

OPTO ENGINEERING

OPTICAL IMAGING TECHNOLOGIES



OPTICS



LIGHTING



CAMERAS



SOFTWARE



ACCESSORIES



AI VISION UNITS



KITS

Opto Engineering[®]

your machine vision application partner

FIND OUT WHAT WE CAN OFFER YOU

- ✓ Vision Experts at your service
- ✓ Feasibility studies performed by our experts directly on your samples
- ✓ A wide selection of innovative machine vision components
- ✓ The best performing components and software to solve metrology applications

WE OFFER IMAGING SOLUTIONS FOR EVERY BUSINESS



Go to [OPTO-E.COM/industries-applications](https://www.opto-e.com/industries-applications) to find examples of successful quality control approaches in food & beverage, pharmaceutical/medical and many other industry sectors.

EXTENSIVE PRODUCT DOCUMENTATION

Our website includes detail product documentation for every part number.

MACHINE VISION EXPERTS

Go to [opto-e.com/basics](https://www.opto-e.com/basics) to find a comprehensive introduction to the main concepts of Machine Vision.



FREE DEMO UNITS

Our subsidiaries are stocked with products specifically set aside to be used for feasibility studies.

In case you need to test our products directly at your site, contact us and we will do our best to make sure you can receive all the demo products you need for your test.

MORE THAN 2400 PRODUCTS AVAILABLE



FEASIBILITY TESTS IN OUR LABORATORIES

Send us your test parts and describe your vision challenge: our technical team has years of experience and can easily test a wide range of products in our fully equipped laboratories and select the best fit for your specific application.



WHO WE ARE

OPTO ENGINEERING® designs, manufactures and markets imaging components.

Our expertise in developing innovative optical systems has earned us worldwide recognition as a supplier of unmatched optical solutions.

OPTO ENGINEERING® is the world leader in telecentric technology as well as the creator of many other optical products which helped our customers solve machine vision applications once considered impossible.

Over the years, our expertise has expanded to other technologies; today Opto Engineering® is also a primary supplier of advanced LED illuminators, imaging software, cameras and artificial intelligence units.

While we transform our know-how and ideas into added-value products and services for our customers, we stay true to our “Optics DNA”: our constant drive is to deliver increasingly more advanced

OPTICAL IMAGING TECHNOLOGIES.

Opto Engineering® is a global organization highly efficient in all the areas of business management, spanning across HR, finance, logistics, marketing, communication, IT and product development.

WE ARE CERTIFIED



ASSOCIATIONS WE SUPPORT





CLOSE TO YOU WORLDWIDE

We are a fast growing company fostered by people of excellence, with a strong focus on the unique requirements of each local market; this allows us to understand our customer's needs and achieve sustainable growth.

Opto Engineering® continuously strives to improve the quality of its operations and the wellness of its employees.

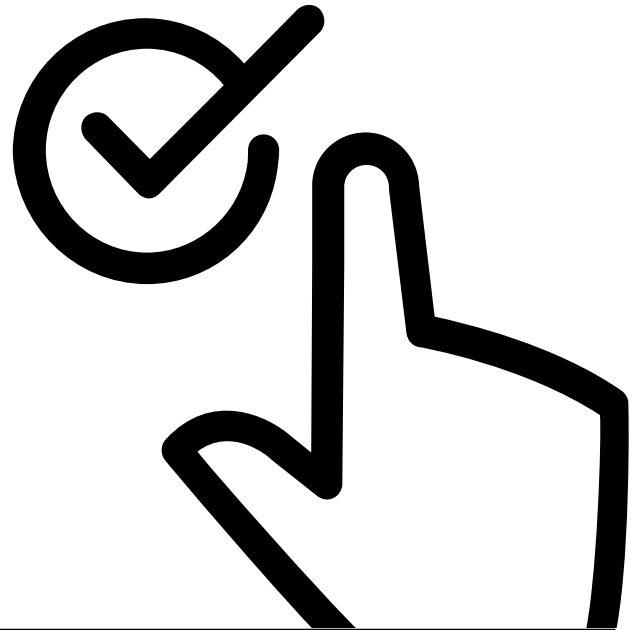


TOOLS AND RESOURCES

Extended documentation is available on our website. 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 **Imaging lens selector** and the **Camera finder** 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.



OPTO-E.COM

Get the right product, right from the start

This section includes several tools to help you select the most suitable Opto Engineering® products for your application.



www.opto-e.com

TRAINING CLASSES

EXPERIENCE THE EXPERTISE
WITH OPTO ENGINEERING®



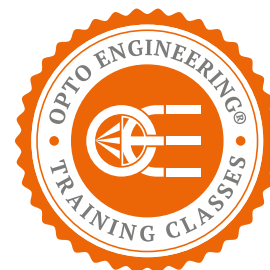
Opto Engineering® has great experience in providing educational contents.

We have a **BASICS** section available on the website, which contains dozens of free pages dedicated to many different topics of machine vision, from optics to cameras, from illumination to image processing.

We organized the **EXE events**, a series of roadshows which brought together Opto Engineering® and its customers in various locations of the world for a day full of live demonstrations, technical speeches and many new product presentations.

We are now finally sharing our expertise in products, applications and technical contents with you through our online and on-site training classes and thanks to the experience of our internal trainers.

Talk to your Area Manager to discover more about our training classes:
Experience the Expertise with Opto Engineering® !



Grünwald, Germany



Penang, Malaysia



Suzhou, China



Boston, USA



Neuchâtel, Switzerland



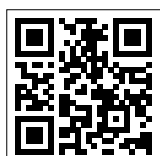
Cologne, Germany



Budapest, Hungary



Versailles, France



*Check the latest news about the training classes calendar and registration directly **on our website.***




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OPTICS



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LIGHTING



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ACCESSORIES



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AI VISION UNITS



280
KITS



SELECTION CHARTS
291



UP TO 2/3" SENSORS

CLASSIC LENSES

- 20 TC series**
Bi-telecentric lenses for sensors up to 2/3" Mag. 0.025-2 x
- 22 TCLWD series**
132 mm working distance telecentric lenses for sensors up to 2/3" Mag. 0.5-3.5 x
- 23 TCHM series**
High magnification telecentric lenses for sensors up to 2/3" * RT
Mag. 1-6 x
- 23 TCVLWD series**
Long working distance telecentric lenses for sensors up to 1/1.8" * RT
Mag. 0.5-3 x

COMPACT LENSES

- 24 TC CORE series**
Compact bi-telecentric lenses for sensors up to 2/3" Mag. 0.052-0.184 x
- 28 TC CORE PLUS series**
Compact large-FOV bi-telecentric lenses for sensors up to 2/3" NEW MODELS
Mag. 0.027-0.059 x

COAXIAL LENSES

- 32 TCCX series**
132 mm working distance coaxial telecentric lenses for sensors up to 2/3" Mag. 0.5-3 x
- 34 TCCXHM series**
High magnification coaxial telecentric lenses for sensors up to 2/3" * RT
Mag. 1-6 x
- 34 TCCXLM series**
Coaxial telecentric lenses for sensors up to 2/3" * RT
Mag. 0.2-0.4 x
- 35 TCCXQ series**
Coaxial telecentric assemblies for sensors up to 2/3" Mag. 0.11-1.5 x

UP TO 4/3" SENSORS

CLASSIC LENSES

- 36 TC1MHR-TC4MHR series**
Telecentric lenses for sensors up to 4/3" Mag. 0.045-4 x

COMPACT LENSES

- 40 TC1MHR-TC4MHR CORE series**
Compact telecentric lenses for sensors up to 4/3" Mag. 0.087-0.369 x
- 44 TC3MHR-TC5MHR CORE PLUS series**
Compact large-FOV telecentric lenses for sensors up to 4/3" NEW MODELS
Mag. 0.053-0.117 x

OPTICS PARAMETERS

Mag. Magnification range (x)

FL Focal length (mm)

COAXIAL LENSES

- 46 TCCX2M series**
Coaxial telecentric lenses for sensors up to 1" * RT
Mag. 0.3-4 x

VERY LARGE & LINE SCAN SENSORS

CLASSIC LENSES

- 47 TC12M series**
Telecentric lenses for sensors up to APS-H and 4k line scan cameras NEW MODELS
Mag. 0.115-1.918 x
- 48 TC16M series**
Telecentric lenses for sensors up to 43.3 mm and 8k line scan cameras Mag. 0.15-4 x
- 50 TC12K series**
Telecentric lenses for sensors up to 62 mm and 12k line scan cameras Mag. 0.26-0.96 x

FLAT LENSES

- 52 TC4K series**
Flat telecentric lenses for 4k line scan cameras Mag. 0.159-0.478 x

SPECIALTIES

FOCUS TUNABLE LENSES

- 54 TCEL series**
Telecentric optics with liquid lenses technology NEW
Mag. 0.25-3.5 x

MULTI-MAG LENSES

- 56 TCDP PLUS series**
Dual magnification telecentric lenses
- 60 TCZRS series**
Bi-telecentric zoom lenses with motorized control

OPTICAL BENCHES

- 62 TCBENCH series**
Telecentric optical benches for precision measurements Mag. 0.093-1 x
- 64 TCBENCH CORE series**
Compact telecentric optical benches for precision measurements Mag. 0.093-0.184 x
- 66 TCEDGEVIS**
Telecentric system for defect detection on flat transparent materials Mag. 0.093-0.243 x

UV LENSES

- 68 TCUV series**
UV bi-telecentric lenses Mag. 0.11-0.175 x

3D LENSES

- 70 TCSM series**
3D bi-telecentric lenses with Scheimpflug adjustment

UP TO 2/3" SENSORS

FIXED FOCAL LENGTH LENSES

- 74 EN2MP series**
Cost-effective 2 Megapixel fixed focal length lenses for sensors up to 2/3" FL 8-75 mm
- 75 EN-2RT series**
2 Megapixel fixed focal length lenses for sensors up to 2/3" FL 5-75 mm * RT
- 76 EN5MP series**
Cost-effective 5 Megapixel fixed focal length lenses for sensors up to 2/3" FL 8-75 mm
- 77 EN-5RT series**
5 Megapixel fixed focal length lenses for sensors up to 2/3" FL 8-50 mm * RT

MACRO LENSES

- 78 MC series**
Zero distortion macro lenses for sensors up to 2/3" Mag. 0.3-3 x

FROM 1" TO APS-C SENSORS

FIXED FOCAL LENGTH LENSES

- 79 EN8MP series**
8 Megapixel fixed focal length lenses for sensors up to 1" FL 8-50 mm
- 80 EN-9RT series**
9 Megapixel fixed focal length lenses for sensors up to 1" FL 8-75 mm * RT
- 80 EN-10RT series**
10 Megapixel fixed focal length lenses for sensors up to 1.1" FL 8-50 mm * RT
- 81 EN10MP series**
10 Megapixel fixed focal length lenses for sensors up to 4/3" FL 12-50 mm
- 81 EN-A5MX series**
5 Megapixel fixed focal length lenses for sensors up to 4/3" FL 12-35 mm * RT

MACRO LENSES

- 82 MC4K series**
Macro lenses for 4k line scan cameras and APS-C sensors Mag. 0.25-2 x

VERY LARGE & LINE SCAN SENSORS

FIXED FOCAL LENGTH LENSES

- 84 EN-MAX series**
Fixed focal length lenses for APS-H, Full Frame and up to 43 mm sensors FL 24-50 mm * RT

MACRO LENSES

- 85 MC12K series**
Macro lenses for 16k line scan cameras and sensors up to 62 mm Mag. 0.08-2 x
- 87 MC16K series**
Macro lenses for 16k line scan cameras and sensors up to 82 mm Mag. 0.50-3 x * RT

ZOOM AND VARIABLE MAGNIFICATION

FIXED FOCAL LENGTH LENSES

- 87 ENVF series**
Varifocal lenses for sensors up to 2/3" FL 12-36 mm

MACRO LENSES

- 88 MC3-03X series**
Zero distortion multi-configuration macro lens Mag. 0.10-3 x
- 90 MCSM1-01X series**
Variable macro lens with Scheimpflug adjustment Mag. 0.25-2 x
- 92 MCZM series**
Macro zoom lenses for sensors up to 2/3" Mag. 0.30-1 x * RT

OUTER INSPECTION LENSES

- 94 PC series**
Pericentric lenses for 360° top and lateral view with just one camera
- 98 PCCD series**
Catadioptric lenses for 360° top and lateral view with just one camera

INNER INSPECTION LENSES

- 100 PCHI series**
Hole inspection lenses for 360° inside view in perfect focus NEW MODELS
- 102 PCBP series**
Boroscopic probes for panoramic cavity imaging and measurement from inside NEW MODELS

* RT see page 15 for description

MULTI-VIEW LENSES

- 104 PCPW series**
Polyview optics for multiple side views
in one image _____
- 106 PCMP series**
Micro-polyview optics for 3D measurement
and imaging of small parts _____
- 108 TCCAGE series**
Bi-telecentric system for multiple side imaging
and measurement at 90° _____ **NEW MODELS**

110

Infrared & UV lenses

SHORT WAVE INFRARED LENSES

- 111 SWIR series**
SWIR fixed focal length lenses for InGaAs sensors
up to 21 mm _____ **FL 35 -75 mm**
- 111 ENSWIRMP series** * RT
SWIR fixed focal length lenses up to 2/3" sensors _____ **FL 16 -50 mm**

MEDIUM WAVE INFRARED LENSES

- 112 MWIR series**
MWIR fixed focal length lenses for InSb sensors
up to 21 mm _____ **FL 35 -100 mm**

LONG WAVE INFRARED LENSES

- 112 LWIR series**
LWIR fixed focal length lenses for uncooled sensors
up to 21 mm _____ **FL 8 -75 mm**

ULTRA VIOLET LENSES

- 113 ENUV2M series** * RT
UV fixed focal length lenses for sensors up to 1" _____ **FL 25 -78 mm**

116

LED illuminators



BACKLIGHTS

- 118 LT2BC series** **NEW MODELS**
High uniformity continuous LED backlights _____ **COLL/DIFF**
- 120 LTBP series** **NEW MODELS**
High power strobed LED backlights _____ **H COLL/DIFF**
- 124 LTBC series**
Continuous LED backlights _____ **DIFF**
- 126 LTBFC series**
Continuous flat side-emitting LED backlights _____ **DIFF**

TELECENTRIC LIGHTS

- 128 LTCLHP series**
High-performance telecentric illuminators _____ **COLL**
- 130 LTCLHP CORE series**
Compact telecentric illuminators _____ **COLL**
- 134 LTCLHP CORE PLUS series** **NEW MODELS**
Compact telecentric illuminators
for large FOV systems _____ **COLL**
- 136 LTCL4K series**
Flat telecentric illuminators
for line scan cameras _____ **COLL**

RING LIGHTS

- 138 LTRNST series**
LED ring illuminators - straight type _____ **α 0° DIFF**
- 140 LTRNDC series**
Continuous LED direct ring lights _____ **α 0°, 15°, 30°, 45° DIR**
- 142 LTLA series**
High power strobe LED low angle
diffused ring lights _____ **H α 60° DIFF**
- 144 LTLAIC series**
Continuous LED low angle diffused ring lights _____ **α 60° DIFF**
- 146 LTLADC series**
Continuous LED low angle direct ring lights _____ **α 75° DIR**
- 148 LTRNOB series**
LED ring illuminators - oblique type _____ **DIFF**
- 150 LTRNOBHP series**
High power LED ring illuminators - oblique type _____ **H DIFF**

LIGHTING TYPES

- COLL** Collimated **IND** Indirect
- DIFF** Diffused **FOC** Focused
- DIR** Direct

DOME LIGHTS

- 152 LTDMC series** NEW MODELS
Continuous LED domes IND
- 154 LTDM series**
High power strobe LED domes H IND
- 156 LTDMLA series**
High power strobe dome
+ low angle illumination systems H IND

BAR LIGHTS

- 158 LTBRZ3 series** NEW
LED bar lights with integrated driving electronics DIR
- 160 LTBRDC series**
Continuous LED bar lights DIR

COAXIAL LIGHTS

- 162 LTCXC series**
Continuous LED coaxial lights DIFF

TUNNEL LIGHTS

- 164 LTTNC series**
Continuous LED tunnel lights IND

LINE LIGHTS

- 166 LTLNC series** NEW MODELS
Continuous LED line lights FOC
- 168 LTLNM series**
Flicker free high power focused modular
LED line lights H FOC/COLL
- 170 LTLNE series**
High power enhanced LED line lights H FOC/COLL

SPECIALTIES

- 172 View-through system**
Space-saving illumination system
for double-side object inspection DIFF/IND
- 174 UV series** NEW
UV illuminators with different geometry

LIGHTING PARAMETERS

H High power: suggested for high speed applications

α Light angle (°)

175

LED pattern projectors

- 176 LTPR series**
LED pattern projectors
- 182 LTPRSMHP3W series**
3W tilting LED pattern projectors

188

Area scan cameras



GIGE VISION CAMERAS UP TO 12 MP

- 190 COE-G series**
GenICam® PoE C-mount cameras 1/2.9" - 1.1" 313 fps
- 192 mvBlueCOUGAR series** * RT
GigE / Dual GigE cameras
with Smart Features 1/3" - 1.1" 436.9 fps

USB3 VISION CAMERAS UP TO 12 MP

- 194 COE-U series**
GenICam® C-mount USB3 cameras 1/2.5" - 1.1" 210 fps
- 196 mvBlueFOX3-2 series** * RT
USB3 cameras
with Smart Features 1/2.9" - 1.1" 436.9 fps

HIGH RESOLUTION CAMERAS FROM 17 TO 71 MP

- 198 COE HR AS-X series**
20 - 26 MP area scan cameras 1" - APS-H 40 fps
- 200 COE HR AS series**
50 - 71 MP area scan cameras 35 mm 27.3 fps
- 202 mvHR series** NEW * RT
17 - 31 MP area scan cameras 4/3" - APS-C 90.1 fps

204

Customized machine vision cameras

206

Line scan cameras

- 207 COE HR LS series**
8k/16k line scan cameras 57.3 mm 77 kfps

CAMERAS PARAMETERS

Sensor format

Frame/line rate, up to

* RT see page 15 for description

210 Machine vision software



- 210 FabImage® Studio Professional**
Software for Machine Vision Engineers _____
- 214 Horus**
Windows OS desktop application for optical measurement _____ **NEW**

217 Machine vision libraries

- 217 FabImage® Library Suite**
Machine Vision Library for C++ and .NET _____
- 220 TCLIB Suite**
Software library and stand-alone tools for the optimization of telecentric setups _____
- 224 360LIB Suite**
Software library and stand-alone tools for the optimization of 360° optics setups _____

228 Optical filters for lenses



- 228 Optical filters**
Filters for telecentric lenses and fixed focal length lenses _____

231 Windows, mirrors & beamsplitters

- 231 CMBS series**
45° beam splitters _____
- 233 CMMR series**
45° first surface mirrors _____
- 237 WI series**
Protective windows for lenses _____
- 238 Flat optics**
Customized protective windows and mirrors _____

239 Diffusing & polarizing plates for lighting

- 239 DFLT series**
Diffusion plates for lighting _____ **NEW**
- 240 PLLT series**
Polarizing plates for lighting _____ **NEW**

* RT see page 15 for description

241 Calibration & resolution patterns

- 241 PTTC, PTCP series**
Accurate calibration patterns for machine vision _____ **NEW MODELS**
- 242 RC series**
Resolution and calibration targets _____ * RT

243 Projection patterns

- 243 PTPR series**
Projection patterns for LED projectors _____

246 Mounting mechanics

- 246 CMT series**
Precision alignment mechanics for lenses _____ **NEW**
- 248 CMHO series**
Clamping mechanics for lenses _____
- 249 CMHOCR series**
Clamping mechanics for CORE lenses _____
- 249 CMPH series**
Holders for calibration patterns _____
- 250 CMPT series**
Mounting plates for optical benches _____
- 250 CMPTCR series**
Mounting plates for CORE optical benches _____
- 251 CMLT series**
Mounting brackets for lighting _____ **NEW MODELS**

252 LED controllers

- 252 LTDV series**
LED lighting strobe controllers _____ **NEW MODELS**
- 256 LTIC series**
LED lighting controllers _____

258 LED sources & replacements

- 258 LTSCHP series**
High-performance replacement LED modules _____
- 258 LDSC series**
LED sources _____ * RT

259

Lens controllers

- 259 MTDV series**
Motion controller for bipolar stepper motors
with additional encoder input _____
- 261 ELDV series**
Controllers for liquid lens modules _____ **NEW**

262

Power supplies

- 262 PS series**
Power supplies _____ *** RT**

264

Cables

- 264 CB series**
Cables _____ *** RT**
- 265 ADPT001**
Adapter RS485-USB + cable with 3 elements
for LTDV6CH connection _____

