

PTGR 050 450 P
16 x 16 lines in projection area

line gap	0.45 mm
line thickness	0.05 mm

PTGR 050 200 P
32 x 32 lines in projection area

line gap	0.20 mm
line thickness	0.05 mm

PTGR 050 100 P
53 x 53 lines in projection area

line gap	0.10 mm
line thickness	0.05 mm

PTGR 050 050 P
80 x 80 lines in projection area

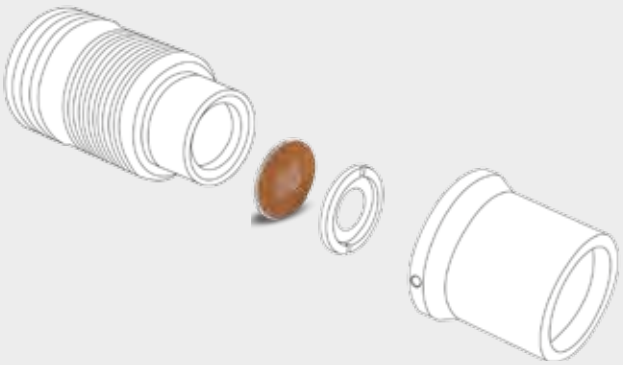
line gap	0.05 mm
line thickness	0.05 mm

Pattern specifications

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

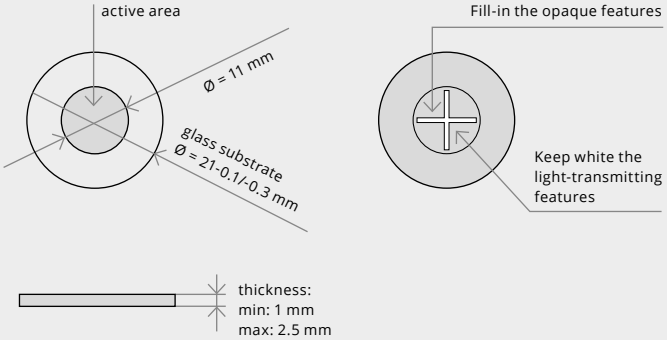
PTPR series

Patterns for LTPR series

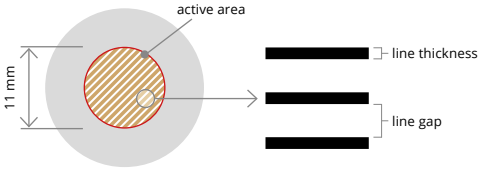


Custom-made pattern

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

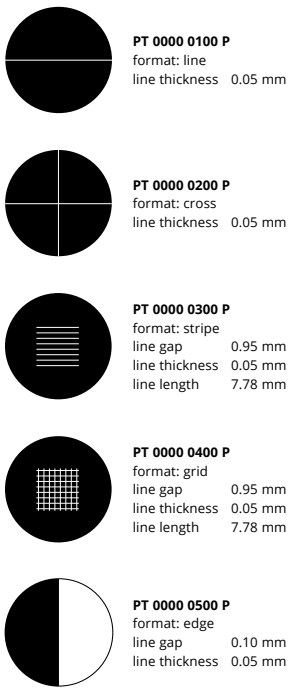


Pattern selection



Compatible pattern projector for machine vision (LTPRHP3W, LTPRXP, LTPRUP).

Photolithography patterns



PT 0000 0100 P
format: line
line thickness 0.05 mm

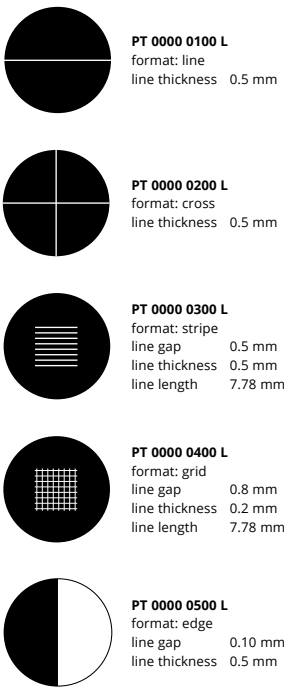
PT 0000 0200 P
format: cross
line thickness 0.05 mm

PT 0000 0300 P
format: stripe
line gap 0.95 mm
line thickness 0.05 mm
line length 7.78 mm

PT 0000 0400 P
format: grid
line gap 0.95 mm
line thickness 0.05 mm
line length 7.78 mm

PT 0000 0500 P
format: edge
line gap 0.10 mm
line thickness 0.05 mm

Laser engraved patterns



PT 0000 0100 L
format: line
line thickness 0.5 mm

PT 0000 0200 L
format: cross
line thickness 0.5 mm

PT 0000 0300 L
format: stripe
line gap 0.5 mm
line thickness 0.5 mm
line length 7.78 mm

PT 0000 0400 L
format: grid
line gap 0.8 mm
line thickness 0.2 mm
line length 7.78 mm

PT 0000 0500 L
format: edge
line gap 0.10 mm
line thickness 0.5 mm

Photolitography pattern

Laser engraved pattern

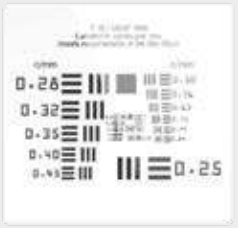
Pattern specifications

Photolithography patterns	
Substrate	Soda lime grass
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

RC series

Resolution and calibration targets



Part number	Description
RT-T-20-P-CG	USAF 1951 Resolution test chart
RT-T-21-P-CG	USAF 1951 Resolution test chart (inches)
RT-T-50-2-P-TM	Star sector test target
RT-T-62-1-P-CG	Linear test pattern
RT-AP-D50-P-CG	Calibration dot grid
RT-AP-DD100-P-CG	Multi-zone calibration dot grid


TC SERIES BI-TELECENTRIC

LTDV series

Strobe controllers

KEY ADVANTAGES

Compatible with most Opto Engineering LT LED lighting solutions.

6 output channels or **1 output channel**.

Max output current up 17.0 A.

Original design
Small, compact unit with DIN rail mounting.

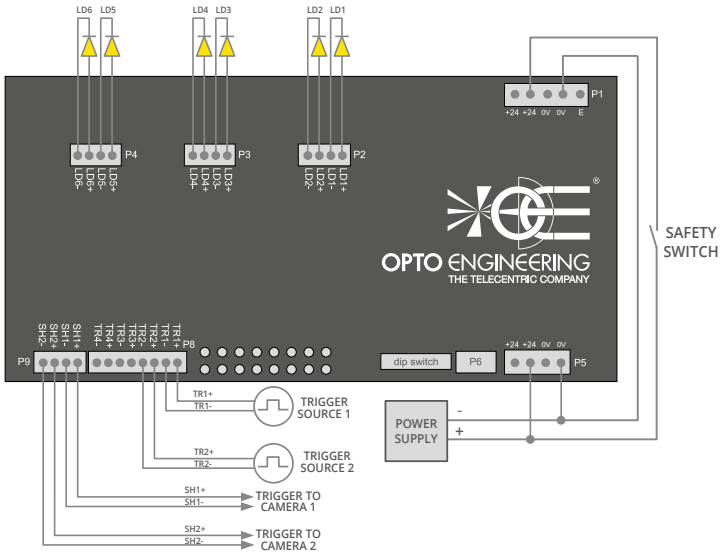
NEW LTDV1CH-17V

Strobe controller 1 channel featuring variable current range from 5 mA to 17A.

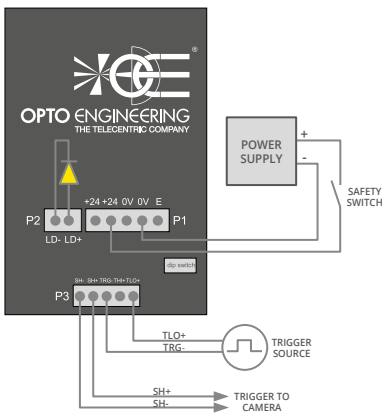
LTDV series are accurate strobe controller units designed to easily power and control illuminators of the LT family, including LTDM, LTLA, LTDMLA, LTPRUP, LTBP series and View-through system.
To get the very best out of Opto Engineering LED lighting solutions, in terms of both brightness stability and control, lights should be driven from a current source, not from a constant voltage supply. This is because small variations in temperature or voltage can cause a large change in brightness in LEDs.

The brightness is approximately linear with current, so by driving the lighting with a current, intensity control is linear.
LTDV series comprises LTDV6CH programmable strobe controller featuring six output channels and LTDV1CH-xx units featuring one output channel.
Additionally LTDV6CH can be quickly configured using an easy-to-use configuration software which can be downloaded from our website.

Wiring examples



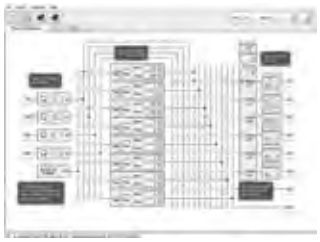
Wiring example for LTDV6CH



Wiring example for LTDV1CH-xx

Easily configure and manage strobe, trigger and camera signals

LTDV6CH

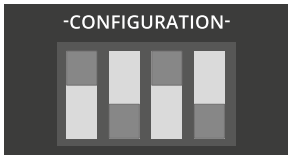


Use LTSW software (included) to configure and set-up any combination of illuminators from LTDM, LTLA, LTDMLA series and View Through system (up to 6 illuminators) using a single PC .
With LTSW software you can:

- Easily set the output current intensity of each connected illuminator in steps of 100 mA
- Set the pulse duration and pulse delay of each illuminator in steps of 1µs
- Control the connected illuminators with up to 4 synchronization inputs
- Control up to 2 synchronization outputs (e.g. up to 2 cameras)
- Write and save different configurations depending on your application

PC must have a native RS485 communication interface or a suitable S485/USB converter must be used (product code ADPT001 can be optionally purchased and shipped with LTDV6CH strobe controller).

LTDV1CH-xx



Simply set the parameters via DIP switches

Part number			LTDV6CH	LTDV1CH-17V	LTDV1CH-7	LTDV1CH-17
Electrical specifications						
User interface			RS485 1	12-way DIP switch	4-way DIP switch	4-way DIP switch
Configuration software			LTSW included	n.a.	n.a.	n.a.
Output channels n°			6 independent constant current outputs	1 constant current output		
Output current range		(A)	3.5A - 17.0A 2	**Low** 5 mA - 160 mA (in steps of 5 mA) 9 **Medium** 100 mA - 3.2 A (in steps of 100 mA) **High** 1.5 A - 17.0 A (in steps of 500 mA)	7.5 (fixed)	17.0 (fixed)
Max dissipable thermal power per channel		(W)	5	8	8	8
Synchronization inputs n°			4 opto-isolated digital inputs 3	1 opto-isolated digital input		
Synchronization outputs n°			2 opto-isolated digital outputs	1 opto-isolated digital output		
Pulse delay		(µs)	0 - 65535 4	n.a.	n.a.	n.a.
Pulse width		(µs)	10 - 65535 4	n.a.	n.a.	n.a.
Timing repeatability	for pulse delay	(µs)	0.1	n.a.	n.a.	n.a.
	for pulse width	(µs)	0.5	n.a.	n.a.	n.a.
Supply voltage		(V, DC)	24 5	24 5	24 - 48	
Output voltage		(V)	0 - 36	0 - 12 (with step-up disabled) 0 - 36 (with step-up enabled)	0 - 12 (with 24V supply) 0 - 36 (with 48V supply)	
Max startup/inrush current		(A)	2.5	2.5	2.5	2.5
Mechanical specifications						
Dimensions 6	length	(mm)	205	70	70	70
	heigth	(mm)	84	82	82	82
	width	(mm)	123	119	119	119
Mounting			DIN rail			
Accessories			ADPT001 7	n.a.	n.a.	n.a.
Compatible products			LTDM series, LTLA series, LTDMLA series, View through system, LTPRUP-x, LTSW	LTDMB2-W, LTDMB2-G, LTDMB2-R, LTDMC2-W, LTDMC2-G, LTDMC2-R, LTLAB2-W, LTLAB2-G, LTLAB2-R, LTLAC2-W, LTLAC2-G, LTLAC2-R, LTDMLAB2-WW, LTDMLAC2-WW, LTPRUP-x 8	LTDMA1-W, LTDMA1-G, LTDMA1-R, LTDMC1-W, LTLAC1-W, LTDMLAC1-WW 8	LTDMB2-W, LTDMB2-G, LTDMB2-R, LTDMC2-W, LTDMC2-G, LTDMC2-R, LTLAB2-W, LTLAB2-G, LTLAB2-R, LTLAC2-W, LTLAC2-G, LTLAC2-R, LTDMLAB2-WW, LTDMLAC2-WW, LTPRUP-x 8

1 With Modbus RTU slave protocol.
2 In steps of 98 mA.
3 Opto Isolated. Operate from 3V to 24V.
4 In steps of 1 µs.
5 Regulated ± 10%.
6 Including DIN fixing.
7 To be ordered separately. ADPT001 consists of - one RS485-USB adapter and - one cable with 3 elements for connection with LTDV6CH. In order to configure LTDV6CH via software ADPT001 must be used. Refer to our website for further info.
8 LTDMLA series require two LTDV1CH strobe controllers to power and control both the two integrated illumination units (dome + ring light).
9 Continuous mode option is also available for the low current range.

MTDV

Motion controller for bipolar stepper motors

NEW

KEY ADVANTAGES

Lens control via RS485 / USB or manual interface.

Designed to drive motorized ENMT and MZMT series with specific configuration file for F-number, focus and/or zoom settings.

Compact aluminum housing with DIN rail mounting.

Demo software included.

MTDV3CH-00A1 is a motion controller for bipolar stepper motors with a winding current of 0.5 A up to 24 V DC. MTDV can drive up to three stepper motors and has been developed to control aperture, focus and zoom of motorized lenses via RS485/USB interface of a PC/PLC system or manually.
Compatible series are ENMT fixed focal length lenses with motorized focus and aperture control and MZMT series, 5X continuous macro zoom lenses with motorized control.

MTDV3CH-00A1 is an open loop controller: motion modes are operated either manual or via PC/PLC and include relative/absolute position, move to a specific F-number, magnification or working distance.

The controller is supplied with a software package including a demo software, dll and code examples to be downloaded from Opto Engineering website.
MTDV lets you easily set specific F-number, focus and/or zoom settings when used in combination with any compatible lens model from MZMT and ENMT series by downloading a specific configuration file from our website. Specific configurations can be saved in the controller non-volatile memory.

DO YOU KNOW?

Download MTDV instruction manual from **www.opto-engineering.com**

In order to connect MTDV3CH-00A1 to ENMT and MZMT series, CBMT001 cable (from circular standard DIN 13Pos Female to DB15F connector) must be ordered.

MTDV features a solid aluminum housing and can be easily mounted on a DIN rail for easy integration in any industrial automation environment.

Product combinations*

MZMT lens + CBMT001 cable + MTDV controller

ENMT lens + CBMT001 cable + MTDV controller

* To be ordered separately

COMPATIBLE MOTORIZED LENSES		
	MZMT series	p. 80
	ENMT series	p. 88
CABLE FOR CONNECTION WITH MZMT AND ENMT		
	CBMT001	p. 186

Part number		**MTDV3CH-00A1**
Description		Motion controller for three bipolar stepper motors, manual, RS485/USB interface
Electrical specifications		
User interface type	Manual:	push buttons, slider
	PC/PLC:	RS485 **1** / USB **2**
Supply voltage, DC	(V, DC)	24
Connector type		DB15F
LED indication		power, motion, motors limit switch, fault (overtemperature, overcurrent)
Non volatile memory		yes
Automatic position saving		yes **3**
Protections		ESD protection, Output overcurrent protection, wrong power polarity protection, Voltage overload protection, External power supply current limitation, Thermal shutdown protection
Software		Windows demo software, dll, code examples
Motion modes	Manual:	CW/CCW constant speed move
	PC/PLC:	move relative, move absolute
		move to F-number, move to magnification, move to working distance WD **4**
Control type		open loop
Motor parameters		
Number of motors		up to 3
Supported motor type		Bipolar stepper
Winding current	(A)	0.5 fixed
Max speed	steps/s	1000
Mechanical specifications		
Lenght	mm	185
Height	mm	64.0
Width	mm	85.0
Mounting		DIN rail
Compatibility 5		
Lenses		ENMT series, MZMT series
Cable **6**		CBMT001 (circular standard DIN 13Pos Female to DB15M connector cable, 2 m)
Accessories		ADPT001 (adapter RS485-USB + cable with 3 elements)

1 With Modbus RTU slave protocol.
2 Mini-B plug.
3 Automatic position saving can be disabled.
4 Download configuration file from Opto Engineering website.
5 All compatible products must be ordered separately
6 Cable is required to connect MTDV3CH-00A1 controller to ENMT/MZMT series.