266

AI Vision units



- 268 PENSO®**
The artificial intelligence-based vision unit _____
- 274 ALBERT**
Self-learning vision system based on artificial intelligence _____

280

KITS



- 282 OEMV STARTER KIT**
Machine vision starter kit for beginners _____ **NEW**
- 284 OEMV LAB KIT**
Machine vision advanced kit for experts _____ **NEW**
- 286 TCKIT case**
Telecentric optics selection for machine vision labs _____
- 287 LTPKIT-A**
Starter high power LED lighting kit, A version _____ **NEW**
- 288 LTPKIT**
High power lighting kit _____
- 289 LTKITRY-FH-OR-V1**
Continuous lighting kit _____
- 290 PENSO® KIT case**
Artificial Intelligence for machine vision - starter kit _____

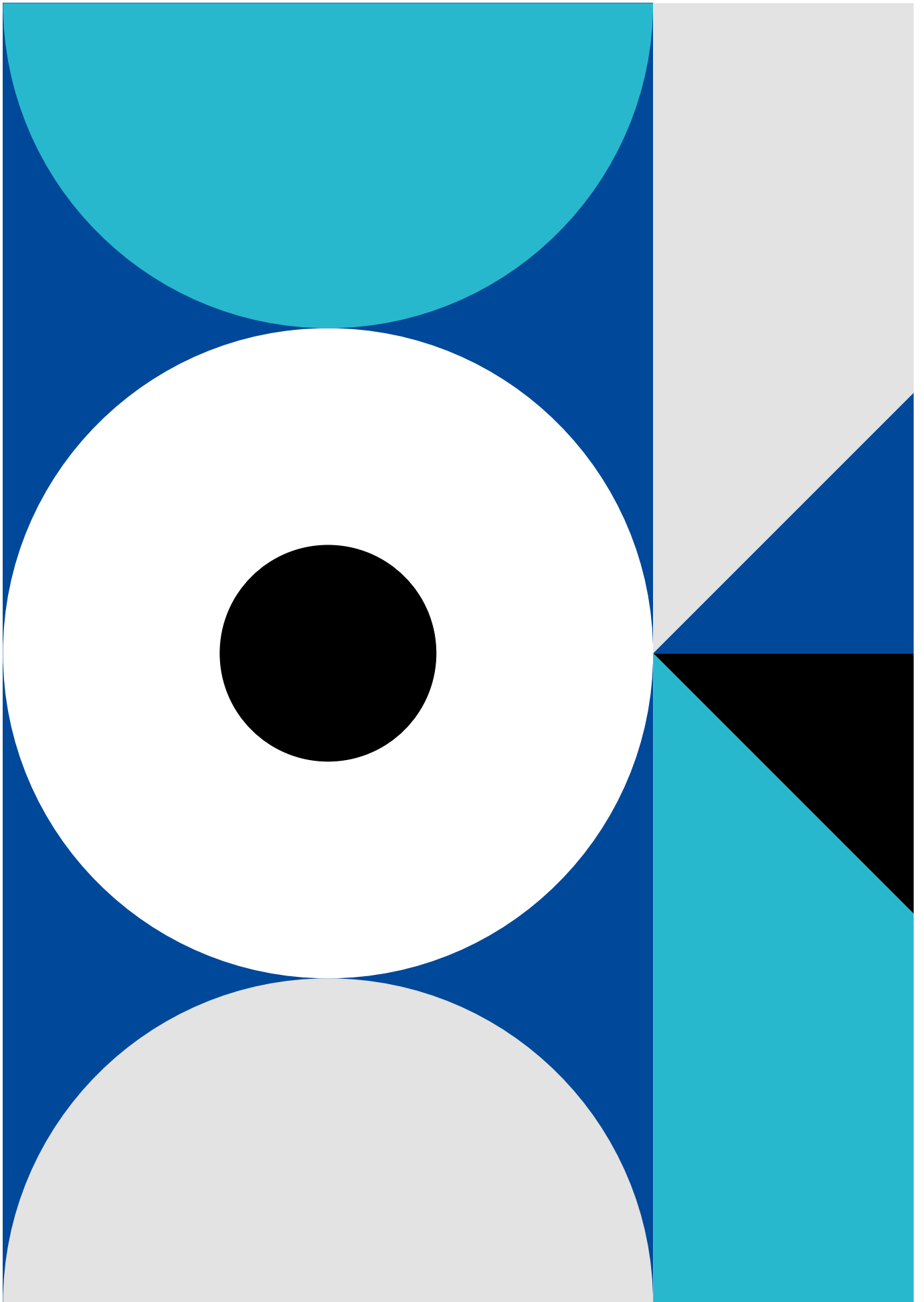
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Selection Charts

- 292 TELECENTRIC LENSES SELECTION CHART** _____
- 296 MACRO LENSES SELECTION CHART** _____
- 298 FIXED FOCAL LENGTH LENSES SELECTION CHART** _____
- 300 LED ILLUMINATORS SELECTION CHART** _____
- 302 LED LINE LIGHTS SELECTION CHART** _____

* RT Products

In order to meet all of 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 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



Selecting the correct machine vision lens is paramount to obtain high quality image for a correct and efficient following processing. Though the result also depends on the camera resolution and pixel size, a lens is in many cases the steppingstone to build a machine vision system, therefore our motto at Opto Engineering® is “OPTICS FIRST”.

Telecentric lenses are employed for demanding machine vision tasks, such as precision measurement, where low distortion is required or when perspective errors must be avoided. Opto Engineering® offers an extensive portfolio of precision telecentric optics to answer all your needs: from standard to high resolution and line scan, from classic designs to compact and flat ones. Moreover, a wide range of magnifications and working distances is available, not to mention all our specialties including telecentric optics with liquid lenses, optical benches, multi-mag lenses and more.

360° View lenses by Opto Engineering® are uniquely designed lenses allowing you to reduce the number of components in a vision system. They offer a smart approach to solving machine vision tasks and have become a standard in many industries.

Macro lenses are employed for close range applications where high precision is required, while fixed focal length lenses are general purpose products, suitable for a wide variety of machine vision tasks: Opto Engineering® offers a wide range of macro and fixed focal length lenses to answer all your needs.

Telecentric lenses **18**

Macro & Fixed focal length lenses **72**

360° View lenses **93**

Infrared & UV lenses **110**

Telecentric lenses

Outstanding optical performance.
Unmatched customer service.

Telecentric lenses represent the core business for Opto Engineering®: these products benefit from two decades of effort in progressive Research & Development, resulting in a wide range of part numbers for a diverse and ever-growing number of applications.

To help you navigate our extensive portfolio and select the perfect optics we have devised the following classification:

- **Classic lenses** - standard industrial design
- **Compact lenses** - optimized to reduce the footprint of vision systems
- **Coaxial lenses** - featuring an integrated coaxial illumination
- **Flat lenses** - special design for line scan applications
- **Multi-mag lenses** - lenses with multiple magnifications for maximum flexibility
- **Optical benches** - pre-assembled optical bundles
- **Specialties** - telecentric optics with liquid lenses, UV lenses and other specialties



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

UP TO 2/3" SENSORS	20 - 35
<i>CLASSIC LENSES</i>	20 - 23
<i>COMPACT LENSES</i>	24 - 31
<i>COAXIAL LENSES</i>	32 - 35

UP TO 4/3" SENSORS	36 - 46
<i>CLASSIC LENSES</i>	36 - 39
<i>COMPACT LENSES</i>	40 - 45
<i>COAXIAL LENSES</i>	46

VERY LARGE & LINE SCAN SENSORS	47 - 53
<i>CLASSIC LENSES</i>	47 - 51
<i>FLAT LENSES</i>	52 - 53

SPECIALTIES	54 - 71
<i>FOCUS TUNABLE LENSES</i>	54 - 55
<i>MULTI-MAG LENSES</i>	56 - 61
<i>OPTICAL BENCHES</i>	62 - 67
<i>UV LENSES</i>	68 - 69
<i>3D LENSES</i>	70 - 71

OPTICS PARAMETER

Mag. Magnification range (x)



TC series

Bi-telecentric lenses for sensors up to 2/3"

Mag. 0.025-2 x



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 sensors such as 5 MP - 2/3", acquiring images with exceptional fidelity and precision.

The Opto Engineering® bi-telecentric design makes these optics truly telecentric: no magnification change occurs when an object is moved closer to or away from the lens, 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 performance in terms of telecentricity and 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 required.

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.

NEW

Camera phase adjustment available on selected models for easy and hassle-free integration.

FOR HIGHER MAGNIFICATION LENSES SEE ALSO	
	TCHM series p. 23
FULL RANGE OF COMPATIBLE ILLUMINATORS	
	LTCLHP CORE, LTCLHP, LTCLHP CORE PLUS series p. 128-135
FULL RANGE OF COMPATIBLE ACCESSORIES	
	Mounting mechanics p. 246-251
FULL RANGE OF COMPATIBLE CAMERAS	
	Area scan cameras p. 188-203



Part number	Detector type			Optical specifications							Mechanical specifications				
	Mag. (x)	Max sensor size	1/3"	1/2"	2/3" - 5 MP	WD (mm)	wF/#	Telecentricity typical (max) (deg)	Distortion typical (max) (%)	Field depth (mm)	CTF @70lp/mm (%)	Mount	Phase adj. availability	Length (mm)	Diam. (mm)
			6.0 mm diag w x h (mm x mm)	8.0 mm diag w x h (mm x mm)	11.1 mm diag w x h (mm x mm)										
Object field of view (mm x mm) 6															
TC 23 004	2.000	2/3"	2.40 x 1.80	3.20 x 2.40	4.25 x 3.55	56.0	11	< 0.08 (0.10)	< 0.04 (0.08)	0.2	> 30	C	No	101.4	28
TC 23 007	1.333	2/3"	3.60 x 2.70	4.80 x 3.60	6.38 x 5.32	60.1	11	< 0.08 (0.10)	< 0.03 (0.08)	0.5	> 30	C	No	78.5	28
TC 23 009	1.000	2/3"	4.80 x 3.60	6.40 x 4.80	8.50 x 7.09	62.2	11	< 0.08 (0.10)	< 0.04 (0.08)	0.9	> 25	C	No	65.0	28
TC 23 012	0.735	2/3"	6.53 x 4.90	8.71 x 6.53	11.6 x 9.65	53.9	14	< 0.04 (0.10)	< 0.04 (0.10)	2.1	> 25	C	No	60.3	28
TC 13 016	0.290	1/3"	16.6 x 12.4	Ø = 16.6	Ø = 20.7	43.1	8	< 0.04 (0.10)	< 0.04 (0.08)	7.8	> 40	C	No	80.9	37.7
TC 12 016	0.385	1/2"	12.5 x 9.35	16.6 x 12.5	Ø = 18.4	43.1	8	< 0.04 (0.10)	< 0.04 (0.08)	4.5	> 40	C	No	93.0	37.7
TC 23 016	0.528	2/3"	9.09 x 6.82	12.1 x 9.09	16.1 x 13.4	43.1	8	< 0.06 (0.10)	< 0.04 (0.07)	2.4	> 30	C	No	112.7	37.7
TC 13 024	0.192	1/3"	25.0 x 18.8	Ø = 25.0	Ø = 31.3	67.2	8	< 0.08 (0.10)	< 0.04 (0.08)	18	> 45	C	No	105.6	44
TC 12 024	0.255	1/2"	18.8 x 14.1	25.1 x 18.8	Ø = 27.8	67.2	8	< 0.08 (0.10)	< 0.04 (0.08)	10	> 45	C	No	117.8	44
TC 23 024	0.350	2/3"	13.7 x 10.3	18.3 x 13.7	24.3 x 20.3	67.2	8	< 0.08 (0.10)	< 0.04 (0.10)	5.4	> 45	C	No	137.5	44
TC 13 036	0.133	1/3"	36.1 x 27.1	Ø = 36.1	Ø = 45.1	102.5	8	< 0.04 (0.08)	< 0.03 (0.08)	37	> 50	C	No	133.0	61
TC 12 036	0.177	1/2"	27.1 x 20.3	36.2 x 27.1	Ø = 40.1	102.5	8	< 0.03 (0.08)	< 0.04 (0.10)	21	> 40	C	No	145.2	61
TC 23 036	0.243	2/3"	19.8 x 14.8	26.3 x 19.8	35.0 x 29.2	102.5	8	< 0.04 (0.08)	< 0.04 (0.10)	11	> 40	C	No	164.9	61
TC 13 048	0.098	1/3"	49.0 x 36.7	Ø = 49.0	Ø = 61.2	133.4	8	< 0.08 (0.10)	< 0.06 (0.10)	69	> 40	C	No	167.9	75
TC 12 048	0.134	1/2"	35.8 x 26.9	47.8 x 35.8	Ø = 52.9	132.9	8	< 0.07 (0.10)	< 0.06 (0.10)	37	> 40	C	No	181.5	75
TC 23 048	0.184	2/3"	26.1 x 19.6	34.8 x 26.1	46.2 x 38.5	132.9	8	< 0.08 (0.10)	< 0.05 (0.10)	19	> 40	C	No	201.0	75
TC 13 056	0.084	1/3"	57.1 x 42.9	Ø = 57.1	Ø = 71.4	157.8	8	< 0.04 (0.08)	< 0.04 (0.08)	94	> 50	C	No	191.5	80
TC 12 056	0.114	1/2"	42.1 x 31.6	56.1 x 42.1	Ø = 62.2	157.8	8	< 0.04 (0.08)	< 0.04 (0.08)	51	> 50	C	No	205.0	80
TC 23 056	0.157	2/3"	30.6 x 22.9	40.8 x 30.6	54.1 x 45.2	157.8	8	< 0.05 (0.08)	< 0.03 (0.08)	27	> 45	C	No	225.0	80
TC 13 064	0.074	1/3"	64.9 x 48.6	Ø = 64.9	Ø = 81.1	181.9	8	< 0.06 (0.08)	< 0.03 (0.07)	121	> 40	C	No	212.3	100
TC 12 064	0.100	1/2"	48.0 x 36.0	64.0 x 48.0	Ø = 70.9	181.8	8	< 0.05 (0.08)	< 0.04 (0.07)	66	> 50	C	No	225.9	100
TC 23 064	0.138	2/3"	34.8 x 26.1	46.4 x 34.8	61.6 x 51.4	181.8	8	< 0.05 (0.08)	< 0.03 (0.07)	35	> 50	C	No	245.5	100
TC 23 072	0.122	2/3"	39.3 x 29.5	52.5 x 39.3	69.7 x 58.1	226.7	8	< 0.04 (0.08)	< 0.03 (0.07)	44	> 40	C	Yes	299.2	116
TC 13 080	0.059	1/3"	81.4 x 61.0	Ø = 81.4	Ø = 101.7	225.9	8	< 0.05 (0.08)	< 0.03 (0.08)	190	> 40	C	No	259.2	116
TC 12 080	0.080	1/2"	60.0 x 45.0	80.0 x 60.0	Ø = 88.6	226.7	8	< 0.03 (0.08)	< 0.04 (0.10)	103	> 50	C	No	271.5	116
TC 23 080	0.110	2/3"	43.6 x 32.7	58.2 x 43.6	77.3 x 64.5	226.7	8	< 0.04 (0.08)	< 0.02 (0.10)	55	> 50	C	No	291.2	116
TC 23 085	0.104	2/3"	46.2 x 34.6	61.5 x 46.2	81.7 x 68.2	279.7	8	< 0.04 (0.08)	< 0.02 (0.08)	61	> 45	C	Yes	344.5	143
TC 13 096	0.050	1/3"	96.0 x 72.0	Ø = 96.0	Ø = 120.0	279.6	8	< 0.06 (0.08)	< 0.04 (0.10)	264	> 50	C	No	303.3	143
TC 12 096	0.068	1/2"	70.6 x 52.9	94.1 x 70.6	Ø = 104.3	278.6	8	< 0.06 (0.08)	< 0.03 (0.08)	143	> 45	C	No	317.0	143
TC 23 096	0.093	2/3"	51.6 x 38.7	68.8 x 51.6	91.4 x 76.2	278.6	8	< 0.06 (0.08)	< 0.04 (0.08)	76	> 40	C	No	336.6	143
TC 23 110	0.079	2/3"	60.8 x 45.6	81.0 x 60.8	107.6 x 89.7	334.5	8	< 0.06 (0.08)	< 0.03 (0.07)	106	> 40	C	Yes	430.4	180
TC 13 120	0.038	1/3"	126.3 x 94.7	Ø = 126.3	Ø = 157.9	334.5	8	< 0.06 (0.08)	< 0.04 (0.10)	450	> 45	C	Yes	388.3	180
TC 12 120	0.052	1/2"	92.3 x 69.2	123.1 x 92.3	Ø = 136.3	334.5	8	< 0.06 (0.08)	< 0.04 (0.10)	247	> 45	C	Yes	402.7	180
TC 23 120	0.072	2/3"	66.7 x 50.0	88.9 x 66.7	118.1 x 98.5	334.5	8	< 0.07 (0.08)	< 0.04 (0.10)	127	> 35	C	Yes	422.4	180
TC 23 130	0.068	2/3"	70.6 x 52.9	94.1 x 70.6	125.0 x 104.3	396.0	8	< 0.05 (0.08)	< 0.04 (0.10)	143	> 40	C	Yes	490.0	200
TC 13 144	0.033	1/3"	145.5 x 109.1	Ø = 145.5	Ø = 181.8	396.0	8	< 0.05 (0.08)	< 0.04 (0.10)	606	> 45	C	Yes	448.8	200
TC 12 144	0.044	1/2"	109.1 x 81.8	145.5 x 109.1	Ø = 161.1	396.0	8	< 0.05 (0.08)	< 0.05 (0.08)	341	> 35	C	Yes	462.1	200
TC 23 144	0.061	2/3"	78.7 x 59.0	104.9 x 78.7	139.3 x 116.2	396.0	8	< 0.05 (0.08)	< 0.04 (0.08)	177	> 40	C	Yes	481.9	200
TC 23 172	0.051	2/3"	94.1 x 70.6	125.5 x 94.1	166.7 x 139.0	526.9	8	< 0.05 (0.08)	< 0.04 (0.10)	254	> 40	C	Yes	630.3	260
TC 13 192	0.025	1/3"	192.0 x 144.0	Ø = 192.0	Ø = 240.0	527.0	8	< 0.06 (0.08)	< 0.04 (0.10)	1056	> 45	C	Yes	598.2	260
TC 12 192	0.033	1/2"	145.5 x 109.1	193.9 x 145.5	Ø = 214.8	526.9	8	< 0.06 (0.08)	< 0.04 (0.08)	606	> 45	C	Yes	602.6	260
TC 23 192	0.046	2/3"	104.3 x 78.3	139.1 x 104.3	184.8 x 154.1	526.9	8	< 0.06 (0.08)	< 0.05 (0.08)	312	> 35	C	Yes	622.3	260
TC 23 200	0.044	2/3"	109.1 x 81.8	145.5 x 109.1	193.2 x 161.1	492.8	8	< 0.06 (0.08)	< 0.05 (0.10)	341	> 40	C	Yes	792.0	322
TC 23 240	0.037	2/3"	129.7 x 97.3	173.0 x 129.7	229.7 x 191.6	492.8	8	< 0.03 (0.08)	< 0.04 (0.08)	482	> 45	C	Yes	775.1	322

- Working distance: distance between the front end of the mechanics and the object.
- Working F-number: the real F-number of a lens in operating conditions.
- Maximum angle between chief rays and optical axis on the object side.
- Percent deviation of the real image compared to an ideal, undistorted image: typical (average production) values and maximum (guaranteed) values are listed.
- 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.
- For the fields with the indication "Ø =", the image of a circular object of such diameter is fully inscribed into the detector.
- If not available, phase adjustment can be supplied upon request (except for TC23004, TC23007, TC23009, TC23012).

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 horizontal field of view (FOV), in millimetres. For instance, a TC12064 features a field of view of 64 (x 48) mm with a 1/2" camera sensor.

TCLWD series

132 mm working distance telecentric lenses for sensors up to 2/3"

Mag. 0.5-3.5 x



FULL RANGE OF COMPATIBLE ILLUMINATORS		
	Backlights LTBP, LTBC, LTBFC series	p. 120-127
COMPATIBLE CLAMPING MECHANICS		
	Mounting clamp CMHO016	p. 248
FULL RANGE OF COMPATIBLE CAMERAS		
	Area scan cameras	p. 188-203

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.

Detailed test report with measured optical parameters.