PS series

Power supplies

Part number	Electrical specifications						Dimensions			Compatibility 4			
	Input		Output								Lighting		
	Supply voltage (V, AC)	Power cord	Channels	Voltage (V, DC)	Max current	Power (W)	Lenght (mm)	Width (mm)	Height (mm)	Controllers 1	LED illuminators	LED pattern projectors	LED sources/ modules
DIN RAIL POWER SUPPLIES													
 **RT-SDR-120-24** 24VDC DIN rail power supply	88 - 264	not included	1	24	5	120	113.5	40	125.2	LTDV1CH-17V, LTDV6CH, MTDV3CH-00A1	LTCLHP, LTCLHP CORE, LTCL4K, TCCX, TCCXQ, TCBENCH, TCBENCH CORE, LTDMC, LTRNST, LTRNOB, LTLAIC, LTLADC, LTRNDC, LTBC, LTBFC, LTBRDC, LTTNC, LTCXC	LTPRHP3W, LTPRSMHP3W, LTPRXP	LTSCHP
 **RT-SDR-240-48** 48VDC DIN rail power supply	88 - 264	not included	1	48	5	240	113.5	63	125.2	LTDV1CH-7, LTDV1CH-17	n.a.	n.a.	n.a.
ANALOG BENCHTOP LIGHTING CONTROLLERS													
 **RT-ANGX1000CH1-24V-xx-TB 2** 24VDC analog lighting controller 1 channel	100 - 240	included (EU, UK or US)	1	24	5	120	330	93	123	n.a.	LTCLHP, LTCLHP CORE, LTCL4K, TCCX, TCCXQ, TCBENCH, TCBENCH CORE, LTDMC, LTRNST, LTRNOB, LTLAIC, LTLADC, LTRNDC, LTBC, LTBFC, LTBRDC, LTTNC, LTCXC	LTPRHP3W, LTPRSMHP3W, LTPRXP	LTSCHP
 **RT-PSP-12122-LV** 12VDC analog power supply for LVx-00614 LED spot light	100 - 240	included (US) 3	2	12	1	12	118	83	38	n.a.	n.a.	n.a.	LDSC (RT-LVW-00614, RT-LVG-00614)

1 Additional wires (not supplied) are required to connect the controllers with the power supply units.
2 xx = UK (240VAC) / EU (220VAC) / US (110VAC).
3 Non removable. Other types available upon request (minimum order quantity is required).
4 Do not exceed lighting/controllers maximum ratings specified in the product datasheet. Refer to specific product documentation for detailed instructions.

CB series - Cables

Part number	Description	Compatibility
CBLT001	Illumination cable, side 1 M12 connector straight, side 2 cable end - 5 m - for single stage systems	LTDMB2-x, LTDMCx-x, LTLAB2-x, LTLACx-x, LTPRUP-x
CBLT002	Illumination cable, side 1 M12 connector right angled, side 2 cable end - 5 m - for single stage systems	
CBLT003	Illumination cable, side 1 M8 connector straight, side 2 cable end - 5 m - for single stage systems	LTDMA1-x
CBLT004	Illumination cable, side 1 M8 connector right angled, side 2 cable end - 5 m - for single stage systems	
CBLT005	Illumination cable, side 1 M12 connector straight, side 2 cable end - 5 m - for double stage systems	LTDMLAB2-WW, LTDMLACx-WW
CBLT006	Illumination cable, side 1 M12 connector right angled, side 2 cable end - 5 m - for double stage systems	
CB244P1500	Power cable, side 1 M8 connector straight, side 2 cable end - 2 m - type 1 labels	LTCLHP series, LTCLHP CORE series, LTCL4K series, TCCX series, LTPR series, LTPRHP3W series, LTPRSMHP3W series, LTSCHP series
CB244P1500L	Power cable, side 1 M8 connector angled, side 2 cable end - 2 m - type 1 labels	
CB244P1501	Power cable, side 1 M8 connector straight, side 2 cable end - 2 m - type 2 labels	LTPRXP series, TCCAGExx096
CB244P1501L	Power cable, side 1 M8 connector angled, side 2 cable end - 2 m - type 2 labels	
COCB243P0600	Electric cable for TCZR and MCZR products	TCZR series, MCZR series
COCBUSB20	USB cable for TCZR and MCZR products	
CBMT001	12 wires PVC grey cable, circular standard DIN 13Pos Female to DB15M connector cable - 2 m	MTDV3CH-00A1, ENMT series, MZMT series

ADPT001

Part number	Description	Compatibility
 **ADPT001**	Adapter RS485-USB + cable with 3 elements for LTDV6CH connection	LTDV6CH, MTDV3CH-00A1

Product combination

LTSCHP series

High-performance replacement LED modules

LTSCHP modules power many series of Opto Engineering LED illuminators featuring excellent current stability.
They are available in four colors (red, green, blue and white) and can be ordered as replacements: LTSCHP1W modules are compatible with LTCLHP, LTCL4K, TCCXQ, TCCX, TCBENCH series, TCBENCH CORE series; LTLCHP CORE and TCBENCH CORE series (only red, green and white), while LTSCHP3W modules are compatible with LTPRHP3W and LTPRSMHP3W pattern projectors.

		Device power ratings				LED power ratings			Compatibility
Part number	**Light color, Wavelength peak**	**DC voltage** 1		**Power consumption**	**Max LED forward current**	**Forward voltage**		**Max pulse current**	
		Minimum (V)	Maximum (V)	(W)	(mA) 2	Typical (V) 3	Maximum (V) 4	(mA) 5	
1W power sources 6									
LTSCHP 1W-R	red, 630 nm	12	24	< 2.5	350	2.4	3.00	2000	LTCLHP, LTCLHP CORE, LTCL4K, TCCX, TCCXQ, TCBENCH, TCBENCH CORE 7
LTSCHP 1W-G	green, 520 nm	12	24	< 2.5	350	3.3	4.00	2000	
LTSCHP 1W-B	blue, 460 nm	12	24	< 2.5	350	3.3	4.00	2000	
LTSCHP 1W-W	white	12	24	< 2.5	350	2.78	-	2000	
3W power sources									
LTSCHP 3W-R	red, 630 nm	12	24	< 4.5	720	2.4	3.00	2000	LTPRHP3W, LTPRSMHP3W
LTSCHP 3W-G	green, 520 nm	12	24	< 4.5	720	3.3	4.00	2000	
LTSCHP 3W-B	blue, 460 nm	12	24	< 4.5	720	3.3	4.00	2000	
LTSCHP 3W-W	white	12	24	< 4.5	720	2.78	-	2000	

1 Tolerance ± 10%.
2 Used in continuous (not pulsed) mode.
3 At max forward current.
4 Tolerance is ±0.06V on forward voltage measurements.
5 At pulse width <= 10 ms, duty cycle <= 10% condition.
Built-in electronics board must be bypassed (see tech info).
6 Shipped not assembled. See LTCLHP instructions manual.
7 Some part numbers are not available in all color options (-R, -G, -B and -W).
See page of each product series for available colors.

CABLES & ELECTRONIC COMPONENTS

LDSC series

LED sources

Part number	Description	Compatibility
RT-LVW-00614	Light source for Optart telecentric lenses with built-in coaxial illumination, white	RT-PSP-12122-LV
RT-LVG-00614	Light source for Optart telecentric lenses with built-in coaxial illumination, green	RT-PSP-12122-LV

FULL RANGE OF COMPATIBLE PRODUCTS		
	TCCXHM series	p. 31
	TCCXLM series	p. 31
	TCCX2M series	p. 42

FOV	1/3" w x h 4.8 x 3.6 mm	1/2.5" w x h 5.70 x 4.28 mm	1/2" w x h 6.4 x 4.8 mm	1/1.8" w x h 7.13 x 5.37 mm	2/3" - 5 Mpx w x h 8.45 x 7.07 mm	KAI-2020 14.8 mm diag 11.84 x 8.88 mm	1" - KAI-04050 16 mm diag 12.8 x 9.6 mm
1 to 1.5 mm	TCLWD350 TCCX350	RT-HR-4M-110 RT-HR-4F-110	RT-HR-6M-110 RT-HR-6F-110	RT-HR-6M-110 RT-HR-6F-110	RT-HR-6M-110 RT-HR-6F-110		
1.5 to 2 mm	TCLWD250 TCCX250	TCLWD350 TCCX350	TCLWD350 TCCX350	RT-HR-4M-110 RT-HR-4F-110	TC4M 004-**x**		
2 to 3 mm	TC 23 004 RT-HR-2M-110 RT-HR-2F-110	TC 23 004 TCLWD250 TCCX250	TCLWD250 TCCX250	TCLWD350 TCCX350 TCLWD250 TCCX250	TCLWD350 TCCX350 TC4M 007-**x**		
3 to 4 mm	TCLWD150 TCCX150 TC 23 007	TCLWD150 TCCX150	TC 23 004	TC 23 004	TCLWD250 TCCX250	TC4M 004-**x** RT-MP-4F-65	TC4M 004-**x** RT-MP-4F-65
4 to 6 mm	TC 23 009 TCLWD100 TCCX100	TC 23 009 TC 23 007 TCLWD100 TCCX100	TC 23 007 TCLWD150 TCCX150	TC 23 007 TCLWD150 TCCX150	TC 23 004 TCLWD150	TC4M 007-**x** TC4M 009-**x**	TC4M 007-**x**
6 to 8 mm	TC 23 012 TCLWD075 TCCX075 TCLWD066 TCCX066	TC 23 012 TCLWD075 TCCX075	TC 23 009 TC 23 012 TCLWD100 TCCX100 TCLWD075 TCCX075	TC 23 009 TCLWD100 TCCX100	TC 23 007	RT-MP-2F-65	TC4M 009-**x** RT-MP-2F-65
8 to 11 mm	TC 23 016 TCLWD050 TCCX050	TC 23 016 TCLWD066 TCCX066	TC 23 016 TCLWD066 TCCX066	TC 23 012 TCLWD075 TCCX075 TCLWD066 TCCX066	TC 23 009 TCLWD100 TCCX100	RT-MP-1.5F-65	RT-MP-1.5F-65
11 to 15 mm	TC 12 016 TC 23 024	TC 12 016 TCLWD050 TCCX050	TC 12 016 TCLWD050 TCCX050	TC 23 016 TCLWD050 TCCX050	TC 23 012 TCLWD075 TCCX075 TCLWD066 TCCX066	TC4MHR 016-**x** RT-MP-1F-65	TC4MHR 016-**x** RT-MP-1F-65
15 to 20 mm	TC 12 024 TC 23 036	TC 23 024	TC 23 024	TC 12 016	TC 23 016 TCLWD050 TCCX050 RT-TCL0450-FU	TC2MHR 016-**x** TC4MHR 024-**x** RT-TCL0750-FU	TC2MHR 016-**x** TC4MHR 024-**x** RT-TCL0750-FU
20 to 30 mm	TC 12 036	TC 12 024 TC 23 036	TC 12 024 TC 23 036	TC 23 024 TC 12 024 TC 23 036	TC 23 024 RT-TCL0300-FU	TC2MHR 024-**x** TC4MHR 036-**x** RT-TCL0600-FU RT-TCL0450-FU	TC2MHR 024-**x** TC4MHR 036-**x** RT-TCL0600-FU RT-TCL0450-FU
30 to 40 mm	TC 23 056, TCCR 23 056 TC 13 036	TC 23 048, TCCR 23 048 TC 12 036 TC 23 056, TCCR 23 056	TC 23 048, TCCR 23 048 TC 12 036 TC 23 056, TCCR 23 056	TC 23 048, TCCR 23 048	TC 23 036	TC4MHR 048-**x**, TCCR4M 048-**x** TC2MHR 036-**x** TC4MHR 056-**x**, TCCR4M 056-**x**	TC4MHR 048-**x**, TCCR4M 048-**x** TC2MHR 036-**x**
40 to 50 mm	TC 12 056, TCCR 12 056 TC 23 080, TCCR 23 080 TC 13 048	TC 23 064, TCCR 23 064 TC 12 048, TCCR 12 048 TC 23 072 TC 12 056, TCCR 12 056	TC 23 064, TCCR 23 064 TC 12 048, TCCR 12 048 TC 23 072 TC 12 056, TCCR 12 056	TC 12 036 TC 23 056, TCCR 23 056	TC 23 048, TCCR 23 048	TC4MHR 064-**x**, TCCR4M 064-**x** TC2MHR 048-**x**, TCCR2M 048-**x** RT-TCL0300-FU	TC4MHR 056-**x**, TCCR4M 056-**x** TC4MHR 064-**x**, TCCR4M 064-**x** TC2MHR 048-**x**, TCCR2M 048-**x** RT-TCL0300-FU
50 to 70 mm	TC 23 096, TCCR 23 096 TC 12 080, TCCR 12 080 TC 13 064	TC 23 080, TCCR 23 080 TC 12 064, TCCR 12 064 TC 23 096, TCCR 23 096	TC 23 080, TCCR 23 080 TC 23 085 TC 12 064, TCCR 12 064 TC 23 096, TCCR 23 096	TC 23 064, TCCR 23 064 TC 12 048, TCCR 12 048 TC 23 072 TC 12 056, TCCR 12 056 TC 23 080, TCCR 23 080 TC 23 085	TC 23 056, TCCR 23 056 TC 23 064, TCCR 23 064 TC 23 072	TC2MHR 056-**x**, TCCR2M 056-**x** TC4MHR 080-**x**, TCCR4M 080-**x** TC2MHR 064-**x**, TCCR2M 064-**x** TC4MHR 096-**x**, TCCR4M 096-**x**	TC2MHR 056-**x**, TCCR2M 056-**x** TC4MHR 080-**x**, TCCR4M 080-**x** TC2MHR 064-**x**, TCCR2M 064-**x** TC4MHR 096-**x**, TCCR4M 096-**x**
70 to 100 mm	TC 12 096, TCCR 12 096 TC 13 080 TC 12 120 TC 13 096	TC 12 080, TCCR 12 080 TC 23 120 TC 12 096, TCCR 12 096 TC 23 144	TC 12 080, TCCR 12 080 TC 23 110 TC 23 120 TC 12 096, TCCR 12 096 TC 23 130 TC 23 144	TC 12 064, TCCR 12 064 TC 23 096, TCCR 23 096 TC 12 080, TCCR 12 080 TC 23 110 TC 23 120	TC 23 080, TCCR 23 080 TC 23 085 TC 23 096, TCCR 23 096	TC2MHR 080-**x**, TCCR2M 080-**x** TC4MHR 120-**x** TC2MHR 096-**x**, TCCR2M 096-**x** TC4MHR 144-**x**	TC2MHR 080-**x**, TCCR2M 080-**x** TC4MHR 120-**x** TC2MHR 096-**x**, TCCR2M 096-**x**
100 to 150 mm	TC 12 144 TC 12 192	TC 12 120 TC 23 172 TC 12 144	TC 12 120 TC 23 172 TC 23 192 TC 12 144 TC 23 200	TC 12 096, TCCR 12 096 TC 23 130 TC 23 144 TC 12 120 TC 23 172	TC 23 110 TC 23 120 TC 23 130 TC 23 144	TC2MHR 120-**x** TC4MHR 192-**x** TC2MHR 144-**x** TC4MHR 240-**x** TC2MHR 192-**x**	TC4MHR 144-**x** TC2MHR 120-**x** TC4MHR 192-**x** TC2MHR 144-**x**
150 to 200 mm		TC 23 240 TC 12 192	TC 23 240 TC 12 192	TC 23 192 TC 12 144 TC 23 200 TC 23 240	TC 23 172 TC 23 192		TC4MHR 240-**x** TC2MHR 192-**x**
200 to 300 mm				TC 12 192	TC 23 200 TC 23 240		