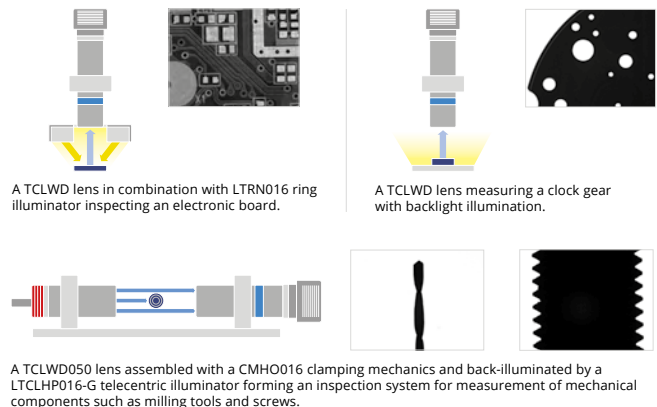
TCLWD series is a range of telecentric lenses specifically designed for electronic and semiconductor Automated Optical Inspection (AOI) and tool pre-setting machines.

All these lenses feature a working distance of 132 mm and offer 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 have 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.

Application examples



Part number	Mag. (x)	Max sensor size	Detector type			Optical specifications					Mechanical specs			
			1/3" 6.0 mm diag w x h (mm x mm)	1/1.8" 8.9 mm diag w x h (mm x mm)	2/3" - 5 MP 11.1 mm diag w x h (mm x mm)	WD (mm)	wf/#	Telecentricity typical (max) (deg)	Distortion typical (max) (%)	Field depth (mm)	CTF @35lp/mm (%)	Mount	Length (mm)	Diam. (mm)
			Object field of view (mm x mm)			1	2	3	4	5				
TCLWD 050	0.50	2/3"	9.60 x 7.20	14.3 x 10.7	16.9 x 14.1	132.3	12	< 0.04 (0.06)	< 0.1 (0.2)	4.0	> 60	C	130.7	37.7
TCLWD 066	0.66	2/3"	7.27 x 5.45	10.8 x 8.14	12.8 x 10.7	132.3	12	< 0.04 (0.06)	< 0.1 (0.2)	2.3	> 58	C	149.3	37.7
TCLWD 075	0.75	2/3"	6.40 x 4.80	9.51 x 7.16	11.3 x 9.43	132.3	12	< 0.04 (0.06)	< 0.1 (0.2)	1.8	> 55	C	155.0	37.7
TCLWD 100	1.00	2/3"	4.80 x 3.60	7.13 x 5.37	8.45 x 7.07	132.3	12	< 0.04 (0.06)	< 0.05 (0.1)	1.0	> 60	C	126.0	37.7
TCLWD 150	1.50	2/3"	3.20 x 2.40	4.75 x 3.58	5.63 x 4.71	132.3	16	< 0.04 (0.06)	< 0.05 (0.1)	0.6	> 50	C	140.4	37.7
TCLWD 250	2.50	2/3"	1.92 x 1.44	2.85 x 2.15	3.38 x 2.83	132.3	20	< 0.04 (0.06)	< 0.05 (0.1)	0.3	> 40	C	157.0	37.7
TCLWD 350	3.50	2/3"	1.37 x 1.03	2.04 x 1.53	2.41 x 2.02	132.3	24	< 0.04 (0.06)	< 0.05 (0.1)	0.2	> 30	C	174.7	37.7

- Working distance: distance between the front end of the mechanics and the object.
- Working F-number: the real F-number of a lens in operating conditions.
- Maximum angle between chief rays and optical axis on the object side.
- Percent deviation of the real image compared to an ideal, undistorted image: typical (average production) values and maximum (guaranteed) values are listed.
- 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.

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.

TCHM series

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



* RT

Mag. 1-6 x

Part number	Mag.	Max sensor size	Detector type			Optical specifications					Mechanical specs		
			1/3"	1/1.8"	2/3" - 5 MP	WD	wF/#	Distortion	Field depth	Nominal resolving power	Mount	Length	Diam.
			6.0 mm diag w x h 4.80 x 3.60 (mm x mm)	8.9 mm diag w x h 7.13 x 5.33 (mm x mm)	11.1 mm diag w x h 8.50 x 7.09 (mm)								
Working distance (WD) 71 mm													
RT-HR-6M-71	6.00	2/3"	0.8 x 0.6	1.2 x 0.9	1.4 x 1.2	71	41.1	0.27	0.10	4.6	C	107.9	18
RT-HR-4M-71	4.00	2/3"	1.2 x 0.9	1.8 x 1.3	2.1 x 1.8	71	29.0	0.24	0.13	4.9	C	100.0	18
RT-HR-2M-71	2.00	2/3"	2.4 x 1.8	3.6 x 2.7	4.2 x 3.5	71	18.5	0.21	0.30	6.2	C	97.0	18
RT-HR-1M-71	1.00	2/3"	4.8 x 3.6	7.1 x 5.4	8.5 x 7.1	71	15.6	0	0.90	10.5	C	116.1	18
Working distance (WD) 110 mm													
RT-HR-6M-110	6.00	2/3"	0.8 x 0.6	1.2 x 0.9	1.4 x 1.2	110	55.6	0.25	0.16	6.2	C	114.2	18
RT-HR-4M-110	4.00	2/3"	1.2 x 0.9	1.8 x 1.3	2.1 x 1.8	110	39.2	0.54	0.20	6.6	C	94.6	18
RT-HR-2M-110	2.00	2/3"	2.4 x 1.8	3.6 x 2.7	4.2 x 3.5	110	23.8	0.78	0.40	8.0	C	87.4	18
RT-HR-1M-110	1.00	2/3"	4.8 x 3.6	7.1 x 5.4	8.5 x 7.1	110	6.7	0.04	1.00	11.2	C	125.2	18

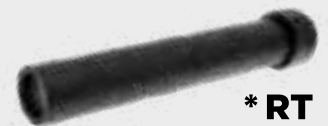
1 Working distance: distance between the front end of the mechanics and the object.

2 Working F-number: the real F-number of a lens in operating conditions.



TCVLWD series

Long working distance telecentric lenses for sensors up to 1/1.8"



* RT

Mag. 0.5-3 x

Part number	Mag.	Max sensor size	Detector type			Optical specifications					Mechanical specs		
			1/3"	1/2"	1/1.8"	WD	wF/#	Distortion	Field depth	Nominal resolving power	Mount	Length	Diam.
			6.0 mm diag w x h 4.80 x 3.60 (mm x mm)	8.0 mm diag w x h 6.40 x 4.80 (mm x mm)	8.9 mm diag w x h 7.13 x 5.33 (mm x mm)								
Object field of view (mm x mm)													
RT-TV-1M-150	1.00	1/2"	4.8 x 3.6	6.4 x 4.8	-	156.0	16.7	0.15	1.00	12.0	C	159.0	24
RT-TV-2M-150	2.00	1/2"	2.4 x 1.8	3.2 x 2.4	-	156.0	25.0	0.07	0.44	9.0	C	168.0	24
RT-TV-3M-150	3.00	1/2"	1.6 x 1.2	2.1 x 1.6	-	156.0	37.5	0.05	0.34	9.0	C	171.8	24
RT-TV-1M-220	1.00	1/2"	4.8 x 3.6	6.4 x 4.8	-	218.2	20.0	0.10	1.24	14.0	C	218.0	27
RT-TV-2M-220	2.00	1/2"	2.4 x 1.8	3.2 x 2.4	-	218.2	33.0	0.10	0.67	11.0	C	227.0	27
RT-TV-3M-220	3.00	1/2"	1.6 x 1.2	2.1 x 1.6	-	218.2	43.0	0.10	0.41	9.6	C	230.8	27
RT-TV-1M-290	1.00	1/2"	4.8 x 3.6	6.4 x 4.8	-	290.7	20.0	0.10	1.24	13.0	C	203.7	27
RT-TV-2M-290	2.00	1/2"	2.4 x 1.8	3.2 x 2.4	-	290.7	33.0	0.10	0.67	11.0	C	212.7	27
RT-TV-3M-290	3.00	1/2"	1.6 x 1.2	2.1 x 1.6	-	290.7	43.0	0.10	0.41	9.6	C	216.5	27
RT-TV-05M-400	0.50	1/2"	9.6 x 7.2	12.8 x 9.6	-	400.0	13.9	0.35	3.07	18.6	C	149.6	34
RT-TV-1M-400	1.00	1/1.8"	4.8 x 3.6	6.4 x 4.8	7.1 x 5.4	400.0	25.0	0.30	1.69	16.8	C	166.2	34
RT-TV-2M-400	2.00	1/1.8"	2.4 x 1.8	3.2 x 2.4	3.6 x 2.7	400.0	33.3	0.07	0.64	11.2	C	176.5	34
RT-TV-05M-800	0.50	1/1.8"	9.6 x 7.2	12.8 x 9.6	14.3 x 10.7	800.0	16.7	0.04	3.89	22.4	C	279.6	58
RT-TV-1M-800	1.00	1/1.8"	4.8 x 3.6	6.4 x 4.8	7.1 x 5.4	800.0	20.0	0.09	1.24	13.4	C	296.7	58

1 Working distance: distance between the front end of the mechanics and the object.

2 Working F-number: the real F-number of a lens in operating conditions.



TC CORE series

Compact bi-telecentric lenses for sensors up to 2/3"

Mag. 0.052-0.184 x



PATENTED

KEY ADVANTAGES

Excellent optical performance

TC CORE bi-telecentric lenses deliver excellent optical performance 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 you to cut costs.

Cost reduction

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.

Detailed test report with measured optical parameters.

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 performance and at the same time are up to 70% smaller than other double-sided telecentric lenses on the market, thus allowing you 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 you 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 performance and is extremely compact.

SEE ALSO		
	TCBENCH CORE series	p. 64
FULL RANGE OF COMPATIBLE ILLUMINATORS		
	LTCLHP CORE series	p. 130
FULL RANGE OF COMPATIBLE ACCESSORIES		
	Mounting mechanics CMHOCR and CMPTR series	p. 249-250
FULL RANGE OF COMPATIBLE CAMERAS		
	Area scan cameras	p. 188-203



Multiple lens surfaces can be used for direct mounting without clamps, thanks to the M6 threaded holes located on 4 sides. This also allows you to cut costs.

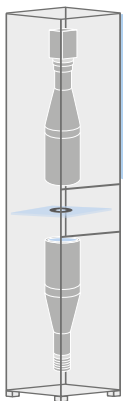


Front CMHOCR clamp available for added mounting flexibility.

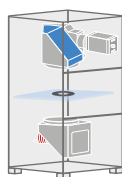


Built-in phase adjustment makes it easy to align the camera sensor.

Off-line precision measurement systems:



Save up to
70%
in height



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

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

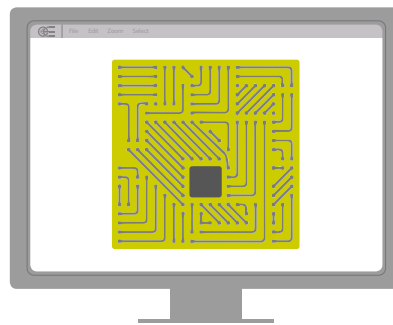
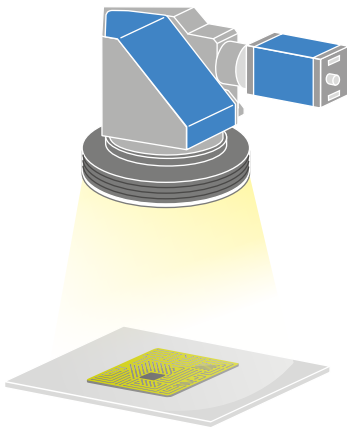
Sell more

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

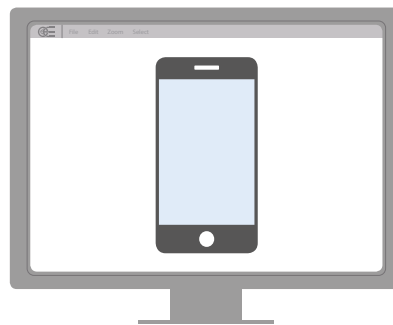
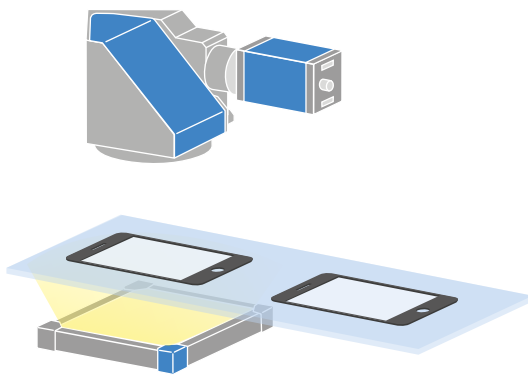
TC CORE series

Compact bi-telecentric lenses for sensors up to 2/3"

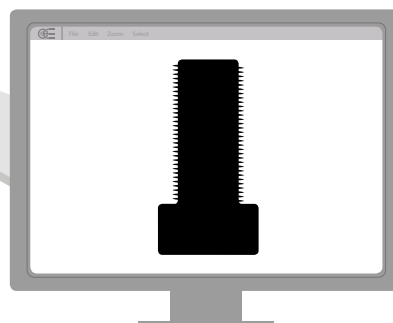
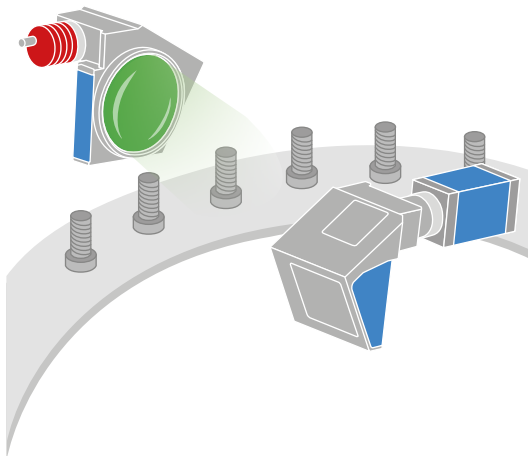
Application examples



Electronic board inspection:
TC CORE with top ring light.



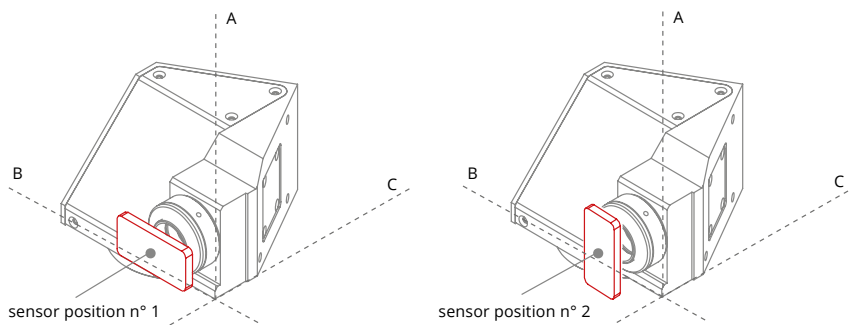
Smartphone glass inspection:
TC CORE mounted directly
on a plate and a flat backlight.



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 (position n°2).

Technical information:

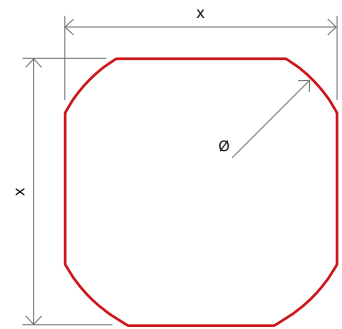


Image shape dimensions (Ø, x).

Part number	Mag. (x)	Max sensor size (Ø, x=mm)	Image shape dimensions (Ø, x=mm)	Detector type			Optical specifications					Mechanical specs					
				1/3" 6.0 mm diag w x h	1/1.8" 8.9 mm diag w x h	2/3" - 5 MP 11.1 mm diag w x h	WD (mm)	wF/#	Telecentricity typical (max) (deg)	Distortion typical (max) (%)	Field depth (mm)	CTF @70 lp/mm (%)	Mount	Dimensions (mm)			
				4.8 x 3.6 (mm x mm)	7.13 x 5.33 (mm x mm)	8.50 x 7.09 (mm x mm)	1	2	3	4	5	A		B	C		
			7	Object field of view (mm x mm) 6													
TCCR 12 048	0.134	1/1.8"	Ø=8.0, x=7.1	35.9 x 26.9	53.0 x 40.1	Ø=60, x=53	132.9	8	< 0.07 (0.10)	< 0.06 (0.10)	37	> 40	C	77	106	115	
TCCR 23 048	0.184	2/3"	Ø=11.0, x=9.6	26.1 x 19.6	38.8 x 29.2	46.0 x 38.4	132.9	8	< 0.08 (0.10)	< 0.05 (0.10)	19	> 40	C	77	106	135	
TCCR 12 056	0.114	1/1.8"	Ø=8.1, x=7.1	42.0 x 31.5	62.0 x 46.9	Ø=71, x=62	157.8	8	< 0.04 (0.08)	< 0.04 (0.10)	51	> 50	C	94	110	125	
TCCR 23 056	0.157	2/3"	Ø=11.1, x=9.6	30.6 x 22.9	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	1/1.8"	Ø=8.4, x=6.9	48.0 x 36.0	69.0 x 53.6	Ø=84, x=69	181.8	8	< 0.05 (0.08)	< 0.04 (0.10)	66	> 50	C	101	122	133	
TCCR 23 064	0.138	2/3"	Ø=11.5, x=9.5	34.9 x 26.2	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	1/1.8"	Ø=8.1, x=6.9	59.8 x 44.8	86.0 x 66.8	Ø=101, x=86	226.7	8	< 0.03 (0.08)	< 0.04 (0.10)	103	> 50	C	119	145	159	
TCCR 23 080	0.110	2/3"	Ø=11.1, x=9.6	43.5 x 32.6	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	1/1.8"	Ø=8.3, x=6.8	70.6 x 52.9	100.0 x 78.9	Ø=122, x=100	278.6	8	< 0.06 (0.08)	< 0.03 (0.10)	143	> 45	C	139	172	183	
TCCR 23 096	0.093	2/3"	Ø=11.4, x=9.4	51.4 x 38.5	76.3 x 57.5	90.4 x 75.6	278.6	8	< 0.06 (0.08)	< 0.04 (0.10)	76	> 40	C	139	172	197	
TCCR 12 120	0.052	1/1.8"	Ø=8.2, x=6.7	92.1 x 69.1	128.0 x 103.3	Ø=157, x=128	334.5	8	< 0.06 (0.08)	< 0.08 (0.10)	244	> 45	C	182	220	231	
TCCR 23 120	0.072	2/3"	Ø=11.2, x=9.3	67.0 x 50.3	99.5 x 75.0	117.9 x 98.7	334.5	8	< 0.06 (0.08)	< 0.08 (0.10)	127	> 35	C	182	220	231	

- Working distance: distance between the front end of the mechanics and the object.
- Working F-number: the real F-number of a lens in operating conditions.
- Maximum angle between chief rays and optical axis on the object side.
- Percent deviation of the real image compared to an ideal, undistorted image: typical (average production) values and maximum (guaranteed) values are listed.
- 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.
- In case of vignetting, FOV dimensions are indicated with "Ø = , x = ", where "Ø =" stands for diameter and "x=" indicates the nominal FOV height and length (see Tech Info for related drawing).
- Indicates the dimensions and shape of image, where "Ø =" stands for diameter and "x=" indicates the nominal image height and length (Tech Info for related drawing).

TC CORE PLUS series

Compact large-FOV bi-telecentric lenses for sensors up to 2/3"

Mag. 0.027-0.059 x

NEW MODELS



KEY ADVANTAGES

Large FOV in a super compact form factor

TC CORE PLUS telecentric lenses are up to 40% shorter than other telecentric lenses on the market. They are designed to image extremely large FOVs in a reduced space.

Optimized working distance

Working distance of TC CORE PLUS lenses has been reduced to greatly minimize dimensions of the system.

Smart integration

TC CORE PLUS lenses integrate a mounting flange for easy integration without additional clamps.

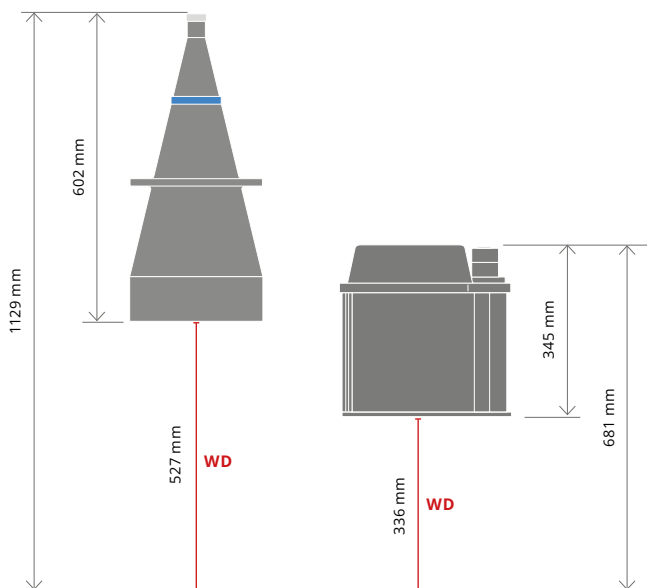
Boost your sales

TC CORE PLUS lenses allow you to reduce the size of your vision system, resulting in less manufacturing, shipping and storage costs.