SENSOR SIZE

SENSOR SIZE CHART
TELECENTRIC

1.2" - KAI-4022/4021 21.5 mm diag 15.2 x 15.2 mm	4/3" - KAI-08050 22.6 mm diag 18.1 x 13.6 mm	Line - 2k 2k x 10 µm 20.48 mm	Line - 4k 4k x 7 µm 28.67 mm	Line - 8k 8k x 5 µm 40.96 mm	Full frame - 35mm w x h 36 x 24 mm	Line - 8k 8k x 7 µm 57.3 mm	Line -16k 16k x 3.5 µm 57.3 mm	Line - 2k 12k x 5 µm 61.4 mm	Line - 12k 12k x 5.2 µm 62.4 mm
TC4M 004-**x**									
TC4M 007-**x**	TC4M 004-**x**	TC 16M 009-**x**							
TC4M 009-**x**	TC4M 007-**x**		TC 16M 009-**x**						
	TC4M 009-**x**	TC 16M 012-**x** TC 16M 018-**x**	TC 16M 012-**x**	TC 16M 009-**x**	TC 16M 009-**x**				
TC4MHR 016-**x**			TC 16M 018-**x**	TC 16M 012-**x**	TC 16M 012-**x**				
	TC4MHR 016-**x**				TC 16M 018-**x**				
TC4MHR 024-**x**	TC4MHR 024-**x**	TC 16M 036-**x** TC 16M 048-**x**	TC 16M 036-**x**	TC 16M 018-**x**					
TC4MHR 036-**x**	TC4MHR 036-**x**	TC 16M 056-**x** TC 16M 064-**x**	TC 16M 048-**x**	TC 16M 036-**x**	TC 16M 036-**x**				
TC4MHR 048-**x**, TCCR4M 048-**x** TC4MHR 056-**x**, TCCR4M 056-**x**	TC4MHR 048-**x**, TCCR4M 048-**x**	TC4K060-**x** TC 16M 080-**x**	TC 16M 056-**x**		TC 16M 048-**x**				
TC4MHR 064-**x**, TCCR4M 064-**x** TC4MHR 080-**x**, TCCR4M 080-**x**	TC4MHR 056-**x**, TCCR4M 056-**x** TC4MHR 064-**x**, TCCR4M 064-**x**	TC 16M 096-**x** TC4K090-**x**	TC4K060-**x** TC 16M 064-**x** TC 16M 080-**x**	TC 16M 048-**x** TC 16M 056-**x**	TC 16M 056-**x** TC 16M 064-**x**	TC12K 064-**x**	TC12K 064-**x**	TC12K 064-**x**	TC12K 064-**x**
TC4MHR 096-**x**, TCCR4M 096-**x**	TC4MHR 080-**x**, TCCR4M 080-**x** TC4MHR 096-**x**, TCCR4M 096-**x**	TC 16M 120-**x** TC16M 144-**x** TC4K120-**x**	TC 16M 096-**x** TC4K090-**x** TC 16M 120-**x**	TC 16M 064-**x** TC 16M 080-**x**	TC 16M 080-**x** TC 16M 096-**x**	TC12K 080-**x**	TC12K 080-**x**	TC12K 080-**x**	TC12K 080-**x**
TC4MHR 120-**x** TC4MHR 144-**x**	TC4MHR 120-**x** TC4MHR 144-**x**	TC16M 192-**x** TC4K180-**x** TC16M 240-**x**	TC16M 144-**x** TC4K120-**x**	TC 16M 096-**x** TC 16M 120-**x**	TC 16M 120-**x** TC16M 144-**x**	TC12K 120-**x** TC12K 144-**x**	TC12K 120-**x** TC12K 144-**x**	TC12K 120-**x** TC12K 144-**x**	TC12K 120-**x** TC12K 144-**x**
TC4MHR 192-**x**	TC4MHR 192-**x**		TC16M 192-**x** TC4K180-**x** TC16M 240-**x**	TC16M 144-**x**	TC16M 192-**x**	TC12K 192-**x**	TC12K 192-**x**	TC12K 192-**x**	TC12K 192-**x**
TC4MHR 240-**x**	TC4MHR 240-**x**			TC16M 192-**x** TC16M 240-**x**	TC16M 240-**x**	TC12K 240-**x**	TC12K 240-**x**	TC12K 240-**x**	TC12K 240-**x**