TC CORE PLUS series are large FOV telecentric lenses for area scan cameras, specifically designed for the latest generation 1/1.8" and 2/3" CMOS sensors. Their opto-mechanical design is ideal to measure large objects in a reduced space. TC CORE PLUS series are up to 40% shorter than other telecentric lenses available on the market.

Their patent-pending optical design, inspired by catadioptric telescopes, allows for large FOV imaging while keeping the overall footprint compact.

The length and working distance of a telecentric lens strongly impacts the size of a vision system. This is especially critical when a large FOV telecentric lens is used with a telecentric illuminator, as the overall system dimensions are doubled. For this reason, the working distance of TC CORE PLUS lenses has been optimized to make a measurement system as compact as possible. TC CORE PLUS lenses feature a built-in mounting flange for easy mounting without additional clamps, making their integration easy and cost-effective.

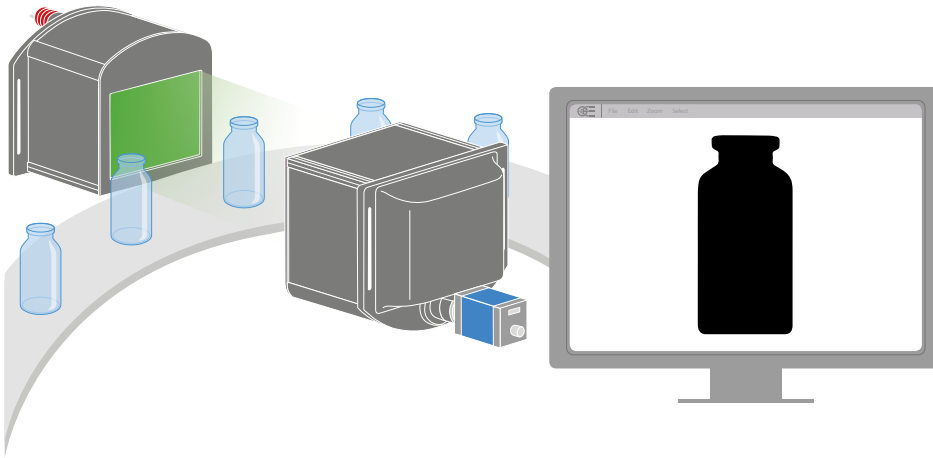


Example: comparison between TC12192 (left) and TCCP12192 (right) lenses with 0.033x mag. and a FOV of 195 x 146 mm.

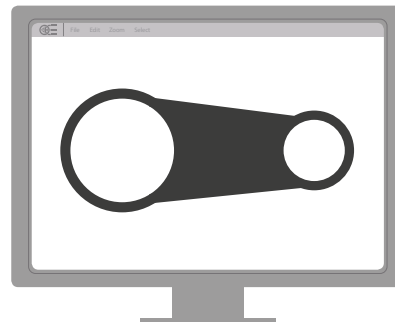
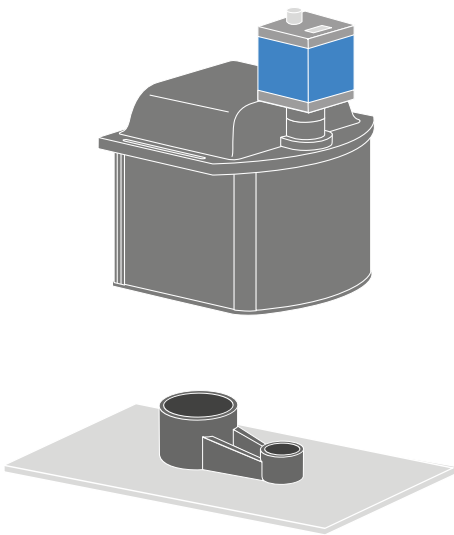
	Mag.	1/1.8" sensor FOV	WD	Lens length	Overall system height
	(x)	(mm x mm)	(mm)	(mm)	(mm)
TC12192	0.033	216 x 162	527	602	1129
TCCP12192	0.033	216 x 162	336	345	681
With CORE PLUS telecentric lens you save:	-	-	191	257	448
			(36%)	(43%)	(40%)

TCCP12192 provides a 216 mm x 162 mm FOV with a 1/1.8" sensor (same as TC12192). Being 257 mm smaller and having a 191 mm shorter working distance, it allows you to save almost 450 mm.

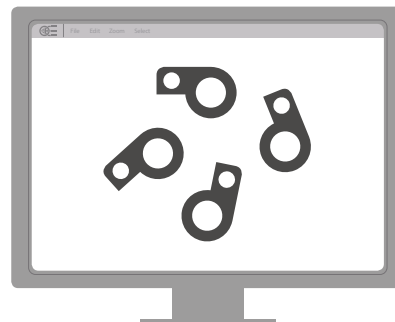
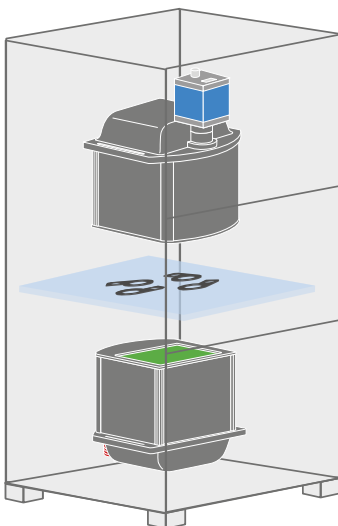
Application examples:



Bottles measurement.



Large mechanical parts measurement.

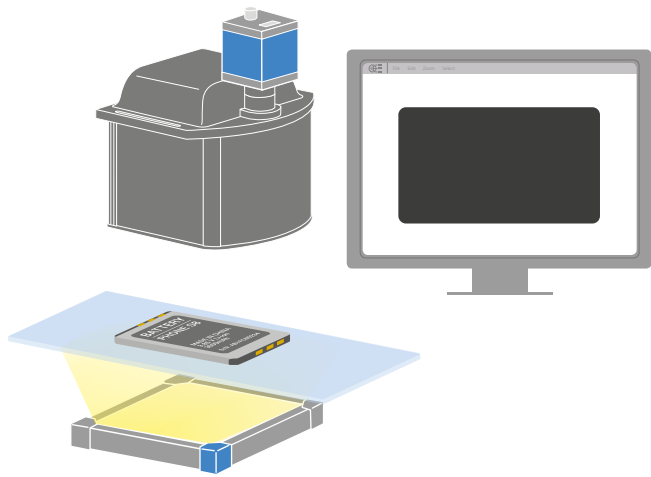


2D profile measurement of multiple parts.

TC CORE PLUS series

Compact large-FOV bi-telecentric lenses for sensors up to 2/3"

Application example:



Smartphone and tablet battery measurement.

ADVANTAGES



Save more

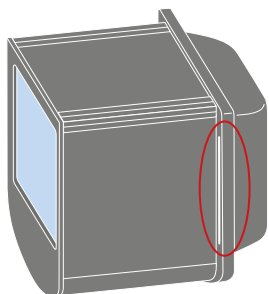
- Lower manufacturing cost due to less material employed
- Cost of mounting is reduced as no additional clamps are needed
- Less space required for storage and use
- Lower shipment expenses due to smaller size
- Lower transportation risks

Sell more

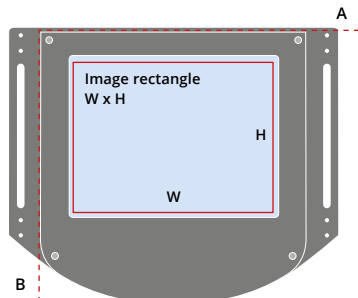
- Compactness brings a competitive advantage

	Compatible backlights	LT2BC series		LTBC series		LTBP series	
	FOV max. (mm)	Part Number	Lighting area dim. (mm)	Part Number	Lighting area dim. (mm)	Part Number	Lighting area dim. (mm)
TCCP 12 144	161.8 x 121.1	LT2BC192144-X	192 x 144	LTBC174174-X	174.5 x 174.5	LTBP192144-X	192 x 144
TCCP 23 144	145.1 x 121.0	LT2BC192144-X	192 x 144	LTBC174174-X	174.5 x 174.5	LTBP192144-X	192 x 144
TCCP 12 192	216.4 x 162.0	LT2BC240180-X	240 x 180	LTBC234234-X	234.5 x 234.5	LTBP240180-X	240 x 180
TCCP 23 192	194.1 x 161.9	LT2BC240180-X	240 x 180	LTBC234234-X	234.5 x 234.5	LTBP240180-X	240 x 180
TCCP 12 260	264.1 x 197.4	LT2BC288216-X	288 x 216	-	-	LTBP288216-X	288 x 216
TCCP 23 260	236.1 x 196.9	LT2BC288216-X	288 x 216	-	-	LTBP288216-X	288 x 216

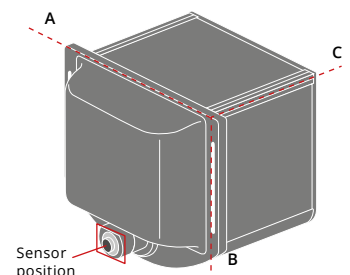
TC CORE PLUS lenses take less space in your system, resulting in less manufacturing, shipping and storage costs. A smaller vision system or measurement machine is the preferred solution in the industry.





Built-in mounting flange: no additional clamps required.





The width of the FOV (W) is aligned along the A axis. The height of the FOV (H) is aligned along the B axis.



The long side of the sensor has to be aligned along the A axis.

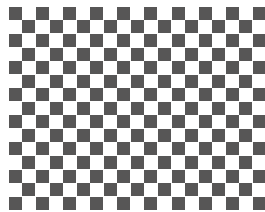
FULL RANGE OF COMPATIBLE ILLUMINATORS		
	LTCLHP CORE PLUS series	p. 134
	LED backlights LT2BC, LTBC, LTBP series	p. 118-125

FULL RANGE OF COMPATIBLE ACCESSORIES	
	PTCP calibration patterns p. 241
FULL RANGE OF COMPATIBLE CAMERAS	
	Area scan cameras p. 188-203

Recommended product setup:



TC CORE PLUS telecentric lens



PTCPxxxx calibration chess-board pattern



TCLIB Suite software library



Fully GeniCam compliant camera

For best measurement accuracy, TC CORE PLUS telecentric lenses should be used with:

- TCLIB Suite, an Opto Engineering® proprietary software library for distortion calibration and overall optimization of telecentric measurement setups (see page 220)
- a fully GeniCam® compliant camera (see page 192-193, 196-197)
- a specifically designed PTCPxxxx chessboard calibration pattern (see page 241)

Part number	Mag. (x)	Max sensor size (mm x mm)	Image rectangle (mm x mm)	Detector type			Optical specifications						Mechanical specifications					
				1/3" 6.0 mm diag w x h	1/1.8" 8.9 mm diag w x h	2/3" - 5 MP 11.1 mm diag w x h	WD (mm)	wF/#	Telecentricity (max) (deg)	Distortion (max) (%)	Residual distortion (%)	Field depth (mm)	CTF @50lp/mm (%)	Mount	Dimensions (mm)			
				4.8 x 3.6 (mm x mm)	7.12 x 5.33 (mm x mm)	8.50 x 7.09 (mm x mm)	2	3	4	5	6	7		A	B	C		
				Object field of view (mm x mm)														
TCCP 12 144	0.044	1/1.8"	7.48 x 5.60	109.1 x 81.8	162.0 x 121.1		217.4	8	< 0.06 (0.1)	< 0.8	< 0.01	214	> 45	C	332.0	302.5	299.4	
TCCP 23 144	0.059	2/3"	8.93 x 7.45	81.9 x 61.4	121.7 x 91.0	145.1 x 121.0	217.4	8	< 0.06 (0.1)	< 0.8	< 0.01	121	> 45	C	332.0	302.5	315.1	
TCCP 12 192	0.033	1/1.8"	7.48 x 5.60	145.9 x 109.4	216.7 x 162.0		328.0	8	< 0.12 (0.18)	< 0.8	< 0.01	382	> 45	C	410.4	344.1	345.0	
TCCP 23 192	0.044	2/3"	8.93 x 7.45	109.6 x 82.2	162.8 x 121.7	194.1 x 161.9	328.0	8	< 0.12 (0.18)	< 0.8	< 0.01	216	> 45	C	410.4	344.1	353.3	
TCCP 12 260	0.027	1/1.8"	7.48 x 5.60	177.8 x 133.3	264.1 x 197.4		366.0	8	< 0.18 (0.22)	< 0.9	< 0.01	568	> 45	C	425.3	396.7	421.0	
TCCP 23 260	0.036	2/3"	8.93 x 7.45	133.3 x 100.0	198.1 x 148.1	236.1 x 196.9	366.0	8	< 0.18 (0.22)	< 0.9	< 0.01	319	> 45	C	425.3	396.7	421.0	

Residual distortion after calibration with TCLIB Suite software library, using PTCPXXX calibration pattern and fully GeniCam compliant camera. For specific setup information see the table below:

Part number	Calibrations software	Calibrations pattern	Setup camera	Recommended cameras	Recommended sensors
TCCP 12 144	TCLIB Suite	PTCP-S1-HR1-C	RT-mvBF3-2032aG	COE-032-x-POE-040-yy-C, RT-mvBF3-2032a, RT-mvBC-XD104h, RT-mvBC-X104i	IMX252, IMX265
TCCP 23 144	TCLIB Suite	PTCP-M1-HR1-C	RT-mvBF3-2051aG	COE-050-x-z-050-yy-C, RT-mvBF3-2051G, RT-mvBF3-2051aG, RT-mvBC-XD105a, RT-mvBC-X105b	IMX250, IMX264
TCCP 12 192	TCLIB Suite	PTCP-L1-HR1-C	RT-mvBF3-2032aG	COE-032-x-POE-040-yy-C, RT-mvBF3-2032a, RT-mvBC-XD104h, RT-mvBC-X104i	IMX252, IMX265
TCCP 23 192	TCLIB Suite	PTCP-S1-HR1-C	RT-mvBF3-2051aG	COE-050-x-z-050-yy-C, RT-mvBF3-2051G, RT-mvBF3-2051aG, RT-mvBC-XD105a, RT-mvBC-X105b	IMX250, IMX264
TCCP 12 260	TCLIB Suite	PTCP-M1-HR1-C	RT-mvBF3-2032aG	COE-032-x-POE-040-yy-C, RT-mvBF3-2032a, RT-mvBC-XD104h, RT-mvBC-X104i	IMX252, IMX265
TCCP 23 260	TCLIB Suite	PTCP-L1-HR1-C	RT-mvBF3-2051aG	COE-050-x-z-050-yy-C, RT-mvBF3-2051G, RT-mvBF3-2051aG, RT-mvBC-XD105a, RT-mvBC-X105b	IMX250, IMX264

- 1 Given the squared shape of the front window, the lens forms a rectangular image.
- 2 Working distance: distance between the front end of the mechanics and the object. Set this distance within +/- 5% of the nominal value for maximum resolution and minimum distortion.
- 3 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.
- 4 Maximum slope of chief rays inside the lens: when converted to millirad, it gives the maximum measurement error for any millimetre of object displacement. Maximum (guaranteed) values are listed.
- 5 Percent deviation of the real image compared to an ideal, undistorted image. Maximum (guaranteed) values of the uncorrected image are listed.
- 6 Residual distortion after calibration with TCLIB Suite software library, using a PTCP calibrations pattern and a fully GeniCam compliant camera. For setup information see related table.
- 7 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.
- 8 Maximum dimension of the clamping flange.
- 9 Measured from the front end of the mechanics to the camera flange.

Due to its original design mainly conceived to reduce the length and weight of a telecentric lens, typically CORE PLUS optics show a thermal drift which is higher than in traditional telecentric optics, especially when the entire FOV is used for measurement. When used for measurement applications, thus, CORE PLUS optics might need to be thermally calibrated depending on the required precision and accuracy.

TCCX series

132 mm working distance coaxial telecentric lenses for sensors up to 2/3" Mag. 0.5-3 x



KEY ADVANTAGES

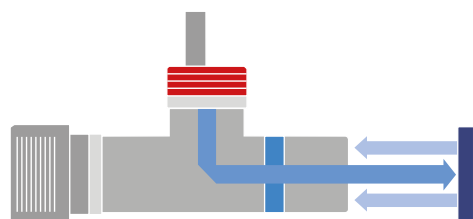
- Large numerical aperture**
For small pixel size camera resolution.
- Long working distance**
Tailored for electronic components inspection.
- Compact built-in illumination**
Ideal for high-end applications in the semiconductor industry.
- Easy rotational phase adjustment**
Robust and precise tuning of the camera phase.
- Detailed test report with measured optical parameters.**

TCCX series is a range of telecentric lenses designed for measurement and defect detection on flat surfaces. They feature 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 detect small surface defects such as scratches or grooves, finding application in many industries, from the electronics and semiconductor industries to the glass and metal fabrication industries. All these lenses operate at a working distance of 132 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 internal reflection issues of conventional coaxial illumination systems: this makes TCCX lenses the perfect choice especially when inspecting highly reflective flat surfaces (approx. > 30% reflectance).

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

FOR OTHER COAXIAL TELECENTRIC LENSES SEE ALSO		
	TCCXHM, TCCXLM series TCCXQ series	p. 34 p. 35
FULL RANGE OF COMPATIBLE ILLUMINATORS		
	Backlights LTBP, LTBC, LTBC series	p. 120-127
FULL RANGE OF COMPATIBLE ACCESSORIES		
	Mounting mechanics CMHO016	p. 248
FULL RANGE OF COMPATIBLE CAMERAS		
	Area scan cameras	p. 188-203

Application examples



TCCX lens inspects objects using coaxial illumination.

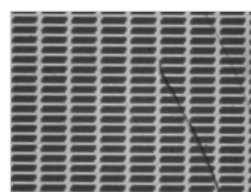
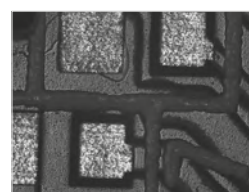


Image of an LCD display taken with a TCCX250 lens.



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



Scratches on a stainless steel surface emphasized by coaxial illumination.

Note

In some cases, low magnification models (e.g. TCCX050-x, TCCX066-x, TCCX075-x) may generate hotspots, especially when imaging non-reflective objects.



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, the built-in electronics behaves as an open circuit allowing for direct control of the LED source.



Electrical specifications

Part number	Light		Device power ratings			LED power ratings		
	Light color, wavelength peak	DC voltage		Power consumption (W)	Max LED fwd current (mA)	Forward voltage		Max pulse current (mA)
		min (V)	max (V)			typ. (V)	max (V)	
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).

Part number	Mag. (x)	Max sensor size	Detector type			Optical specifications						Mechanical specs		
			1/3" 6.0 mm diag w x h	1/1.8" 8.9 mm diag w x h	2/3" - 5 MP 11.1 mm diag w x h	WD (mm)	wF/#	Telecentricity (deg)	Distortion (typical max) (%)	Field depth (mm)	CTF @35lp/mm (%)	Mount	Length (mm)	Diam. (mm)
			Object field of view (mm x mm)			1	2	3	4	5				
TCCX 050-x	0.50	2/3"	9.60 x 7.20	14.3 x 10.7	17.0 x 14.2	132.3	12	< 0.04 (0.06)	< 0.1 (0.20)	4.0	> 60	C	131.2	37.7
TCCX 066-x	0.66	2/3"	7.27 x 5.45	10.8 x 8.08	12.9 x 10.7	132.3	12	< 0.04 (0.06)	< 0.1 (0.20)	2.3	> 58	C	149.8	37.7
TCCX 075-x	0.75	2/3"	6.40 x 4.80	9.51 x 7.11	11.3 x 9.45	132.3	12	< 0.04 (0.06)	< 0.1 (0.20)	1.8	> 55	C	155.5	37.7
TCCX 100-x	1.00	2/3"	4.80 x 3.60	7.13 x 5.33	8.50 x 7.09	132.3	12	< 0.04 (0.06)	< 0.05 (0.10)	1.0	> 60	C	132.9	37.7
TCCX 150-x	1.50	2/3"	3.20 x 2.40	4.75 x 3.55	5.67 x 4.73	132.3	16	< 0.04 (0.06)	< 0.05 (0.10)	0.6	> 50	C	147.2	37.7
TCCX 250-x	2.50	2/3"	1.92 x 1.44	2.85 x 2.13	3.40 x 2.84	132.3	20	< 0.04 (0.06)	< 0.05 (0.10)	0.3	> 40	C	163.9	37.7
TCCX 350-x	3.50	2/3"	1.37 x 1.03	2.04 x 1.53	2.43 x 2.03	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.
- 2 Working F-number: the real F-number of a lens in operating conditions.
- 3 Maximum angle between chief rays and optical axis on the object side.
- 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.

Ordering information

It's easy to select the right lens for your application: the last digit of the part number "-x" defines the source color. All models are available with **green (-G)** or **white (-W)** light.

TCCXHM series

High magnification coaxial telecentric lenses for sensors up to 2/3"



* RT

Mag. 1-6 x

Part number	Mag.	Max sensor size	Detector type			Optical specifications					Mechanical specs		
			1/3" 6.0 mm diag w x h 4.80 x 3.60 (mm x mm)	1/1.8" 8.9 mm diag w x h 7.13 x 5.33 (mm x mm)	2/3" - 5 MP 11.1 mm diag w x h 8.50 x 7.09 (mm)	WD	wF/#	Distortion	Field depth	Nominal resolving power	Mount	Length	Diam.
	(x)		Object field of view (mm x mm)			(mm)		(%)	(mm)	(µm)		(mm)	(mm)
Working distance (WD) 71 mm													
RT-HR-6F-71	6.00	2/3"	0.8 x 0.6	1.2 x 0.9	1.4 x 1.2	71	41.1	0.27	0.10	4.6	C	107.9	18
RT-HR-4F-71	4.00	2/3"	1.2 x 0.9	1.8 x 1.3	2.1 x 1.8	71	29.0	0.24	0.13	4.9	C	100	18
RT-HR-2F-71	2.00	2/3"	2.4 x 1.8	3.6 x 2.7	4.2 x 3.5	71	18.5	0.21	0.30	6.2	C	97	18
RT-HR-1F-71	1.00	2/3"	4.8 x 3.6	7.1 x 5.4	8.5 x 7.1	71	15.6	0.00	0.90	10.5	C	116.1	18
Working distance (WD) 110 mm													
RT-HR-6F-110	6.00	2/3"	0.8 x 0.6	1.2 x 0.9	1.4 x 1.2	110	55.6	0.25	0.16	6.2	C	114.17	18
RT-HR-4F-110	4.00	2/3"	1.2 x 0.9	1.8 x 1.3	2.1 x 1.8	110	39.2	0.54	0.20	6.6	C	94.6	18
RT-HR-2F-110	2.00	2/3"	2.4 x 1.8	3.6 x 2.7	4.2 x 3.5	110	23.8	0.78	0.40	8.0	C	87.36	18
RT-HR-1F-110	1.00	2/3"	4.8 x 3.6	7.1 x 5.4	8.5 x 7.1	110	6.7	0.04	1.00	11.2	C	125.16	18

- 1 Working distance: distance between the front end of the mechanics and the object.
- 2 Working F-number: the real F-number of a lens in operating conditions.

FULL RANGE OF COMPATIBLE LED SOURCES

 LDSC series p. 258

FULL RANGE OF COMPATIBLE CAMERAS

 Area scan cameras p. 188-203

TCCXLM series

Coaxial telecentric lenses for sensors up to 2/3"



* RT

Mag. 0.2-0.4 x

Part number	Mag.	Max sensor size	Detector type			Optical specifications					Mechanical specs		
			1/3" 6.0 mm diag w x h 4.80 x 3.60 (mm x mm)	1/1.8" 8.9 mm diag w x h 7.13 x 5.33 (mm x mm)	2/3" - 5 MP 11.1 mm diag w x h 8.50 x 7.09 (mm x mm)	WD	wF/#	Distortion	Field depth	Nominal resolving power	Mount	Length	Diam.
	(x)		Object field of view (mm x mm)			(mm)		(%)	(mm)	(µm)		(mm)	(mm)
RT-TCL0400-F	0.40	2/3"	12.0 x 9.00	17.8 x 13.4	21.1 x 17.7	78.50	8 - 40	-0.015	2.10	15.00	C	188	44
RT-TCL0300-F	0.30	2/3"	16.0 x 12.0	23.8 x 17.9	28.2 x 23.6	108.20	8 - 40	0.008	3.70	20.00	C	224	49
RT-TCL0200-F	0.20	2/3"	24.0 x 18.0	35.7 x 26.7	42.3 x 35.4	167.00	8 - 40	0.012	8.40	31.00	C	297	68

- 1 Working distance: distance between the front end of the mechanics and the object.
- 2 Working F-number: the real F-number of a lens in operating conditions.

FULL RANGE OF COMPATIBLE LED SOURCES

 LDSC series p. 258

FULL RANGE OF COMPATIBLE CAMERAS

 Area scan cameras p. 188-203

TCCXQ series

Coaxial telecentric assemblies for sensors up to 2/3"

Mag. 0.11-1.5 x



KEY ADVANTAGES

Completely free from stray-light

Compatible with both reflective and diffusive surface objects.

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.

Detailed test report with measured optical parameters.

FOR OTHER COAXIAL SOLUTIONS SEE ALSO		
	TCCX series	p. 32
FULL RANGE OF COMPATIBLE CAMERAS		
	Area scan cameras	p. 188-203

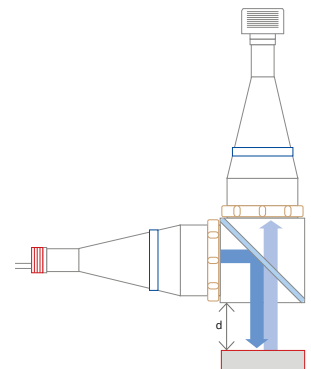
TCCXQ optical assemblies combine the high optical performance of TC and TCLWD telecentric lenses and the LTCLHP series ability to provide accurate and reliable illumination. Pairing these two Opto Engineering® flagship products results in a system completely free from straylight and back-reflections, while marking superior optical performance (in terms of resolution, telecentricity and distortion) even at the highest magnifications.

This optical layout also minimizes the overall height of the system, also allowing the user to easily adjust the camera orientation and back focal distance of the lens. TCCXQ assemblies can be successfully employed in high accuracy measurement applications as well as Automated Optical Inspection (AOI) setups.

Electrical specifications

Part number	Light	Device power ratings				LED power ratings		
	Light color, wavelength peak	DC voltage		Power consumption (W)	Max LED fwd current (mA)	Forward voltage		Max pulse current (mA)
		min (V)	max (V)			typ. (V)	max (V)	
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).



Part number	Mag. (x)	Max sensor size	Detector type			Optical specifications		Mechanical specifications		
			1/3" 6.0 mm diag w x h	1/1.8" 8.9 mm diag w x h	2/3" - 5 MP 11.1 mm diag w x h	Object distance d (mm)	Mount	Length (mm)	Width (mm)	Height (mm)
			Object field of view (mm x mm)							
TCCXQ 150-x	1.50	2/3"	3.20 x 2.40	4.75 x 3.55	5.67 x 4.73	82.8	C	155.0	198.9	64
TCCXQ 100-x	1.00	2/3"	4.80 x 3.60	7.13 x 5.33	8.50 x 7.09	82.8	C	155.0	182.5	64
TCCXQ 075-x	0.75	2/3"	6.40 x 4.80	9.51 x 7.11	11.33 x 9.45	82.8	C	155.0	213.5	64
TCCXQ 066-x	0.66	2/3"	7.27 x 5.45	10.80 x 8.08	12.88 x 10.74	82.8	C	155.0	207.8	64
TCCXQ 050-x	0.50	2/3"	9.60 x 7.20	14.26 x 10.66	17.00 x 14.18	82.8	C	155.0	189.2	64
TCCXQ 024-x	0.24	2/3"	19.8 x 14.8	29.34 x 21.93	34.98 x 29.18	20.1	C	235.9	252.4	88
TCCXQ 018-x	0.18	2/3"	26.1 x 19.6	38.75 x 28.97	46.20 x 38.53	37.0	C	285.2	303.2	102
TCCXQ 016-x	0.16	2/3"	30.6 x 22.9	45.41 x 33.95	54.14 x 45.16	50.7	C	319.2	336.7	108
TCCXQ 014-x	0.14	2/3"	34.8 x 26.1	51.67 x 38.62	61.59 x 51.38	63.8	C	350.3	367.6	128
TCCXQ 011-x	0.11	2/3"	43.6 x 32.7	64.82 x 48.45	77.27 x 64.45	90.1	C	415.6	433.1	144

Ordering information

It's easy to select the right lens for your application: the last digit of the part number "-x" defines the source color. All models are available with **green (-G)** or **white (-W)** light.

TC1MHR-TC4MHR series

Telecentric lenses for sensors up to 4/3"

Mag. 0.045-4 x



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.

TC1MHR-TC4MHR series are high resolution telecentric lenses designed for detectors larger than 2/3", making them the perfect choice for advanced metrology applications.

The TC1MHR-TC4MHR series delivers unmatched resolution, low distortion and homogeneous image quality while offering the best performance to price ratio.

TC1MHR-TC4MHR feature a compact and robust design that allows for easy integration in industrial environments. Additionally, the camera phase can be easily adjusted by simply loosening the set screws positioned in the eyepiece part.

TC1MHR series for up to 1/1.2" sensors

Part number	Mag.	Max sensor size (x)	Detector type				Optical specifications					Mechanical specs			
			1/1.2" IMX174 / IMX249 13.3 mm diag w x h	1" IMX255 / IMX267 16.1 mm diag w x h	1.1" IMX253 / IMX304 17.6 mm diag w x h	4/3" IMX387 21.7 mm diag w x h	WD (mm)	wF/#	Telecentricity typical (max) (deg)	Distortion typical (max) (%)	Field depth (mm)	CTF @50lp/mm (%)	Mount	Length (mm)	Diam. (mm)
			11.35 x 7.13 (mm x mm)	14.19 x 7.51 (mm x mm)	14.16 x 10.37 (mm x mm)	18.9 x 10.6 (mm x mm)	1	2	3	4	5				
Object field of view (mm x mm) 6															
TC1MHR 016-C	0.639	1/1.2"	17.75 x 11.15	Ø = 11.75	Ø = 16.23	Ø = 16.65	44.3	11	<0.08 (0.10)	<0.08 (0.10)	2.0	> 40	C	125.4	40
TC1MHR 024-C	0.424	1/1.2"	26.76 x 16.81	Ø = 17.71	Ø = 24.46	Ø = 25.09	67.2	11	<0.08 (0.10)	<0.08 (0.10)	4.6	> 45	C	150.2	44
TC1MHR 036-C	0.295	1/1.2"	38.46 x 24.16	Ø = 25.46	Ø = 35.16	Ø = 36.07	102.6	11	<0.08 (0.10)	<0.08 (0.10)	9.5	> 40	C	177.6	61
TC1MHR 048-C	0.222	1/1.2"	51.10 x 32.10	Ø = 33.83	Ø = 46.72	Ø = 47.93	132.4	8	<0.08 (0.10)	<0.08 (0.10)	12.2	> 55	C	215.9	75
TC1MHR 056-C	0.190	1/1.2"	59.71 x 37.51	Ø = 39.53	Ø = 54.58	Ø = 56.00	157.8	8	<0.08 (0.10)	<0.08 (0.10)	16.6	> 55	C	238.7	80
TC1MHR 064-C	0.166	1/1.2"	68.34 x 42.93	Ø = 45.24	Ø = 62.48	Ø = 64.10	181.9	8	<0.08 (0.10)	<0.08 (0.10)	21.8	> 55	C	259.8	100
TC1MHR 080-C	0.134	1/1.2"	84.66 x 53.18	Ø = 56.04	Ø = 77.40	Ø = 79.40	226.8	8	<0.08 (0.10)	<0.08 (0.10)	33.4	> 50	C	305.4	116
TC1MHR 096-C	0.114	1/1.2"	99.52 x 62.51	Ø = 65.88	Ø = 90.97	Ø = 93.33	278.6	8	<0.08 (0.10)	<0.08 (0.10)	46.2	> 55	C	342.7	143
TC1MHR 120-C	0.087	1/1.2"	130.40 x 81.91	Ø = 86.32	Ø = 119.21	Ø = 122.30	334.6	8	<0.08 (0.10)	<0.08 (0.10)	79.3	> 55	C	428.3	180
TC1MHR 144-C	0.074	1/1.2"	153.31 x 96.30	Ø = 101.49	Ø = 140.15	Ø = 143.78	396.0	8	<0.08 (0.10)	<0.08 (0.10)	109.6	> 55	C	487.8	200
TC1MHR 192-C	0.056	1/1.2"	202.59 x 127.25	Ø = 134.11	Ø = 185.20	Ø = 190.00	527.6	8	<0.08 (0.10)	<0.08 (0.10)	191.3	> 50	C	628.2	260
TC1MHR 240-C	0.045	1/1.2"	252.11 x 158.36	Ø = 166.89	Ø = 230.47	Ø = 236.44	492.9	8	<0.08 (0.10)	<0.08 (0.10)	296.3	> 55	C	788.4	322

- 1 Working distance: distance between the front end of the mechanics and the object.
- 2 Working F-number: the real F-number of a lens in operating conditions.
- 3 Maximum angle between chief rays and optical axis on the object side.
- 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 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.



TC2MHR series for up to 1" sensors

Part number	Mag.	Max sensor size (x)	Detector type				Optical specifications					Mechanical specs			
			1/1.2" IMX174 / IMX249 13.3 mm diag	1" IMX255 / IMX267 16.1 mm diag	1.1" IMX253 / IMX304 17.6 mm diag	4/3" IMX387 21.7 mm diag	WD	wf/#	Telecentricity typical (max)	Distortion typical (max)	Field depth	CTF @50lp/mm	Mount	Length	Diam.
			w x h (mm x mm)	w x h (mm x mm)	w x h (mm x mm)	w x h (mm x mm)	(mm)		(deg)	(%)	(mm)	(%)		(mm)	(mm)
Object field of view (mm x mm) 6															
TC2MHR 016-E	0.767	1"	14.79 x 9.29	18.50 x 9.79	Ø = 13.52	Ø = 13.87	43.8	16	<0.08 (0.10)	<0.04 (0.10)	2.0	> 30	M42x1 FD16.00	147	52
TC2MHR 024-C	0.508	1"	22.33 x 14.03	27.93 x 14.78	Ø = 20.42	Ø = 20.94	67.2	16	<0.08 (0.10)	<0.04 (0.10)	4.7	> 40	C	170.4	45
TC2MHR 024-F	0.508	1"	22.33 x 14.03	27.93 x 14.78	Ø = 20.42	Ø = 20.94	67.2	16	<0.08 (0.10)	<0.04 (0.10)	4.7	> 40	F	141.4	64
TC2MHR 024-E	0.508	1"	22.33 x 14.03	27.93 x 14.78	Ø = 20.42	Ø = 20.94	67.2	16	<0.08 (0.10)	<0.04 (0.10)	4.7	> 40	M42x1 FD16.00	171.9	52
TC2MHR 036-C	0.353	1"	32.14 x 20.19	40.20 x 21.27	Ø = 29.38	Ø = 30.14	102.6	16	<0.08 (0.10)	<0.08 (0.10)	9.6	> 30	C	197.7	61
TC2MHR 036-F	0.353	1"	32.14 x 20.19	40.20 x 21.27	Ø = 29.38	Ø = 30.14	102.6	16	<0.08 (0.10)	<0.08 (0.10)	9.6	> 30	F	168.7	64
TC2MHR 036-E	0.353	1"	32.14 x 20.19	40.20 x 21.27	Ø = 29.38	Ø = 30.14	102.6	16	<0.08 (0.10)	<0.08 (0.10)	9.6	> 30	M42x1 FD16.00	199.2	61
TC2MHR 048-C	0.268	1"	42.33 x 26.59	52.95 x 28.02	Ø = 38.70	Ø = 39.70	133.4	16	<0.08 (0.10)	<0.08 (0.10)	16.7	> 30	C	232.8	75
TC2MHR 048-F	0.268	1"	42.33 x 26.59	52.95 x 28.02	Ø = 38.70	Ø = 39.70	133.4	16	<0.08 (0.10)	<0.08 (0.10)	16.7	> 30	F	203.8	75
TC2MHR 048-E	0.268	1"	42.33 x 26.59	52.95 x 28.02	Ø = 38.70	Ø = 39.70	133.4	16	<0.08 (0.10)	<0.08 (0.10)	16.7	> 30	M42x1 FD16.00	234.3	75
TC2MHR 056-C	0.228	1"	49.76 x 31.25	62.24 x 32.94	Ø = 45.49	Ø = 46.67	157.8	16	<0.04 (0.08)	<0.05 (0.10)	23.1	> 40	C	257.1	80
TC2MHR 056-F	0.228	1"	49.76 x 31.25	62.24 x 32.94	Ø = 45.49	Ø = 46.67	157.8	16	<0.04 (0.08)	<0.05 (0.10)	23.1	> 40	F	228.1	80
TC2MHR 056-E	0.228	1"	49.76 x 31.25	62.24 x 32.94	Ø = 45.49	Ø = 46.67	157.8	16	<0.04 (0.08)	<0.05 (0.10)	23.1	> 40	M42x1 FD16.00	258.7	80
TC2MHR 064-C	0.200	1"	56.73 x 35.63	70.95 x 37.55	Ø = 51.86	Ø = 53.20	181.9	16	<0.04 (0.08)	<0.05 (0.10)	30.0	> 40	C	278.3	100
TC2MHR 064-F	0.200	1"	56.73 x 35.63	70.95 x 37.55	Ø = 51.86	Ø = 53.20	181.9	16	<0.04 (0.08)	<0.05 (0.10)	30.0	> 40	F	249.3	100
TC2MHR 064-E	0.200	1"	56.73 x 35.63	70.95 x 37.55	Ø = 51.86	Ø = 53.20	181.9	16	<0.04 (0.08)	<0.05 (0.10)	30.0	> 40	M42x1 FD16.00	279.8	100
TC2MHR 080-C	0.160	1"	70.91 x 44.54	88.69 x 46.94	Ø = 64.82	Ø = 66.50	226.8	16	<0.04 (0.08)	<0.05 (0.10)	46.9	> 40	C	324	116
TC2MHR 080-F	0.160	1"	70.91 x 44.54	88.69 x 46.94	Ø = 64.82	Ø = 66.50	226.8	16	<0.04 (0.08)	<0.05 (0.10)	46.9	> 40	F	295	116
TC2MHR 080-E	0.160	1"	70.91 x 44.54	88.69 x 46.94	Ø = 64.82	Ø = 66.50	226.8	16	<0.04 (0.08)	<0.05 (0.10)	46.9	> 40	M42x1 FD16.00	325.5	116
TC2MHR 096-C	0.137	1"	82.81 x 52.01	103.58 x 54.82	Ø = 75.70	Ø = 77.66	278.6	16	<0.05 (0.10)	<0.07 (0.10)	63.9	> 40	C	369.4	143
TC2MHR 096-F	0.137	1"	82.81 x 52.01	103.58 x 54.82	Ø = 75.70	Ø = 77.66	278.6	16	<0.05 (0.10)	<0.07 (0.10)	63.9	> 40	F	340.4	143
TC2MHR 096-E	0.137	1"	82.81 x 52.01	103.58 x 54.82	Ø = 75.70	Ø = 77.66	278.6	16	<0.05 (0.10)	<0.07 (0.10)	63.9	> 40	M42x1 FD16.00	370.9	143
TC2MHR 120-C	0.104	1"	109.09 x 68.52	136.44 x 72.21	Ø = 99.72	Ø = 102.31	334.6	16	<0.07 (0.10)	<0.07 (0.10)	110.9	> 40	C	451.4	180
TC2MHR 120-F	0.104	1"	109.09 x 68.52	136.44 x 72.21	Ø = 99.72	Ø = 102.31	334.6	16	<0.07 (0.10)	<0.07 (0.10)	110.9	> 40	F	422.4	180
TC2MHR 120-E	0.104	1"	109.09 x 68.52	136.44 x 72.21	Ø = 99.72	Ø = 102.31	334.6	16	<0.07 (0.10)	<0.07 (0.10)	110.9	> 40	M42x1 FD16.00	452.9	180
TC2MHR 144-C	0.089	1"	127.47 x 80.07	159.44 x 84.38	Ø = 116.53	Ø = 119.55	396.0	16	<0.05 (0.10)	<0.05 (0.10)	151.5	> 40	C	510.8	200
TC2MHR 144-F	0.089	1"	127.47 x 80.07	159.44 x 84.38	Ø = 116.53	Ø = 119.55	396.0	16	<0.05 (0.10)	<0.05 (0.10)	151.5	> 40	F	481.8	200
TC2MHR 144-E	0.089	1"	127.47 x 80.07	159.44 x 84.38	Ø = 116.53	Ø = 119.55	396.0	16	<0.05 (0.10)	<0.05 (0.10)	151.5	> 40	M42x1 FD16.00	512.4	200
TC2MHR 192-C	0.067	1"	169.33 x 106.36	211.79 x 112.09	Ø = 154.79	Ø = 158.80	527.5	16	<0.05 (0.10)	<0.04 (0.10)	267.3	> 40	C	649.2	260
TC2MHR 192-F	0.067	1"	169.33 x 106.36	211.79 x 112.09	Ø = 154.79	Ø = 158.80	527.5	16	<0.05 (0.10)	<0.04 (0.10)	267.3	> 40	F	620.2	260
TC2MHR 192-E	0.067	1"	169.33 x 106.36	211.79 x 112.09	Ø = 154.79	Ø = 158.80	527.5	16	<0.05 (0.10)	<0.04 (0.10)	267.3	> 40	M42x1 FD16.00	650.8	260
TC2MHR 240-C	0.053	1"	214.06 x 134.45	267.74 x 141.70	Ø = 195.68	Ø = 200.75	492.9	16	<0.05 (0.10)	<0.04 (0.10)	427.2	> 40	C	812.2	322
TC2MHR 240-F	0.053	1"	214.06 x 134.45	267.74 x 141.70	Ø = 195.68	Ø = 200.75	492.9	16	<0.05 (0.10)	<0.04 (0.10)	427.2	> 40	F	783.2	322
TC2MHR 240-E	0.053	1"	214.06 x 134.45	267.74 x 141.70	Ø = 195.68	Ø = 200.75	492.9	16	<0.05 (0.10)	<0.04 (0.10)	427.2	> 40	M42x1 FD16.00	813.7	322

- 1 Working distance: distance between the front end of the mechanics and the object.
- 2 Working F-number: the real F-number of a lens in operating conditions.
- 3 Maximum angle between chief rays and optical axis on the object side.
- 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 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.