FOV	1/3" w x h 4.8 x 3.6 mm	1/2.5" w x h 5.70 x 4.28 mm	1/2" w x h 6.4 x 4.8 mm	1/1.8" w x h 7.13 x 5.37 mm	2/3" - 5 Mpx w x h 8.45 x 7.07 mm	1" - KAI-04050 16 mm diag 12.8 x 9.6 mm
1.5 to 2 mm	MC300X MC3-03X	MC300X MC3-03X				
2 to 3 mm	MC200X MC3-03X	MC200X MC3-03X	MC3-03X MC300X	MC3-03X MC300X	MC300X MC3-03X	
3 to 4 mm	MC150X MC3-03x	MC150X MC3-03X	MC200X MC3-03X	MC200X MC3-03X	MC3-03X	
4 to 6 mm	MC100X MC3-03X	MC100X MC3-03X	MC150X MC3-03X	MC150X MC3-03X	MC200X MC150X MC3-03X	
6 to 8 mm	MC075X MC3-03X	MC075X MC3-03X	MC100X MC3-03X	MC100X MC3-03X	MC3-03X	MC4K200X-**x** MC4K175X-**x**
8 to 11 mm	MC050X MC3-03X	MC3-03X	MC075X MC3-03X	MC075X MC3-03X	MC100X MC3-03X	MC4K150X-**x** MC4K125X-**x**
11 to 15 mm	MC033X MC3-03X	MC050X MC3-03X	MC050X MC3-03X	MC050X MC3-03x	MC075X MC3-03X	MC4K100X-**x**
15 to 20 mm	MC3-03X	MC033X MC3-03X	MC3-03X MC033X	MC3-03X	MC050X	MC4K075X-**x**
20 to 30 mm	MC3-03x	MC3-03X	MC3-03x	MC033X MC3-03X	MC033X MC3-03X	MC4K050X-**x**
30 to 40 mm	MC3-03x	MC3-03X	MC3-03X	MC3-03X	MC3-03X	
40 to 50 mm	MC3-03x	MC3-03X	MC3-03X	MC3-03X	MC3-03X	MC4K025X-**x**
50 to 70 mm	RT-H0514-MP2 @ 60 mm RT-M0824-MPW2 @ 90 mm RT-M1224-MPW2 @ 140 mm RT-M1620-MPW2 @ 180 mm RT-M2518-MPW2 @ 290 mm RT-M3520-MPW2 @ 400 mm RT-M5028-MPW2 @ 570 mm	MC3-03X	MC3-03X	MC3-03X	MC3-03X	MC4K025X-**x**
70 to 100 mm	RT-H0514-MP2 @ 80 mm RT-M0824-MPW2 @ 120 mm RT-M1224-MPW2 @ 190 mm RT-M1620-MPW2 @ 250 mm RT-M2518-MPW2 @ 390 mm RT-M3520-MPW2 @ 550 mm RT-M5028-MPW2 @ 780 mm	RT-H0514-MP2 @ 70 mm RT-M0824-MPW2 @ 110 mm RT-M1224-MPW2 @ 160 mm RT-M1620-MPW2 @ 210 mm RT-M2518-MPW2 @ 330 mm RT-M3520-MPW2 @ 460 mm RT-M5028-MPW2 @ 660 mm	RT-H0514-MP2 @ 60 mm RT-M0824-MPW2 @ 100 mm RT-M1224-MPW2 @ 140 mm RT-M1620-MPW2 @ 190 mm RT-M2518-MPW2 @ 300 mm RT-M3520-MPW2 @ 420 mm RT-M5028-MPW2 @ 600 mm	MC3-03X	MC3-03X	RT-FL-YFL3528 RT-FL-YFL5028A-02 RT-FL-YFL5028
100 to 150 mm	RT-H0514-MP2 @ 110 mm RT-M0824-MPW2 @ 170 mm RT-M1224-MPW2 @ 260 mm RT-M1620-MPW2 @ 350 mm RT-M2518-MPW2 @ 550 mm RT-M3520-MPW2 @ 760 mm	RT-H0514-MP2 @ 90 mm RT-M0824-MPW2 @ 150 mm RT-M1224-MPW2 @ 220 mm RT-M1620-MPW2 @ 300 mm RT-M2518-MPW2 @ 460 mm RT-M3520-MPW2 @ 650 mm	RT-H0514-MP2 @ 80 mm RT-M0824-MPW2 @ 130 mm RT-M1224-MPW2 @ 200 mm RT-M1620-MPW2 @ 270 mm RT-M2518-MPW2 @ 420 mm RT-M3520-MPW2 @ 580 mm	RT-H0514-MP2 @ 80 mm RT-M0824-MPW2 @ 120 mm RT-M1224-MPW2 @ 180 mm RT-M1620-MPW2 @ 240 mm RT-M2518-MPW2 @ 380 mm RT-M3520-MPW2 @ 530 mm	RT-H0514-MP2 @ 60 mm RT-M0824-MPW2 @ 100 mm RT-M1224-MPW2 @ 150 mm RT-M1620-MPW2 @ 210 mm RT-M2518-MPW2 @ 320 mm RT-M3520-MPW2 @ 450 mm	RT-FL-YFL3528 RT-FL-YFL5028A-02 RT-FL-YFL5028
150 to 200 mm	RT-H0514-MP2 @ 160 mm RT-M0824-MPW2 @ 260 mm RT-M1224-MPW2 @ 390 mm RT-M1620-MPW2 @ 520 mm RT-M2518-MPW2 @ 810 mm	RT-H0514-MP2 @ 140 mm RT-M0824-MPW2 @ 220 mm RT-M1224-MPW2 @ 330 mm RT-M1620-MPW2 @ 440 mm RT-M2518-MPW2 @ 680 mm RT-M3520-MPW2 @ 960 mm	RT-H0514-MP2 @ 120 mm RT-M0824-MPW2 @ 200 mm RT-M1224-MPW2 @ 290 mm RT-M1620-MPW2 @ 390 mm RT-M2518-MPW2 @ 610 mm RT-M3520-MPW2 @ 860 mm	RT-H0514-MP2 @ 110 mm RT-M0824-MPW2 @ 180 mm RT-M1224-MPW2 @ 260 mm RT-M1620-MPW2 @ 350 mm RT-M2518-MPW2 @ 550 mm RT-M3520-MPW2 @ 770 mm	RT-H0514-MP2 @ 90 mm RT-M0824-MPW2 @ 150 mm RT-M1224-MPW2 @ 230 mm RT-M1620-MPW2 @ 300 mm RT-M2518-MPW2 @ 470 mm RT-M3520-MPW2 @ 660 mm RT-M5028-MPW2 @ 940 mm	RT-VHF8MK @ 100 mm RT-VHF12.5MK @ 160 mm RT-VHF16MK @ 200 mm RT-FL-BC2518-9M @ 320 mm RT-FL-BC3518-9M @ 450 mm RT-FL-BC5024-9M @ 640 mm
200 to 300 mm	RT-H0514-MP2 @ 210 mm RT-M0824-MPW2 @ 340 mm RT-M1224-MPW2 @ 510 mm RT-M1620-MPW2 @ 680 mm	RT-H0514-MP2 @ 180 mm RT-M0824-MPW2 @ 290 mm RT-M1224-MPW2 @ 430 mm RT-M1620-MPW2 @ 580 mm RT-M2518-MPW2 @ 900 mm	RT-H0514-MP2 @ 160 mm RT-M0824-MPW2 @ 260 mm RT-M1224-MPW2 @ 390 mm RT-M1620-MPW2 @ 520 mm RT-M2518-MPW2 @ 810 mm	RT-H0514-MP2 @ 150 mm RT-M0824-MPW2 @ 230 mm RT-M1224-MPW2 @ 350 mm RT-M1620-MPW2 @ 460 mm RT-M2518-MPW2 @ 730 mm	RT-H0514-MP2 @ 120 mm RT-M0824-MPW2 @ 200 mm RT-M1224-MPW2 @ 300 mm RT-M1620-MPW2 @ 390 mm RT-M2518-MPW2 @ 620 mm RT-M3520-MPW2 @ 860 mm	RT-VHF8MK @ 130 mm RT-VHF12.5MK @ 210 mm RT-VHF16MK @ 270 mm RT-FL-BC2518-9M @ 420 mm RT-FL-BC3518-9M @ 580 mm RT-FL-BC5024-9M @ 830 mm
300 to 400 mm	RT-H0514-MP2 @ 320 mm RT-M0824-MPW2 @ 510 mm RT-M1224-MPW2 @ 760 mm	RT-H0514-MP2 @ 270 mm RT-M0824-MPW2 @ 430 mm RT-M1224-MPW2 @ 640 mm RT-M1620-MPW2 @ 860 mm	RT-H0514-MP2 @ 240 mm RT-M0824-MPW2 @ 380 mm RT-M1224-MPW2 @ 570 mm RT-M1620-MPW2 @ 770 mm	RT-H0514-MP2 @ 220 mm RT-M0824-MPW2 @ 340 mm RT-M1224-MPW2 @ 520 mm RT-M1620-MPW2 @ 690 mm	RT-H0514-MP2 @ 180 mm RT-M0824-MPW2 @ 290 mm RT-M1224-MPW2 @ 440 mm RT-M1620-MPW2 @ 580 mm RT-M2518-MPW2 @ 910 mm	RT-VHF8MK @ 200 mm RT-VHF12.5MK @ 310 mm RT-VHF16MK @ 390 mm RT-FL-BC2518-9M @ 610 mm RT-FL-BC3518-9M @ 860 mm
400 to 500 mm	RT-H0514-MP2 @ 420 mm RT-M0824-MPW2 @ 670 mm	RT-H0514-MP2 @ 360 mm RT-M0824-MPW2 @ 570 mm RT-M1224-MPW2 @ 850 mm	RT-H0514-MP2 @ 320 mm RT-M0824-MPW2 @ 510 mm RT-M1224-MPW2 @ 760 mm	RT-H0514-MP2 @ 290 mm RT-M0824-MPW2 @ 460 mm RT-M1224-MPW2 @ 690 mm RT-M1620-MPW2 @ 910 mm	RT-H0514-MP2 @ 240 mm RT-M0824-MPW2 @ 390 mm RT-M1224-MPW2 @ 580 mm RT-M1620-MPW2 @ 770 mm	RT-VHF8MK @ 260 mm RT-VHF12.5MK @ 400 mm RT-VHF16MK @ 520 mm RT-FL-BC2518-9M @ 810 mm
500 to 1000 mm	RT-H0514-MP2 @ 530 mm RT-M0824-MPW2 @ 840 mm	RT-H0514-MP2 @ 440 mm RT-M0824-MPW2 @ 710 mm	RT-H0514-MP2 @ 400 mm RT-M0824-MPW2 @ 630 mm RT-M1224-MPW2 @ 950 mm	RT-H0514-MP2 @ 360 mm RT-M0824-MPW2 @ 570 mm RT-M1224-MPW2 @ 850 mm	RT-H0514-MP2 @ 300 mm RT-M0824-MPW2 @ 480 mm RT-M1224-MPW2 @ 720 mm RT-M1620-MPW2 @ 960 mm	RT-VHF8MK @ 320 mm RT-VHF12.5MK @ 500 mm RT-VHF16MK @ 640 mm