TC1MHR-TC4MHR series

Telecentric lenses for sensors up to 4/3"



Mount C





Mount E = M42x1



Mount F

FOR COAXIAL TELECENTRIC LENSES UP TO 1" DETECTORS SEE ALSO		
	TCCX2M series	p. 46
FULL RANGE OF COMPATIBLE ILLUMINATORS		
	LTCLHP series	p. 128

FULL RANGE OF COMPATIBLE ACCESSORIES		
	CMMR series	p. 233
FULL RANGE OF COMPATIBLE CAMERAS		
	Area scan cameras	p. 188-203

TC3MHR series for up to 1.1" sensors

Part number	Mag.	Max sensor size	Detector type				Optical specifications					Mechanical specs			
			1/1.2" IMX174 / IMX249 13.3 mm diag w x h	1" IMX255 / IMX267 16.1 mm diag w x h	1.1" IMX253 / IMX304 17.6 mm diag w x h	4/3" IMX387 21.7 mm diag w x h	WD	wF/#	Telecentricity	Distortion	Field depth	CTF	Mount	Length	Diam.
			11.35 x 7.13 (mm x mm)	14.19 x 7.51 (mm x mm)	14.16 x 10.37 (mm x mm)	18.9 x 10.6 (mm x mm)	(mm)		typical (max)	typical (max)	(mm)	@50lp/mm		(mm)	(mm)
Object field of view (mm x mm) 6															
TC3MHR 016-C	0.850	1.1"	13.35 x 8.38	16.69 x 8.84	16.66 x 12.20	Ø = 12.52	43.1	11	<0.08 (0.10)	<0.08 (0.10)	1.1	> 30	C	155.2	40
TC3MHR 024-C	0.564	1.1"	20.12 x 12.63	25.16 x 13.32	25.10 x 18.39	Ø = 18.86	67.2	11	<0.08 (0.10)	<0.08 (0.10)	2.6	> 40	C	177.0	44
TC3MHR 036-C	0.392	1.1"	28.94 x 18.18	36.20 x 19.16	36.12 x 26.46	Ø = 27.14	102.6	11	<0.08 (0.10)	<0.08 (0.10)	5.4	> 40	C	204.4	61
TC3MHR 048-C	0.303	1.1"	37.44 x 23.52	46.83 x 24.79	46.73 x 34.23	Ø = 35.11	132.9	8	<0.08 (0.10)	<0.08 (0.10)	6.5	> 50	C	223.4	75
TC3MHR 056-C	0.259	1.1"	43.80 x 27.51	54.79 x 29.00	54.67 x 40.04	Ø = 41.08	157.8	8	<0.08 (0.10)	<0.08 (0.10)	8.9	> 55	C	246.7	80
TC3MHR 064-C	0.227	1.1"	49.98 x 31.39	62.51 x 33.08	62.37 x 45.69	Ø = 46.87	181.9	8	<0.08 (0.10)	<0.08 (0.10)	11.6	> 55	C	284.0	100
TC3MHR 080-C	0.182	1.1"	62.34 x 39.15	77.97 x 41.26	77.80 x 56.98	Ø = 58.46	226.8	8	<0.08 (0.10)	<0.08 (0.10)	18.1	> 50	C	313.7	116
TC3MHR 096-C	0.153	1.1"	74.15 x 46.58	92.75 x 49.08	92.54 x 67.78	Ø = 69.54	278.6	8	<0.08 (0.10)	<0.08 (0.10)	25.6	> 55	C	354.7	143
TC3MHR 120-C	0.118	1.1"	96.14 x 60.39	120.25 x 63.64	119.99 x 87.89	Ø = 90.17	334.6	8	<0.08 (0.10)	<0.08 (0.10)	43.1	> 55	C	440.4	180
TC3MHR 144-C	0.100	1.1"	113.45 x 71.26	141.90 x 75.10	141.59 x 103.71	Ø = 106.40	396.0	8	<0.08 (0.10)	<0.08 (0.10)	60.0	> 55	C	499.8	200
TC3MHR 192-C	0.075	1.1"	151.27 x 95.01	189.20 x 100.13	188.79 x 138.28	Ø = 141.86	527.6	8	<0.08 (0.10)	<0.08 (0.10)	106.7	> 50	C	640.3	260
TC3MHR 240-C	0.059	1.1"	192.29 x 120.78	240.51 x 127.29	239.98 x 175.78	Ø = 180.34	492.9	8	<0.08 (0.10)	<0.08 (0.10)	172.4	> 55	C	801.6	322

- Working distance: distance between the front end of the mechanics and the object.
- Working F-number: the real F-number of a lens in operating conditions.
- Maximum angle between chief rays and optical axis on the object side.
- Percent deviation of the real image compared to an ideal, undistorted image: typical (average production) values and maximum (guaranteed) values are listed.
- 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.
- For the fields with the indication "Ø =", the image of a circular object of such diameter is fully inscribed into the detector.

TC4MHR series for up to 4/3" sensors

Part number	Mag.	Max sensor size (x)	Detector type				Optical specifications						Mechanical specs			
			1/1.2" IMX174 / IMX249 13.3 mm diag w x h	1" IMX255 / IMX267 16.1 mm diag w x h	1.1" IMX253 / IMX304 17.6 mm diag w x h	4/3" IMX387 21.7 mm diag w x h	WD	wF/#	Telecentricity typical (max)	Distortion typical (max)	Field depth	CTF @50lp/mm	Mount	Length	Diam.	
			(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)	(mm)		(deg)	(%)	(mm)	(%)		(mm)	(mm)	
TC4M lenses			Object field of view (mm x mm) 6													
TC4M 004-C	4.000	4/3"	2.84 x 1.78	3.55 x 1.88	3.54 x 2.59	4.72 x 2.66	57.1	22	<0.08 (0.10)	<0.08 (0.10)	0.1	> 30	C	206.4	45	
TC4M 004-F	4.000	4/3"	2.84 x 1.78	3.55 x 1.88	3.54 x 2.59	4.72 x 2.66	57.1	22	<0.08 (0.10)	<0.08 (0.10)	0.1	> 30	F	178.4	45	
TC4M 007-C	2.667	4/3"	4.25 x 2.67	5.32 x 2.82	5.31 x 3.89	7.08 x 3.99	31.2	22	<0.08 (0.10)	<0.06 (0.10)	0.2	> 30	C	183.5	45	
TC4M 007-F	2.667	4/3"	4.25 x 2.67	5.32 x 2.82	5.31 x 3.89	7.08 x 3.99	31.2	22	<0.08 (0.10)	<0.06 (0.10)	0.2	> 30	F	155.4	45	
TC4M 009-C	2.000	4/3"	5.67 x 3.56	7.10 x 3.76	7.08 x 5.19	9.44 x 5.32	63.3	22	<0.08 (0.10)	<0.05 (0.10)	0.4	> 30	C	170.0	45	
TC4M 009-F	2.000	4/3"	5.67 x 3.56	7.10 x 3.76	7.08 x 5.19	9.44 x 5.32	63.3	22	<0.08 (0.10)	<0.05 (0.10)	0.4	> 30	F	142.0	45	
TC4MHR lenses																
TC4MHR 016-C	1.055	4/3"	10.75 x 6.75	13.45 x 7.12	13.42 x 9.83	17.89 x 10.09	43.8	16	<0.08 (0.10)	<0.04 (0.10)	1.1	> 30	C	169.6	45	
TC4MHR 016-F	1.055	4/3"	10.75 x 6.75	13.45 x 7.12	13.42 x 9.83	17.89 x 10.09	43.8	16	<0.08 (0.10)	<0.04 (0.10)	1.1	> 30	F	140.6	64	
TC4MHR 016-E	1.055	4/3"	10.75 x 6.75	13.45 x 7.12	13.42 x 9.83	17.89 x 10.09	43.8	16	<0.08 (0.10)	<0.04 (0.10)	1.1	> 30	M42x1 FD16.00	171.1	52	
TC4MHR 024-C	0.700	4/3"	16.21 x 10.18	20.27 x 10.73	20.23 x 14.82	26.97 x 15.20	67.2	16	<0.08 (0.10)	<0.04 (0.10)	2.4	> 30	C	194.8	45	
TC4MHR 024-F	0.700	4/3"	16.21 x 10.18	20.27 x 10.73	20.23 x 14.82	26.97 x 15.20	57.2	16	<0.08 (0.10)	<0.04 (0.10)	2.4	> 30	F	165.8	64	
TC4MHR 024-E	0.700	4/3"	16.21 x 10.18	20.27 x 10.73	20.23 x 14.82	26.97 x 15.20	57.2	16	<0.08 (0.10)	<0.04 (0.10)	2.4	> 30	M42x1 FD16.00	196.3	52	
TC4MHR 036-C	0.486	4/3"	23.34 x 14.66	29.20 x 15.45	29.13 x 21.34	38.84 x 21.89	102.6	16	<0.05 (0.10)	<0.08 (0.10)	5.1	> 30	C	222.0	61	
TC4MHR 036-F	0.486	4/3"	23.34 x 14.66	29.20 x 15.45	29.13 x 21.34	38.84 x 21.89	102.6	16	<0.05 (0.10)	<0.08 (0.10)	5.1	> 30	F	193.0	64	
TC4MHR 036-E	0.486	4/3"	23.34 x 14.66	29.20 x 15.45	29.13 x 21.34	38.84 x 21.89	102.6	16	<0.05 (0.10)	<0.08 (0.10)	5.1	> 30	M42x1 FD16.00	223.6	61	
TC4MHR 048-C	0.369	4/3"	30.75 x 19.31	38.46 x 20.35	38.37 x 28.11	51.16 x 28.83	133.4	16	<0.08 (0.10)	<0.08 (0.10)	8.8	> 40	C	257.1	75	
TC4MHR 048-F	0.369	4/3"	30.75 x 19.31	38.46 x 20.35	38.37 x 28.11	51.16 x 28.83	133.4	16	<0.08 (0.10)	<0.08 (0.10)	8.8	> 40	F	228.1	75	
TC4MHR 048-E	0.369	4/3"	30.75 x 19.31	38.46 x 20.35	38.37 x 28.11	51.16 x 28.83	133.4	16	<0.08 (0.10)	<0.08 (0.10)	8.8	> 40	M42x1 FD16.00	258.6	75	
TC4MHR 056-C	0.314	4/3"	36.13 x 22.69	45.19 x 23.92	45.09 x 33.03	60.12 x 33.88	157.8	16	<0.05 (0.10)	<0.04 (0.10)	12.2	> 40	C	280.7	80	
TC4MHR 056-F	0.314	4/3"	36.13 x 22.69	45.19 x 23.92	45.09 x 33.03	60.12 x 33.88	157.8	16	<0.05 (0.10)	<0.04 (0.10)	12.2	> 40	F	251.7	80	
TC4MHR 056-E	0.314	4/3"	36.13 x 22.69	45.19 x 23.92	45.09 x 33.03	60.12 x 33.88	157.8	16	<0.05 (0.10)	<0.04 (0.10)	12.2	> 40	M42x1 FD16.00	282.2	80	
TC4MHR 064-C	0.275	4/3"	41.25 x 25.91	51.60 x 27.31	51.49 x 37.71	68.65 x 38.69	181.9	16	<0.05 (0.10)	<0.04 (0.10)	15.9	> 40	C	301.8	100	
TC4MHR 064-F	0.275	4/3"	41.25 x 25.91	51.60 x 27.31	51.49 x 37.71	68.65 x 38.69	181.9	16	<0.05 (0.10)	<0.04 (0.10)	15.9	> 40	F	272.8	100	
TC4MHR 064-E	0.275	4/3"	41.25 x 25.91	51.60 x 27.31	51.49 x 37.71	68.65 x 38.69	181.9	16	<0.05 (0.10)	<0.04 (0.10)	15.9	> 40	M42x1 FD16.00	303.4	100	
TC4MHR 080-C	0.221	4/3"	51.33 x 32.24	64.21 x 33.98	64.07 x 46.93	85.42 x 48.14	226.8	16	<0.05 (0.10)	<0.04 (0.10)	24.6	> 40	C	347.6	116	
TC4MHR 080-F	0.221	4/3"	51.33 x 32.24	64.21 x 33.98	64.07 x 46.93	85.42 x 48.14	226.8	16	<0.05 (0.10)	<0.04 (0.10)	24.6	> 40	F	318.6	116	
TC4MHR 080-E	0.221	4/3"	51.33 x 32.24	64.21 x 33.98	64.07 x 46.93	85.42 x 48.14	226.8	16	<0.05 (0.10)	<0.04 (0.10)	24.6	> 40	M42x1 FD16.00	349.1	116	
TC4MHR 096-C	0.186	4/3"	60.99 x 38.31	76.29 x 40.38	76.12 x 55.76	101.50 x 57.20	278.6	16	<0.05 (0.10)	<0.04 (0.10)	34.7	> 35	C	392.8	143	
TC4MHR 096-F	0.186	4/3"	60.99 x 38.31	76.29 x 40.38	76.12 x 55.76	101.50 x 57.20	278.6	16	<0.05 (0.10)	<0.04 (0.10)	34.7	> 35	F	363.8	143	
TC4MHR 096-E	0.186	4/3"	60.99 x 38.31	76.29 x 40.38	76.12 x 55.76	101.50 x 57.20	278.6	16	<0.05 (0.10)	<0.04 (0.10)	34.7	> 35	M42x1 FD16.00	394.3	143	
TC4MHR 120-C	0.143	4/3"	79.34 x 49.83	99.23 x 52.52	99.01 x 72.52	132.02 x 74.40	334.6	16	<0.05 (0.10)	<0.04 (0.10)	58.7	> 30	C	475.2	180	
TC4MHR 120-F	0.143	4/3"	79.34 x 49.83	99.23 x 52.52	99.01 x 72.52	132.02 x 74.40	334.6	16	<0.05 (0.10)	<0.04 (0.10)	58.7	> 30	F	446.2	180	
TC4MHR 120-E	0.143	4/3"	79.34 x 49.83	99.23 x 52.52	99.01 x 72.52	132.02 x 74.40	334.6	16	<0.05 (0.10)	<0.04 (0.10)	58.7	> 30	M42x1 FD16.00	476.7	180	
TC4MHR 144-C	0.122	4/3"	92.99 x 58.41	116.31 x 61.56	116.06 x 85.01	154.74 x 87.21	396.0	16	<0.05 (0.10)	<0.04 (0.10)	80.6	> 30	C	537.7	200	
TC4MHR 144-F	0.122	4/3"	92.99 x 58.41	116.31 x 61.56	116.06 x 85.01	154.74 x 87.21	396.0	16	<0.05 (0.10)	<0.04 (0.10)	80.6	> 30	F	508.7	200	
TC4MHR 144-E	0.122	4/3"	92.99 x 58.41	116.31 x 61.56	116.06 x 85.01	154.74 x 87.21	396.0	16	<0.05 (0.10)	<0.04 (0.10)	80.6	> 30	M42x1 FD16.00	539.2	200	
TC4MHR 192-C	0.092	4/3"	123.32 x 77.46	154.24 x 81.63	153.90 x 112.73	205.20 x 115.65	527.6	16	<0.05 (0.10)	<0.04 (0.10)	141.8	> 30	C	679.1	260	
TC4MHR 192-F	0.092	4/3"	123.32 x 77.46	154.24 x 81.63	153.90 x 112.73	205.20 x 115.65	527.6	16	<0.05 (0.10)	<0.04 (0.10)	141.8	> 30	F	650.1	260	
TC4MHR 192-E	0.092	4/3"	123.32 x 77.46	154.24 x 81.63	153.90 x 112.73	205.20 x 115.65	527.6	16	<0.05 (0.10)	<0.04 (0.10)	141.8	> 30	M42x1 FD16.00	680.7	260	
TC4MHR 240-C	0.073	4/3"	155.41 x 97.62	194.38 x 102.88	193.96 x 142.07	258.61 x 145.75	492.9	16	<0.05 (0.10)	<0.05 (0.10)	225.2	> 30	C	827.3	322	
TC4MHR 240-F	0.073	4/3"	155.41 x 97.62	194.38 x 102.88	193.96 x 142.07	258.61 x 145.75	492.9	16	<0.05 (0.10)	<0.05 (0.10)	225.2	> 30	F	798.3	322	
TC4MHR 240-E	0.073	4/3"	155.41 x 97.62	194.38 x 102.88	193.96 x 142.07	258.61 x 145.75	492.9	16	<0.05 (0.10)	<0.05 (0.10)	225.2	> 30	M42x1 FD16.00	828.8	322	

- 1 Working distance: distance between the front end of the mechanics and the object.
- 2 Working F-number: the real F-number of a lens in operating conditions.
- 3 Maximum angle between chief rays and optical axis on the object side.
- 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 5.5 µm.
- 6 For the fields with the indication "∅ =", the image of a circular object of such diameter is fully inscribed into the detector.

TC1MHR-TC4MHR CORE series

Compact telecentric lenses for sensors up to 4/3"

Mag. 0.087-0.369 x



KEY ADVANTAGES

Excellent optical performance

TC1MHR-TC4MHR CORE telecentric lenses deliver excellent optical performance as other comparable Opto Engineering® telecentric lenses.

Extremely compact

TC1MHR-TC4MHR CORE lenses are up to 70% smaller than other telecentric lenses on the market.

Designed for flexibility and smart integration

TC1MHR-TC4MHR CORE lenses integrate a camera phase adjustment and can be mounted on multiple sides with or without clamps, allowing you to cut costs.

Cost reduction

Systems integrating TC1MHR-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.

Detailed test report with measured optical parameters.

TC1MHR-TC4MHR CORE series are ultra compact telecentric lenses tailored for high-resolution sensors up to 4/3".

TC1MHR-TC4MHR CORE lenses deliver excellent optical performance 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.

TC1MHR-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 performance and is extremely compact.

FULL RANGE OF COMPATIBLE ILLUMINATORS		
	LTCLHP CORE series	p. 130
FULL RANGE OF COMPATIBLE ACCESSORIES		
	CMHOCR series	p. 249
FULL RANGE OF COMPATIBLE CAMERAS		
	Area scan cameras	p. 188-203



TCCR2M080-C
with C Mount



TCCR4M096-E
with E Mount (M42x1)

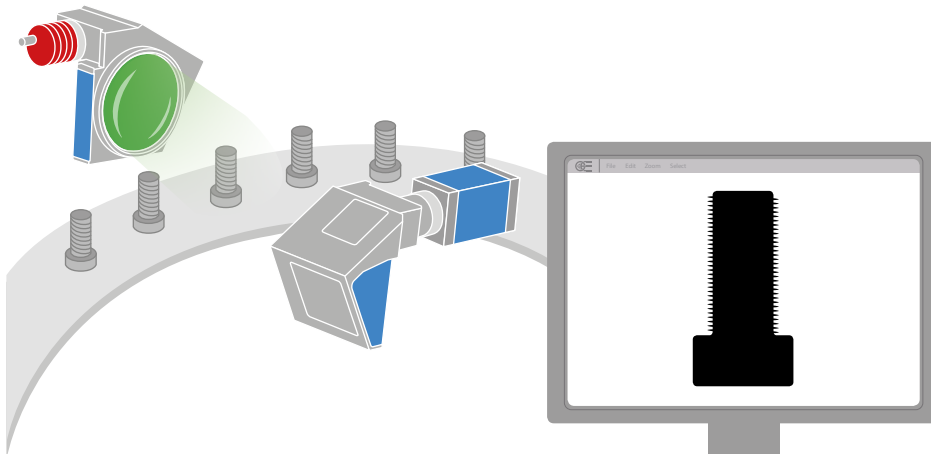


TCCR4M056-F
with F Mount



Built-in phase adjustment makes it easy to align the camera sensor.

Application example



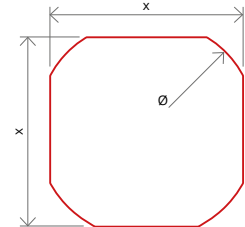
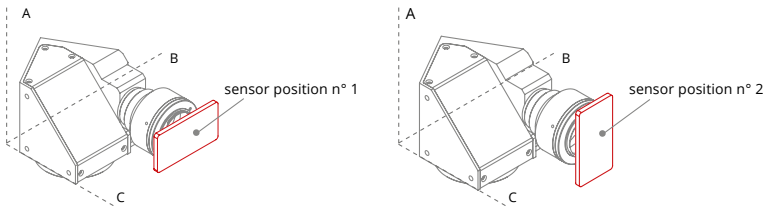
Standard solution with a 4/3" camera, TC4MHR CORE lens and a LTCLHP CORE illuminator.

TC1MHR-TC4MHR CORE series

Compact telecentric lenses for sensors up to 4/3"

TC1MHR-TC4MHR CORE lens dimensions (A, B, C) and correct position of the sensor in relation to the lens:

Technical information:



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

Image shape dimensions (Ø, x).

TC1MHR CORE series for up to 1/1.2" sensors

Part number	Mag.	Max sensor size (x)	Image shape dimensions (Ø, x=mm)	Detector type				Optical specifications					Mechanical specs				
				1/1.2" IMX174 / IMX249 13.3 mm	1" IMX255/ IMX267 16 mm	1.1" IMX253 / IMX304 17.6 mm	4/3" IMX387 21.7 mm	WD	wF/#	Telecentricity	Distortion	Field	CTF	Mount	Dimensions		
				diag. w x h 11.35 x 7.13 (mm x mm)	diag. w x h 12.8 x 9.6 (mm x mm)	diag. w x h 14.16 x 10.37 (mm x mm)	diag. w x h 18.9 x 10.6 (mm x mm)	(mm)		typical (max)	typical (max)	depth	@50lp/mm		A	B	C
				Object field of view (mm x mm) 6				1	2	3	4	5					
TC1MHR 048-C	0.222	1/1.2"	Ø=13.3, x=11.6	50.9 x 32.0	Ø=60, x=43	Ø=60, x=47	Ø=60, x=48	132.4	8	< 0.08 (0.10)	< 0.08 (0.10)	13.4	> 55	C	77	106	144
TC1MHR 056-C	0.190	1/1.2"	Ø=13.4, x=11.6	59.5 x 37.4	Ø=71, x=51	Ø=71, x=55	Ø=71, x=56	157.8	8	< 0.08 (0.10)	< 0.08 (0.10)	18.3	> 55	C	94	110	154
TC1MHR 064-C	0.166	1/1.2"	Ø=13.7, x=11.5	68.1 x 42.8	Ø=83, x=58	Ø=83, x=63	Ø=83, x=64	181.9	8	< 0.08 (0.10)	< 0.08 (0.10)	24.0	> 55	C	101	122	162
TC1MHR 080-C	0.134	1/1.2"	Ø=13.4, x=11.5	84.3 x 53.0	Ø=100, x=72	Ø=100, x=78	Ø=100, x=79	226.8	8	< 0.08 (0.10)	< 0.08 (0.10)	36.8	> 50	C	119	145	181
TC1MHR 096-C	0.114	1/1.2"	Ø=13.7, x=11.3	99.1 x 62.3	Ø=120, x=84	Ø=120, x=91	Ø=120, x=93	278.6	8	< 0.08 (0.10)	< 0.08 (0.10)	50.8	> 55	C	139	172	198
TC1MHR 120-C	0.087	1/1.2"	Ø=13.5, x=11.1	129.9 x 81.6	Ø=155, x=110	Ø=155, x=120	Ø=155, x=122	334.6	8	< 0.08 (0.10)	< 0.08 (0.10)	87.2	> 55	C	182	220	231

TC2MHR CORE series for up to 1" sensors

Part number	Mag.	Max sensor size (x)	Image shape dimensions (Ø, x=mm)	Detector type				Optical specifications					Mechanical specs				
				1/1.2" IMX174 / IMX249 13.3 mm	1" IMX255/ IMX267 16 mm	1.1" IMX253 / IMX304 17.6 mm	4/3" IMX387 21.7 mm	WD	wF/#	Telecentricity	Distortion	Field	CTF	Mount	Dimensions		
				diag. w x h 11.35 x 7.13 (mm x mm)	diag. w x h 12.8 x 9.6 (mm x mm)	diag. w x h 14.16 x 10.37 (mm x mm)	diag. w x h 18.9 x 10.6 (mm x mm)	(mm)		typical (max)	typical (max)	depth	@50lp/mm		A	B	C
				Object field of view (mm x mm) 6				1	2	3	4	5					
TC2MHR 048-C	0.268	1"	Ø=16.1, x=13.9	42.2 x 26.5	47.8 x 35.8	Ø=60, x=39	Ø=60, x=40	133.4	16	< 0.08 (0.10)	< 0.08 (0.10)	18.4	> 30	C	77	109	168
TC2MHR 048-E	0.268	1"	Ø=16.1, x=13.9	42.2 x 26.5	47.8 x 35.8	Ø=60, x=39	Ø=60, x=40	133.4	16	< 0.08 (0.10)	< 0.08 (0.10)	18.4	> 30	M42x1 FD16.00	77	112	170
TC2MHR 056-C	0.228	1"	Ø=16.2, x=13.9	49.6 x 31.1	56.1 x 42.1	Ø=71, x=46	Ø=71, x=46	157.8	16	< 0.04 (0.08)	< 0.05 (0.10)	25.4	> 40	C	94	112	178
TC2MHR 056-E	0.228	1"	Ø=16.2, x=13.9	49.6 x 31.1	56.1 x 42.1	Ø=71, x=46	Ø=71, x=46	157.8	16	< 0.04 (0.08)	< 0.05 (0.10)	25.4	> 40	M42x1 FD16.00	94	114	178
TC2MHR 064-C	0.200	1"	Ø=16.6, x=14.0	56.5 x 35.5	64.0 x 48.0	Ø=83, x=52	Ø=83, x=53	181.9	16	< 0.04 (0.08)	< 0.05 (0.10)	33.0	> 40	C	101	125	185
TC2MHR 064-E	0.200	1"	Ø=16.6, x=14.0	56.5 x 35.5	64.0 x 48.0	Ø=83, x=52	Ø=83, x=53	181.9	16	< 0.04 (0.08)	< 0.05 (0.10)	33.0	> 40	M42x1 FD16.00	101	127	187
TC2MHR 080-C	0.160	1"	Ø=16.3, x=13.8	70.6 x 44.4	80.0 x 60.0	Ø=102, x=65	Ø=102, x=66	226.8	16	< 0.04 (0.08)	< 0.05 (0.10)	51.6	> 40	C	119	145	205
TC2MHR 080-E	0.160	1"	Ø=16.3, x=13.8	70.6 x 44.4	80.0 x 60.0	Ø=102, x=65	Ø=102, x=66	226.8	16	< 0.04 (0.08)	< 0.05 (0.10)	51.6	> 40	M42x1 FD16.00	119	149	207
TC2MHR 096-C	0.137	1"	Ø=16.7, x=13.7	82.5 x 51.8	93.4 x 70.1	Ø=122, x=76	Ø=122, x=77	278.6	16	< 0.05 (0.10)	< 0.07 (0.10)	70.3	> 40	C	139	172	230
TC2MHR 096-E	0.137	1"	Ø=16.7, x=13.7	82.5 x 51.8	93.4 x 70.1	Ø=122, x=76	Ø=122, x=77	278.6	16	< 0.05 (0.10)	< 0.07 (0.10)	70.3	> 40	M42x1 FD16.00	139	172	232
TC2MHR 120-C	0.104	1"	Ø=16.4, x=13.4	108.7 x 68.3	123.1 x 92.3	Ø=158, x=100	Ø=158, x=102	334.6	16	< 0.06 (0.10)	< 0.08 (0.10)	122.0	> 40	C	182	220	258
TC2MHR 120-E	0.104	1"	Ø=16.4, x=13.4	108.7 x 68.3	123.1 x 92.3	Ø=158, x=100	Ø=158, x=102	334.6	16	< 0.06 (0.10)	< 0.08 (0.10)	122.0	> 40	M42x1 FD16.00	182	220	260
TC2MHR 120-F	0.104	1"	Ø=16.4, x=13.4	108.7 x 68.3	123.1 x 92.3	Ø=158, x=100	Ø=158, x=102	334.6	16	< 0.06 (0.10)	< 0.08 (0.10)	122.0	> 40	F	182	220	233

- Working distance: distance between the front end of the mechanics and the object.
- Working F-number: the real F-number of a lens in operating conditions.
- Maximum angle between chief rays and optical axis on the object side.
- Percent deviation of the real image compared to an ideal, undistorted image: typical (average production) values and maximum (guaranteed) values are listed.
- 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.
- In case of vignetting, FOV dimensions are indicated with "Ø = , x = ", where "Ø =" stands for diameter and "x=" indicates the nominal FOV height and length (see Tech Info for related drawing).
- Indicates the dimensions and shape of image, where "Ø =" stands for diameter and "x=" indicates the nominal image height and length (see Tech Info for related drawing).

TC3MHR-TC5MHR CORE PLUS series

Compact large-FOV telecentric lenses for sensors up to 4/3"

Mag. 0.053-0.117 x

NEW MODELS



PATENTED

KEY ADVANTAGES

Make your large FOV system up to 45% smaller

TC3MHR-5MHR CORE PLUS lenses are up to 45% shorter than other telecentric lenses on the market. The short working distance minimizes the size of the whole system.

Designed for the latest camera sensors

TC3MHR CORE PLUS telecentric lenses are designed for sensors up to 1.1" like the IMX387, while TC5MHR CORE PLUS series lenses are ideal for sensors up to 4/3" like the KAC-12040.

Smart integration

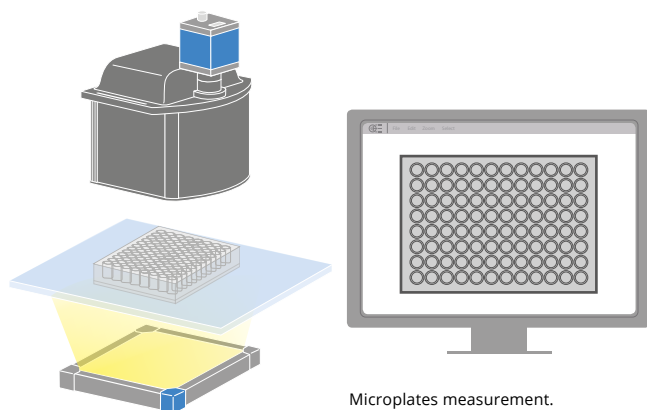
TC3MHR-5MHR CORE PLUS lenses integrate a mounting flange for easy integration without additional clamps.

System compactness is a competitive advantage

TC3MHR-5MHR CORE PLUS lenses minimize the size of your system, resulting in less manufacturing, shipping and storage costs.

TC3MHR-5MHR CORE PLUS series are large FOV telecentric lenses for the latest generation sensors up to 1.1" like the IMX387 and 4/3" sensors like the KAC-12040. They are specifically designed to accurately measure large objects in a reduced space. Inspired by catadioptric telescopes, their folded optical path allows large FOV imaging while keeping the overall footprint compact. The size reduction is up to 45% compared with other telecentric lenses on the market.

The length and working distance of a telecentric lens strongly impact the size of a vision system. This is especially critical when a large FOV telecentric lens is used with a telecentric illuminator, as the overall dimensions of the system are doubled. For this reason the working distance of TC3MHR-5MHR CORE PLUS series has been reduced to make a measurement system as compact as possible.



Microplates measurement.

ADVANTAGES



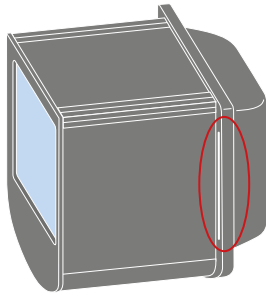
Save more

- Lower manufacturing cost due to less material employed
- Cost of mounting is reduced as no additional clamps are needed
- Less space required for storage and use
- Lower shipment expenses due to smaller size
- Lower transportation risks

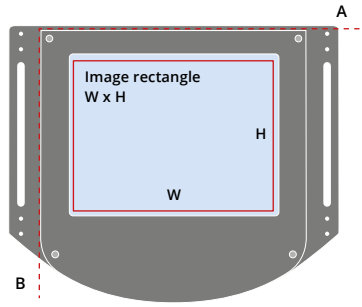
Sell more

- Compactness brings a competitive advantage

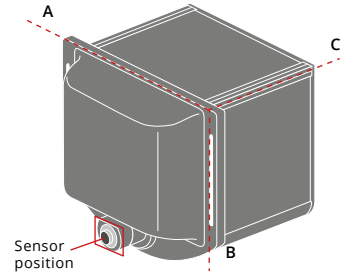
Compatible backlights	LT2BC series		LTBC series		LTBP series		
	FOV max. (mm)	Part Number	Lighting area dim. (mm)	Part Number	Lighting area dim. (mm)	Part Number	Lighting area dim. (mm)
TCCP3 MHR 144-C	165.4 x 121	LT2BC192144-X	192 x 144	LTBC174174-X	174.5 x 174.5	LTBP192144-X	192 x 144
TCCP3 MHR 192-C	221.4 x 161.9	LT2BC192144-X	192 x 144	LTBC174174-X	174.5 x 174.5	LTBP240180-X	240 x 180
TCCP3 MHR 260-C	267.9 x 196.2	LT2BC288216-X	288 x 216	-	-	LTBP288216-X	288 x 216
TCCP5 MHR 144-F	161.2 x 121.1	LT2BC240180-X	240 x 180	LTBC234234-X	234.5 x 234.5	LTBP192144-X	192 x 144
TCCP5 MHR 192-F	215.7 x 162	LT2BC240180-X	240 x 180	LTBC234234-X	234.5 x 234.5	LTBP240180-X	240 x 180
TCCP5 MHR 260-F	251.4 x 188.9	LT2BC288216-X	288 x 216	-	-	LTBP288216-X	288 x 216



Built-in mounting flange: no additional clamps required.

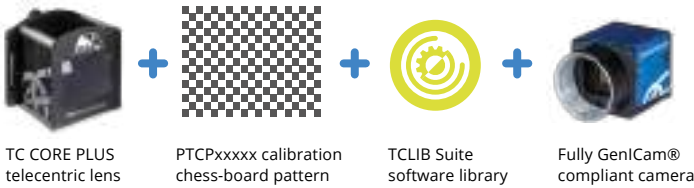


The width of the FOV (W) is aligned along the A axis.
The height of the FOV (H) is aligned along the B axis.



The long side of the sensor has to be aligned along the A axis.

Recommended product setup:



FULL RANGE OF COMPATIBLE TELECENTRIC ILLUMINATORS	
	LTCLHP CORE PLUS series p. 134
FULL RANGE OF COMPATIBLE BACKLIGHTS	
	LT2BC, LTBC, LTBP series p. 118-125
FULL RANGE OF COMPATIBLE ACCESSORIES	
	PTCP calibration patterns p. 241
FULL RANGE OF COMPATIBLE CAMERAS	
	Area scan cameras p. 188-203

For best measurement accuracy, TC CORE PLUS telecentric lenses should be used with:

- TCLIB Suite, an Opto Engineering® proprietary software library for distortion calibration and overall optimization of telecentric measurement setups (see page 220)
- a fully GenICam® compliant camera (see page 192-193, 196-197)
- a specifically designed PTCPxxxx chessboard calibration pattern (see page 241)

Part number	Mag. (x)	Max sensor size (mm x mm)	Image rectangle (mm x mm)	Detector type			Optical specifications							Mechanical specs			
				1" IMX255 / IMX267 17.6 mm diag. w x h (mm x mm)	1.1" IMX253 / IMX304 17.6 mm diag. w x h (mm x mm)	4/3" IMX387 21.7 mm diag. w x h (mm x mm)	WD (mm)	wF/#	Tele- centricity typical (max) (deg)	Distor- tion (max) (%)	Residual distortion (max) (%)	Field depth (mm)	CTF @50lp/mm (%)	Mount	Dimensions (mm)		
				1	2	3	4	5	6	7	8	A	B	C	9		
TCCP3 MHR 144-C	0.086	1.1"	14.90 x 10.90	165.4 x 87.5	165.5 x 121.2	-	232.0	11	<0.06 (0.10)	< 0.8	< 0.01	77	> 40	C	332.0	302.5	339.4
TCCP3 MHR 192-C	0.064	1.1"	14.90 x 10.90	200.0 x 117.2	200.0 x 162.2	-	288.0	10	<0.12 (0.18)	< 0.8	< 0.01	126	> 45	C	410.4	344.1	365.0
TCCP3 MHR 260-C	0.053	1.1"	14.90 x 10.90	267.7 x 141.7	267.9 x 196.2	-	366.0	10	<0.18 (0.22)	< 0.9	< 0.01	184	> 50	C	480.0	396.7	436.8
TCCP5 MHR 144-F	0.117	4/3"	19.82 x 14.88	121.2 x 64.2	121.3 x 88.8	161.3 x 90.9	217.0	14	<0.06 (0.10)	< 0.8	< 0.01	53	> 35	F	332.0	302.5	350.4
TCCP5 MHR 192-F	0.088	4/3"	19.82 x 14.88	162.2 x 85.8	162.3 x 118.9	198.0 x 121.6	288.0	12	<0.12 (0.18)	< 0.8	< 0.01	81	> 40	F	410.4	344.1	370.8
TCCP5 MHR 260-F	0.072	4/3"	19.82 x 14.88	197.1 x 104.3	197.2 x 144.4	262.2 x 147.8	346.0	12	<0.18 (0.22)	< 0.9	< 0.01	120	> 40	F	480.0	396.7	436.4

Residual distortion after calibration with TCLIB Suite software library, using PTCPXXX calibration pattern and fully GenICam® compliant camera.
For specific setup information see the table below:

Part number	Calibrations software	Calibrations pattern	Setup camera	Recommended cameras	Recommended sensors
TCCP3 MHR 144	TCLIB Suite	PTCP-S1-HR1-C	RT-mvBF3-2124aG	COE-123-x-z-080-yy-C, RT-mvBF3-2124aG, RT-mvBF3-2124G, RT-mvBC-X1012b, RT-mvBC-XD1012b	IMX253, IMX304
TCCP3 MHR 192	TCLIB Suite	PTCP-M1-HR1-C			
TCCP3 MHR 260	TCLIB Suite	PTCP-L1-HR1-C			
TCCP5 MHR 144	TCLIB Suite	PTCP-S1-HR1-C	COE29MUSB3IR-F	COE-290-x-z-110-yy-A, COE29xxx, COE50xxx, COE71xxx	KAI-29050, CMV50000, CHR70M
TCCP5 MHR 192	TCLIB Suite	PTCP-M1-HR1-C			
TCCP5 MHR 260	TCLIB Suite	PTCP-L1-HR1-C			

- Given the squared shape of the front window, the lens forms a rectangular image.
- Working distance: distance between the front end of the mechanics and the object.
- Working F-number: the real F-number of a lens in operating conditions.
- Maximum angle between chief rays and optical axis on the object side.
- Percent deviation of the real image compared to an ideal, undistorted image.
Maximum (guaranteed) values of the uncorrected image are listed.
- Residual distortion after calibration with TCLIB Suite software library, using a PTCP calibrations pattern and a fully GenICam compliant camera. For setup information see related table.
- 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.
- Maximum dimension of the clamping flange.
- Measured from the front end of the mechanics to the camera flange.