SENSOR SIZE

SENSOR SIZE CHART
ENTOCENTRIC

1.2" - KAI4022/4021 21.5 mm diag 15.2 x 15.2 mm	4/3" - KAI-08050 22.6 mm diag 18.1 x 13.6 mm	Line - 2k 2k x 10 µm 20.48 mm	Line - 4k 4k x 7 µm 28.67 mm	Line - 8k 8k x 5 µm 40.96 mm	Full frame - 35mm w x h 36 x 24 mm	Line - 8k 8k x 7 µm 57.3 mm	Line -16k 16k x 3.5 µm 57.3 mm	Line - 2k 12k x 5 µm 61.4 mm	Line - 12k 12k x 5.2 µm 62.4 mm	Line - 16k 16k x 5.2 µm 81.9 mm
MC4K200X-**x**					MC12K200-**x**	RT-OPKE16-300M95	RT-OPKE16-300M95			
MC4K175X-**x** MC4K150X-**x**	MC4K200X-**x** MC4K175X-**x**	MC4K200X-**x**								
MC4K125X-**x**	MC4K150X-**x** MC4K125X-**x**	MC4K175X-**x** MC4K150X-**x**	MC4K200X-**x**							
MC4K100X-**x**	MC4K100X-**x**	MC4K125X-**x** MC4K100X-**x**	MC4K175X-**x** MC4K150X-**x**	MC12K200-**x** MC12K150-**x**	MC12K150-**x**	MC12K200-**x**	MC12K200-**x**	RT-OPKE16-300M95	RT-OPKE16-300M95	RT-OPKE16-300M95
MC4K075X-**x** MC4K050X-**x**	MC4K075X-**x**	MC4K075X-**x**	MC4K125X-**x** MC4K100X-**x**	MC4K075X-**x**	MC12K100-**x**	MC12K150-**x**	MC12K150-**x**	MC12K200-**x**	MC12K200-**x**	
MC4K050X-**x**	MC4K050X-**x**	MC4K050X-**x**	MC4K075X-**x**	MC12K100-**x**	MC12K100-**x**	MC12K067-**x**	MC12K067-**x**	MC12K150-**x**	MC12K150-**x**	RT-OPKE16-200M95
MC4K075X-**x**	MC4K075X-**x**	MC4K050X-**x**	MC12K100-**x**	MC12K067-**x**	MC12K067-**x** MC12K050-**x**	MC12K100-**x**	MC12K100-**x**	MC12K100-**x**	MC12K100-**x**	RT-OPKE16-150M95
MC4K025X-**x**	MC4K025X-**x**	MC4K025X-**x**	MC4K050X-**x**	MC12K050-**x**	MC12K050-**x**	MC12K067-**x**	MC12K067-**x**	MC12K067-**x**	MC12K067-**x**	RT-OPKE16-100M95
RT-FL-YFL3528 RT-FL-YFL5028A-02 RT-FL-YFL5028	RT-FL-YFL3528 RT-FL-YFL5028A-02 RT-FL-YFL5028	RT-FL-YFL5028A-035	MC4K025X-**x**	RT-FL-YFL5028A-02 RT-FL-YFL5028A-035	MC12K025-**x**	MC12K050-**x**	MC12K050-**x**	MC12K050-**x**	MC12K050-**x**	RT-OPKE16-070M95
RT-FL-YFL3528 RT-FL-YFL5028	RT-FL-YFL3528 RT-FL-YFL5028	RT-FL-YFL3528 RT-FL-YFL5028	RT-FL-YFL5028A-02	MC12K025-**x**	MC12K025-**x**	MC12K025-**x**	MC12K025-**x**	MC12K025-**x**	MC12K025-**x**	RT-OPKE16-050M95
RT-FL-YFL3528 RT-FL-YFL5028	RT-FL-YFL3528 RT-FL-YFL5028	RT-FL-YFL3528 RT-FL-YFL5028	RT-FL-YFL3528 RT-FL-YFL5028A-02 RT-FL-YFL5028	MC12K012-**x**	MC12K012-**x**	MC12K025-**x**	MC12K025-**x**	MC12K025-**x**	MC12K025-**x**	
RT-FL-YFL3528 RT-FL-YFL5028	RT-FL-YFL3528 RT-FL-YFL5028	RT-FL-YFL3528 RT-FL-YFL5028	RT-FL-YFL3528 RT-FL-YFL5028	MC12K012-**x**	MC12K012-**x** MC12K008-**x**					
RT-FL-YFL3528 RT-FL-YFL5028	RT-FL-YFL3528 RT-FL-YFL5028	RT-FL-YFL3528 RT-FL-YFL5028	RT-FL-YFL3528 RT-FL-YFL5028	MC12K008-**x**	MC12K008-**x**	MC12K012-**x**	MC12K012-**x**	MC12K012-**x**	MC12K012-**x**	
RT-FL-YFL3528 RT-FL-YFL5028	RT-FL-YFL3528 RT-FL-YFL5028	RT-FL-YFL3528 RT-FL-YFL5028	RT-FL-YFL3528 RT-FL-YFL5028	MC12K008-**x**	MC12K008-**x**	MC12K012-**x** MC12K008-**x**	MC12K012-**x** MC12K008-**x**	MC12K012-**x** MC12K008-**x**	MC12K012-**x** MC12K008-**x**	

LONGEST SIDE OF ILLUMINATED OBJECT	COLLIMATED		BACKLIGHT	BAR LIGHT	DOME
	Circular Beam	Linear Beam			
1 to 1.5 mm	LTCLHP023**x**-**x**		RT-BHDS-25X36-1-**x**-24V-FL LTBP048036-**x**	RT-LBRX-00-040-6-**x**-24V-FL LTBP048036-**x**	LTDMA1-**x**
1.5 to 2 mm	LTCLHP023**x**-**x**		RT-BHDS-25X36-1-**x**-24V-FL LTBP048036-**x**	RT-LBRX-00-040-6-**x**-24V-FL LTBP048036-**x**	LTDMA1-**x**
2 to 3 mm	LTCLHP023**x**-**x**		RT-BHDS-25X36-1-**x**-24V-FL LTBP048036-**x**	RT-LBRX-00-040-6-**x**-24V-FL LTBP048036-**x**	LTDMA1-**x**
3 to 4 mm	LTCLHP023**x**-**x**		RT-BHDS-25X36-1-**x**-24V-FL LTBP048036-**x**	RT-LBRX-00-040-6-**x**-24V-FL LTBP048036-x	LTDMA1-**x**
4 to 6 mm	LTCLHP023**x**-**x**		RT-BHDS-25X36-1-**x**-24V-FL LTBP048036-**x**	RT-LBRX-00-040-6-**x**-24V-FL LTBP048036-**x**	LTDMA1-**x**
6 to 8 mm	LTCLHP023**x**-**x**		RT-BHDS-25X36-1-**x**-24V-FL LTBP048036-**x**	RT-LBRX-00-040-6-**x**-24V-FL LTBP048036-**x**	LTDMA1-**x**
8 to 11 mm	LTCLHP023**x**-**x**		RT-BHDS-25X36-1-**x**-24V-FL LTBP048036-**x**	RT-LBRX-00-040-6-**x**-24V-FL LTBP048036-**x**	LTDMA1-**x**
11 to 15 mm	LTCLHP016-**x**		RT-BHDS-25X36-1-**x**-24V-FL LTBP048036-**x**	RT-LBRX-00-040-6-**x**-24V-FL LTBP048036-**x**	LTDMA1-**x**
15 to 20 mm	LTCLHP024-**x**		RT-BHDS-25X36-1-**x**-24V-FL LTBP048036-**x**	RT-LBRX-00-040-6-**x**-24V-FL LTBP048036-**x**	LTDMA1-**x**
20 to 30 mm	LTCLHP036-**x** LTCLCR036-**x**		RT-BHDS-31X58-1-**x**-24V-FL LTBC054054-**x** LTBP048036-**x**	RT-LBRX-00-040-6-**x**-24V-FL LTBP048036-**x**	LTDMA1-**x**
30 to 40 mm	LTCLHP036-**x** LTCLCR036-**x**		RT-BHDS-31X58-1-**x**-24V-FL LTBC054054-**x** LTBP048036-**x**	RT-LBRX-00-040-6-**x**-24V-FL LTBP048036-**x**	LTDMA1-**x**
40 to 50 mm	LTCLHP048-**x** LTCLCR048-**x**		RT-BHDS-31X58-1-**x**-24V-FL LTBC054054-**x** LTBP096072-**x**	RT-LBRX-00-080-6-**x**-24V-FL LTBP096036-**x**	LTDMB2-**x**
50 to 70 mm	LTCLHP056-**x** LTCLCR056-**x** LTCLHP064-**x** LTCLCR064-**x**	LTCL4K060-**x**	LTBC114114-**x** RT-BHD-00-070-1-**x**-24V-FL RT-BHDS-00-070-1-**x**-24V-FL LTBP096072-x	RT-LBRX-00-080-6-**x**-24V-FL LTBP096036-**x**	LTDMB2-**x** LTDMCX-**x**
70 to 100 mm	LTCLHP080-**x** LTCLCR080-**x** LTCLHP096-**x** LTCLCR096-**x**	LTCL4K090-**x**	LTBC114114-**x** RT-BHD-00-100-1-**x**-24V-FL LTBP144108-**x**	RT-LBRX-00-080-6-**x**-24V-FL RT-LBRX-00-120-6-**x**-24V-FL LTBP144036-**x**	LTDMCX-**x**
100 to 150 mm	LTCLHP120-**x** LTCLHP144-**x**	LTCL4K120-**x** LTCL4K180-**x**	LTBC114114-**x** LTBC174174-**x** LTBP192180-**x**	RT-LBRX-00-120-6-**x**-24V-FL RT-LBRX-00-160-6-**x**-24V-FL LTBP192036-**x**	RT-IDS4-00-150-2-**x**-24V-FL RT-IDS4-00-200-2-**x**-24V-FL
150 to 200 mm	LTCLHP192-**x**	LTCL4K180-**x**	LTBC174174-**x** LTBC234234-**x** LTBP240216-**x**	RT-LBRX-00-200-6-**x**-24V-FL LTBP240036-**x**	RT-IDS4-00-200-2-**x**-24V-FL RT-IDS4-00-250-2-**x**-24V-FL
200 to 300 mm	LTCLHP240-**x**		LTBC234234-**x** LTBP288216-**x**	LTBP288036-**x**	RT-IDS4-00-250-2-**x**-24V-FL

SELECTION CHART
ILLUMINATORS

RINGLIGHT				COMBINED	TUNNEL	COAXIAL
Low Angle		Normal Angle				
Diffused	Direct	Diffused	Direct			
RT-DLR2-60-050-2-x-24V-FL LTLAB2-x		LTRN023xx		LTVTBENCH		RT-CAS2-00-025-x-x-24V-FL
RT-DLR2-60-050-2-x-24V-FL LTLAB2-x		LTRN023xx		LTVTBENCH		RT-CAS2-00-025-x-x-24V-FL
RT-DLR2-60-050-2-x-24V-FL LTLAB2-x		LTRN023xx		LTVTBENCH		RT-CAS2-00-025-x-x-24V-FL
RT-DLR2-60-050-2-x-24V-FL LTLAB2-x		LTRN023xx		LTVTBENCH		RT-CAS2-00-025-x-x-24V-FL
RT-DLR2-60-050-2-x-24V-FL LTLAB2-x		LTRN023xx		LTVTBENCH		RT-CAS2-00-025-x-x-24V-FL
RT-DLR2-60-050-2-x-24V-FL LTLAB2-x		LTRN023xx	RT-LSW-15-050-2-x-24V-FL	LTVTBENCH		RT-CAS2-00-025-x-x-24V-FL
RT-DLR2-60-050-2-x-24V-FL LTLAB2-x	RT-LSW-45-070-3-x-24V-FL	LTRN016xx	RT-LSW-15-050-2-x-24V-FL	LTVTBENCH LTDMLAB2-WW	RT-IDT2-00-150-1-x-24V-FL	RT-CAS2-00-025-x-x-24V-FL
RT-DLR2-60-050-2-x-24V-FL LTLAB2-x	RT-LSW-45-070-3-x-24V-FL	LTRN016xx	RT-LSW-15-050-2-x-24V-FL	LTVTBENCH LTDMLAB2-WW	RT-IDT2-00-150-1-x-24V-FL	RT-CAS2-00-025-x-x-24V-FL
RT-DLR2-60-050-2-x-24V-FL LTRN050x45 LTLAB2-x	RT-LSW-45-070-3-x-24V-FL	LTRN024xx	RT-LSW-15-050-2-x-24V-FL	LTVTBENCH LTDMLAB2-WW	RT-IDT2-00-150-1-x-24V-FL	RT-CAS2-00-025-x-x-24V-FL
RT-DLR2-60-050-2-x-24V-FL LTRN050x45 LTRN075x45 LTLAB2-x	RT-LSW-45-070-3-x-24V-FL	LTRN036xx	RT-LSW-15-050-2-x-24V-FL	LTVTBENCH LTDMLAB2-WW	RT-IDT2-00-150-1-x-24V-FL	RT-CAS2-00-025-x-x-24V-FL
RT-DLR2-60-050-2-x-24V-FL LTRN075x45 LTLAB2-x	RT-LSW-45-070-3-x-24V-FL	LTRN036xx LTRN048xx	RT-LSW-15-050-2-x-24V-FL	LTVTBENCH LTDMLAB2-WW	RT-IDT2-00-150-1-x-24V-FL	RT-CAS2-00-040-x-x-24V-FL
RT-DLR2-60-070-2-x-24V-FL LTRN165x45 LTRN165x20 LTLAB2-x	RT-LSW-45-070-3-x-24V-FL	LTRN048xx LTRN056xx	RT-LSW-15-050-2-x-24V-FL RT-LSW-15-070-3-x-24V-FL	LTDMLAB2-WW	RT-IDT2-00-150-1-x-24V-FL	RT-CAS2-00-040-x-x-24V-FL
RT-DLR2-60-070-2-x-24V-FL RT-DLR2-60-100-2-x-24V-FL LTRN165x45 LTRN165x20 LTRN245x35 LTRN245x45 LTLACX-x	RT-LLA-75-130-3-x-24V-FL RT-LSW-45-100-3-x-24V-FL	LTRN064xx LTRN080xx	RT-LSW-15-070-3-x-24V-FL RT-LSW-15-100-5-x-24V-FL	LTDMLAB2-WW LTDMLACx-WW	RT-IDT2-00-150-1-x-24V-FL	RT-CAS2-00-070-x-x-24V-FL
RT-DLR2-60-100-2-x-24V-FL RT-DLR2-60-120-2-x-24V-FL LTRN165x20 LTRN245x25 LTLACX-x	RT-LLA-75-130-3-x-24V-FL RT-LSW-45-100-5-x-24V-FL	LTRN096xx LTRN120xx	RT-LSW-15-100-5-x-24V-FL	LTDMLACx-WW	RT-IDT2-00-150-1-x-24V-FL	RT-CAS2-00-100-x-x-24V-FL
RT-DLR2-60-120-2-x-24V-FL	RT-LLA-75-130-3-x-24V-FL RT-LLA-75-170-3-x-24V-FL	LTRN120xx LTRN144xx			RT-IDT2-00-200-1-x-24V-FL	
	RT-LLA-75-170-3-x-24V-FL					

Opto Engineering

Notes

Tools and resources

Extended documentation is available on our website, localized in nine languages. For every part number you will find full specifications, product compatibilities, 2D and 3D models in the most popular CAD formats.

Interactive tools such as the **TC selection form** and the **telecentric/ entocentric sensor charts** provide an essential aid in navigating our product range.

Moreover, we regularly publish papers and video guides about Opto Engineering products and technologies as well as broader machine vision optics tutorials.

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