Due to its original design mainly conceived to reduce the length and weight of a telecentric lens, typically CORE PLUS optics show a thermal drift which is higher than in traditional telecentric optics, especially when the entire FOV is used for measurement. When used for measurement applications, thus, CORE PLUS optics might need to be thermally calibrated depending on the required precision and accuracy.

TCCX2M series

Coaxial telecentric lenses for sensors up to 1"



* RT

Mag 0.3-4 x

Part number	Mag. (x)	Max sensor size	Detector type			Optical specifications					Mechanical specs		
			1/1.8"	1/1.8"	KAI-04050 16 mm diag	WD	wF/#	Distortion	Field depth	Nominal resolving power	Mount	Length	Diam.
			w x h 7.13 x 5.37 (mm x mm)	w x h 8.45 x 7.07 (mm x mm)	w x h 12.8 x 9.6 (mm x mm)	(mm)		(%)	(mm)	(µm)		(mm)	(mm)
			Object field of view (mm x mm)			1	2						
RT-MP-4F-65	4.00	1"	1.8 x 1.3	2.1 x 1.8	3.2 x 2.4	65.0	16.7	0.23	0.044	2.8	C	165.5	29
RT-MP-2F-65	2.00	1"	3.6 x 2.7	4.2 x 3.5	6.4 x 4.8	65.0	10	0.40	0.095	3.4	C	127.0	29
RT-MP-1.5F-65	1.50	1"	4.8 x 3.6	5.6 x 4.7	8.5 x 6.4	65.0	7.5	0.50	0.110	3.4	C	114.6	29
RT-MP-1F-65	1.00	1"	7.1 x 5.4	8.5 x 7.1	12.8 x 9.6	65.5	8	-0.10	0.280	5.4	C	133.1	32
RT-TCL0750-FU	0.75	1"	9.5 x 7.2	11.3 x 9.4	17.1 x 12.8	60.7	12-60	-0.028	0.8	11.0	C	206.4	38
RT-TCL0600-FU	0.60	1"	11.9 x 9.0	14.1 x 11.8	21.3 x 16.0	78.5	12-60	-0.015	1.3	13.5	C	228.5	44
RT-TCL0450-FU	0.45	1"	15.8 x 11.9	18.8 x 15.7	28.4 x 21.3	108.2	12-60	0.008	2.2	18.0	C	265.4	49
RT-TCL0300-FU	0.30	1"	23.8 x 17.9	28.2 x 23.6	42.7 x 32.0	167.0	12-60	0.012	5.0	27.0	C	338.2	68

- 1 Working distance: distance between the front end of the mechanics and the object.
- 2 Working F-number: the real F-number of a lens in operating conditions.

FULL RANGE OF COMPATIBLE LED SOURCES	
	LDSC series p. 258
FULL RANGE OF COMPATIBLE POWER SUPPLIES	
	RT-PSP-12122-LV-xx power supply p. 256
FULL RANGE OF COMPATIBLE CAMERAS	
	Area scan cameras p. 188-203

TC12M series

Telecentric lenses for sensors up to APS-H and 4k line scan cameras

Mag 0.115-1.918 x

NEW MODELS



KEY ADVANTAGES

Wide image circle suitable for sensors up to APS-H.

Excellent resolution and low distortion.

Simple and robust design for industrial environments.

Detailed test report with certified optical parameters.

TC12M high resolution telecentric lenses designed for detectors with up to 33.5 mm image circle. They perfectly fit cameras with large sensors, up to APS-H sensor format. TC12M series lenses feature a compact and robust design that makes them ideal for various industrial applications.

To help you pick the right lens, we listed some of the most popular area scan sensors in the matrix chart below: just choose the column with your camera sensor and scroll down the table until you find the field of view that best matches your application, then scroll left to find the lens part number.

FULL RANGE OF COMPATIBLE ILLUMINATORS		
	LTCLHP CORE PLUS series	p. 135
FULL RANGE OF COMPATIBLE CLAMPING MECHANICS		
	CMHO series	p. 248
FULL RANGE OF COMPATIBLE CAMERAS		
	COE HR AS-X series	p. 198

Part number	Mag. (x)	Max sensor size	Detector type			Optical specifications					Mechanical specifications			
			APS-C IMX342 27.9 mm diag w x h (mm x mm)	Line -4k 4k x 7 μm w (mm)	APS-H PYTHON 25K 32.58 mm diag w x h (mm x mm)	WD (mm)	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				
TC12M 016-F	1.825	APS-H	12.25 x 9.19	15.71	12.62 x 12.62	42.3	16	<0.08 (0.10)	<0.08 (0.10)	0.4	> 30	F	213.0	64
TC12M 016-J	1.825	APS-H	12.25 x 9.19	15.71	12.62 x 12.62	42.3	16	<0.08 (0.10)	<0.08 (0.10)	0.4	> 30	M42x1 FD12	247.5	64
TC12M 024-F	1.208	APS-H	18.51 x 13.88	23.73	19.07 x 19.07	66.7	16	<0.08 (0.10)	<0.08 (0.10)	0.9	> 30	F	222.1	64
TC12M 024-J	1.208	APS-H	18.51 x 13.88	23.73	19.07 x 19.07	66.7	16	<0.08 (0.10)	<0.08 (0.10)	0.9	> 30	M42x1 FD12	256.6	64
TC12M 036-F	0.838	APS-H	26.68 x 20.01	34.21	27.49 x 27.49	101.9	12	<0.08 (0.10)	<0.08 (0.10)	1.4	> 40	F	270.1	64
TC12M 036-J	0.838	APS-H	26.68 x 20.01	34.21	27.49 x 27.49	101.9	12	<0.08 (0.10)	<0.08 (0.10)	1.4	> 40	M42x1 FD12	304.1	64
TC12M 048-F	0.635	APS-H	35.21 x 26.41	45.15	36.28 x 36.28	131.1	12	<0.08 (0.10)	<0.08 (0.10)	2.5	> 40	F	292.7	75
TC12M 048-J	0.635	APS-H	35.21 x 26.41	45.15	36.28 x 36.28	131.1	12	<0.08 (0.10)	<0.08 (0.10)	2.5	> 40	M42x1 FD12	327.2	75
TC12M 056-F	0.531	APS-H	42.10 x 31.58	53.99	43.39 x 43.39	136.5	11	<0.08 (0.10)	<0.08 (0.10)	3.2	> 40	F	331.7	82
TC12M 056-J	0.531	APS-H	42.10 x 31.58	53.99	43.39 x 43.39	136.5	11	<0.08 (0.10)	<0.08 (0.10)	3.2	> 40	M42x1 FD12	366.2	82
TC12M 064-F	0.465	APS-H	48.08 x 36.06	61.66	49.55 x 49.55	157.6	11	<0.08 (0.10)	<0.08 (0.10)	4.2	> 45	F	353.5	100
TC12M 064-J	0.465	APS-H	48.08 x 36.06	61.66	49.55 x 49.55	157.6	11	<0.08 (0.10)	<0.08 (0.10)	4.2	> 45	M42x1 FD12	388.0	100
TC12M 080-F	0.376	APS-H	59.46 x 44.60	76.25	61.28 x 61.28	199.0	11	<0.08 (0.10)	<0.08 (0.10)	6.4	> 45	F	401.2	116
TC12M 080-J	0.376	APS-H	59.46 x 44.60	76.25	61.28 x 61.28	199.0	11	<0.08 (0.10)	<0.08 (0.10)	6.4	> 45	M42x1 FD12	435.7	116
TC12M 096-F	0.306	APS-H	73.06 x 54.80	93.69	75.29 x 75.29	256.0	8	<0.08 (0.10)	<0.08 (0.10)	7.0	> 50	F	423.7	143
TC12M 096-J	0.306	APS-H	73.06 x 54.80	93.69	75.29 x 75.29	256.0	8	<0.08 (0.10)	<0.08 (0.10)	7.0	> 50	M42x1 FD12	458.2	143
TC12M 120-F	0.233	APS-H	95.95 x 71.97	123.05	98.88 x 98.88	303.9	8	<0.08 (0.10)	<0.08 (0.10)	12.2	> 55	F	508.7	180
TC12M 120-J	0.233	APS-H	95.95 x 71.97	123.05	98.88 x 98.88	303.9	8	<0.08 (0.10)	<0.08 (0.10)	12.2	> 55	M42x1 FD12	543.2	180
TC12M 144-F	0.196	APS-H	114.06 x 85.56	146.28	117.55 x 117.55	358.5	8	<0.08 (0.10)	<0.08 (0.10)	17.2	> 55	F	564.2	200
TC12M 144-J	0.196	APS-H	114.06 x 85.56	146.28	117.55 x 117.55	358.5	8	<0.08 (0.10)	<0.08 (0.10)	17.2	> 55	M42x1 FD12	598.7	200
TC12M 192-F	0.144	APS-H	155.25 x 116.46	199.10	160.00 x 160.00	475.9	8	<0.08 (0.10)	<0.08 (0.10)	31.8	> 50	F	700.2	260
TC12M 192-J	0.144	APS-H	155.25 x 116.46	199.10	160.00 x 160.00	475.9	8	<0.08 (0.10)	<0.08 (0.10)	31.8	> 50	M42x1 FD12	734.7	260
TC12M 240-F	0.115	APS-H	194.40 x 145.83	249.30	200.35 x 200.35	542.8	8	<0.08 (0.10)	<0.08 (0.10)	49.9	> 55	F	849.8	322
TC12M 240-J	0.115	APS-H	194.40 x 145.83	249.30	200.35 x 200.35	542.8	8	<0.08 (0.10)	<0.08 (0.10)	49.9	> 55	M42x1 FD12	884.3	322

- 1 Working distance: distance between the front end of the mechanics and the object.
- 2 Working F-number: the real F-number of a lens in operating conditions.
- 3 Maximum angle between chief rays and optical axis on the object side.
- 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.

TC16M series

Telecentric lenses for sensors up to 43.3 mm and 8k line scan cameras Mag 0.15-4 x



TC16M series telecentric lenses have been specifically designed to fit 45 mm format (36 x 24 mm) detectors with very high resolution, such as 48 and 71 MP.

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 4k and 8k line scan cameras and can be successfully used to measure 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 certified optical parameters.



Mount F



Mount Q = M58x0.75

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-e.com/faqs

FULL RANGE OF COMPATIBLE ILLUMINATORS		
	LTCLHP, LTCLHP CORE series	p. 128-133
	LTCLHP CORE PLUS series	p. 134
FULL RANGE OF COMPATIBLE CLAMPING MECHANICS		
	CMHO series	p. 248
FULL RANGE OF COMPATIBLE CLAMPING MECHANICS		
	CMMR series 45° first surface mirrors	p. 233
FULL RANGE OF COMPATIBLE CAMERAS		
	HR Area scan cameras	p. 198-203



Part number	Mag. (x)	Max sensor size	Detector type			Optical specifications						Mechanical specifications			
			Line 8k 8k x 5 µm	Full frame 35 mm 43.3 mm diag w x h	CMV50000 45.72 mm diag w x h	WD	wF/#	Telecentricity typical (max)	Distortion typical (max)	Field Depth	CTF @50lp/mm	Mount	Length	Diam.	
			w (mm)	w x h (mm x mm)	w x h (mm x mm)	(mm)		(deg)	(%)	(mm)	(%)		(mm)	(mm)	
Object field of view (mm)															
TC16M 009	4.00	43.3	10.20	9.00 x 6.00	9.11 x 6.90	57.8	22	< 0.03 (0.05)	< 0.03 (0.05)	0.1	> 20	F	487.9	64	
TC16M 009-Q	4.00	43.3	10.20	9.00 x 6.00	9.11 x 6.90	57.8	22	< 0.03 (0.05)	< 0.03 (0.05)	0.1	> 20	M58X0.75 FD 6.56	527.9	64	
TC16M 009-K	4.00	43.3	10.20	9.00 x 6.00	9.11 x 6.90	57.8	22	< 0.03 (0.05)	< 0.03 (0.05)	0.1	> 20	M58x0.75 FD 12.96	521.5	64	
TC16M 012	3.00	43.3	13.60	12.00 x 8.00	12.14 x 9.21	57.8	18	< 0.03 (0.05)	< 0.03 (0.05)	0.2	> 30	F	378.7	64	
TC16M 012-Q	3.00	43.3	13.60	12.00 x 8.00	12.14 x 9.21	57.8	18	< 0.03 (0.05)	< 0.03 (0.05)	0.2	> 30	M58X0.75 FD 6.56	418.7	64	
TC16M 012-K	3.00	43.3	13.60	12.00 x 8.00	12.14 x 9.21	57.8	18	< 0.03 (0.05)	< 0.03 (0.05)	0.2	> 30	M58x0.75 FD 12.96	412.3	64	
TC16M 018	2.00	43.3	20.40	18.00 x 12.00	18.22 x 13.81	57.8	16	< 0.03 (0.05)	< 0.03 (0.05)	0.3	> 40	F	259.6	64	
TC16M 018-Q	2.00	43.3	20.40	18.00 x 12.00	18.22 x 13.81	57.8	16	< 0.03 (0.05)	< 0.03 (0.05)	0.3	> 40	M58X0.75 FD 6.56	299.5	64	
TC16M 018-K	2.00	43.3	20.40	18.00 x 12.00	18.22 x 13.81	57.8	16	< 0.03 (0.05)	< 0.03 (0.05)	0.3	> 40	M58x0.75 FD 12.96	293.1	64	
TC16M 036	1.00	42	40.80	36.00 x 24.00	36.43 x 27.62	102.6	16	< 0.03 (0.05)	< 0.02 (0.03)	1.3	> 30	F	309.0	64	
TC16M 036-Q	1.00	43.3	40.80	36.00 x 24.00	36.43 x 27.62	102.6	16	< 0.03 (0.05)	< 0.02 (0.03)	1.3	> 30	M58X0.75 FD 6.56	348.9	64	
TC16M 036-K	1.00	43.3	40.80	36.00 x 24.00	36.43 x 27.62	102.6	16	< 0.03 (0.05)	< 0.02 (0.03)	1.3	> 30	M58x0.75 FD 12.96	342.6	64	
TC16M 048	0.75	43.3	54.40	48.00 x 32.00	48.58 x 36.82	125.6	16	< 0.06 (0.10)	< 0.05 (0.10)	2.3	> 30	F	315.2	75	
TC16M 048-Q	0.75	43.3	54.40	48.00 x 32.00	48.58 x 36.82	125.6	16	< 0.06 (0.10)	< 0.05 (0.10)	2.3	> 30	M58X0.75 FD 6.56	355.2	75	
TC16M 048-K	0.75	43.3	54.40	48.00 x 32.00	48.58 x 36.82	125.6	16	< 0.06 (0.10)	< 0.05 (0.10)	2.3	> 30	M58x0.75 FD 12.96	348.9	75	
TC16M 056	0.64	43.3	63.65	56.16 x 37.44	56.84 x 43.09	148.6	16	< 0.04 (0.08)	< 0.04 (0.10)	3.2	> 40	F	338.5	80	
TC16M 056-Q	0.64	43.3	63.65	56.16 x 37.44	56.84 x 43.09	148.6	16	< 0.04 (0.08)	< 0.04 (0.10)	3.2	> 40	M58X0.75 FD 6.56	378.5	80	
TC16M 056-K	0.64	43.3	63.65	56.16 x 37.44	56.84 x 43.09	148.6	16	< 0.04 (0.08)	< 0.04 (0.10)	3.2	> 40	M58x0.75 FD 12.96	372.2	80	
TC16M 064	0.56	43.3	72.73	64.17 x 42.78	64.94 x 49.23	170.6	16	< 0.04 (0.08)	< 0.06 (0.15)	4.2	> 30	F	359.6	100	
TC16M 064-Q	0.56	43.3	72.73	64.17 x 42.78	64.94 x 49.23	170.6	16	< 0.04 (0.08)	< 0.06 (0.15)	4.2	> 30	M58X0.75 FD 6.56	399.6	100	
TC16M 064-K	0.56	43.3	72.73	64.17 x 42.78	64.94 x 49.23	170.6	16	< 0.04 (0.08)	< 0.06 (0.15)	4.2	> 30	M58x0.75 FD 12.96	393.3	100	
TC16M 080	0.46	43.3	88.12	77.75 x 51.84	78.69 x 59.65	197.3	16	< 0.03 (0.08)	< 0.09 (0.20)	6.2	> 30	F	406.4	116	
TC16M 080-Q	0.46	43.3	88.12	77.75 x 51.84	78.69 x 59.65	197.3	16	< 0.03 (0.08)	< 0.09 (0.20)	6.2	> 30	M58X0.75 FD 6.56	446.4	116	
TC16M 080-K	0.46	43.3	88.12	77.75 x 51.84	78.69 x 59.65	197.3	16	< 0.03 (0.08)	< 0.09 (0.20)	6.2	> 30	M58x0.75 FD 12.96	440.1	116	
TC16M 096	0.38	43.3	107.37	94.74 x 63.16	95.87 x 72.68	262.3	16	< 0.06 (0.08)	< 0.07 (0.15)	9.1	> 40	F	449.2	143	
TC16M 096-Q	0.38	43.3	107.37	94.74 x 63.16	95.87 x 72.68	262.3	16	< 0.06 (0.08)	< 0.07 (0.15)	9.1	> 40	M58X0.75 FD 6.56	489.1	143	
TC16M 096-K	0.38	43.3	107.37	94.74 x 63.16	95.87 x 72.68	262.3	16	< 0.06 (0.08)	< 0.07 (0.15)	9.1	> 40	M58x0.75 FD 12.96	482.8	143	
TC16M 120	0.29	43.3	141.18	124.57 x 83.04	126.06 x 95.56	331.6	16	< 0.05 (0.08)	< 0.05 (0.10)	15.8	> 40	F	538.1	180	
TC16M 120-Q	0.29	43.3	141.18	124.57 x 83.04	126.06 x 95.56	331.6	16	< 0.05 (0.08)	< 0.05 (0.10)	15.8	> 40	M58X0.75 FD 6.56	578.1	180	
TC16M 120-K	0.29	43.3	141.18	124.57 x 83.04	126.06 x 95.56	331.6	16	< 0.05 (0.08)	< 0.05 (0.10)	15.8	> 40	M58x0.75 FD 12.96	571.8	180	
TC16M 144	0.25	43.3	166.53	146.94 x 97.96	148.70 x 112.73	397.4	16	< 0.05 (0.08)	< 0.08 (0.20)	22.0	> 40	F	597.8	200	
TC16M 144-Q	0.25	43.3	166.53	146.94 x 97.96	148.70 x 112.73	397.4	16	< 0.05 (0.08)	< 0.08 (0.20)	22.0	> 40	M58X0.75 FD 6.56	637.7	200	
TC16M 144-K	0.25	43.3	166.53	146.94 x 97.96	148.70 x 112.73	397.4	16	< 0.05 (0.08)	< 0.08 (0.20)	22.0	> 40	M58x0.75 FD 12.96	631.4	200	
TC16M 192	0.19	43.3	218.18	192.51 x 128.34	194.82 x 147.69	457.5	16	< 0.06 (0.08)	< 0.05 (0.10)	37.7	> 40	F	742.0	260	
TC16M 192-Q	0.19	43.3	218.18	192.51 x 128.34	194.82 x 147.69	457.5	16	< 0.06 (0.08)	< 0.05 (0.10)	37.7	> 40	M58X0.75 FD 6.56	781.5	260	
TC16M 192-K	0.19	43.3	218.18	192.51 x 128.34	194.82 x 147.69	457.5	16	< 0.06 (0.08)	< 0.05 (0.10)	37.7	> 40	M58x0.75 FD 12.96	775.1	260	
TC16M 240	0.15	43.3	272.00	240.00 x 160.00	242.88 x 184.12	542.8	16	< 0.06 (0.08)	< 0.08 (0.15)	58.7	> 40	F	899.0	322	
TC16M 240-Q	0.15	43.3	272.00	240.00 x 160.00	242.88 x 184.12	542.8	16	< 0.06 (0.08)	< 0.08 (0.15)	58.7	> 40	M58X0.75 FD 6.56	938.7	322	
TC16M 240-K	0.15	43.3	272.00	240.00 x 160.00	242.88 x 184.12	542.8	16	< 0.06 (0.08)	< 0.08 (0.15)	58.7	> 40	M58x0.75 FD 12.96	932.3	322	

- 1 Working distance: distance between the front end of the mechanics and the object.
- 2 Working F-number: the real F-number of a lens in operating conditions.
- 3 Maximum angle between chief rays and optical axis on the object side.
- 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.

TC12K series

Telecentric lenses for sensors up to 62 mm and 12k line scan cameras





Mag. 0.26-0.96 x



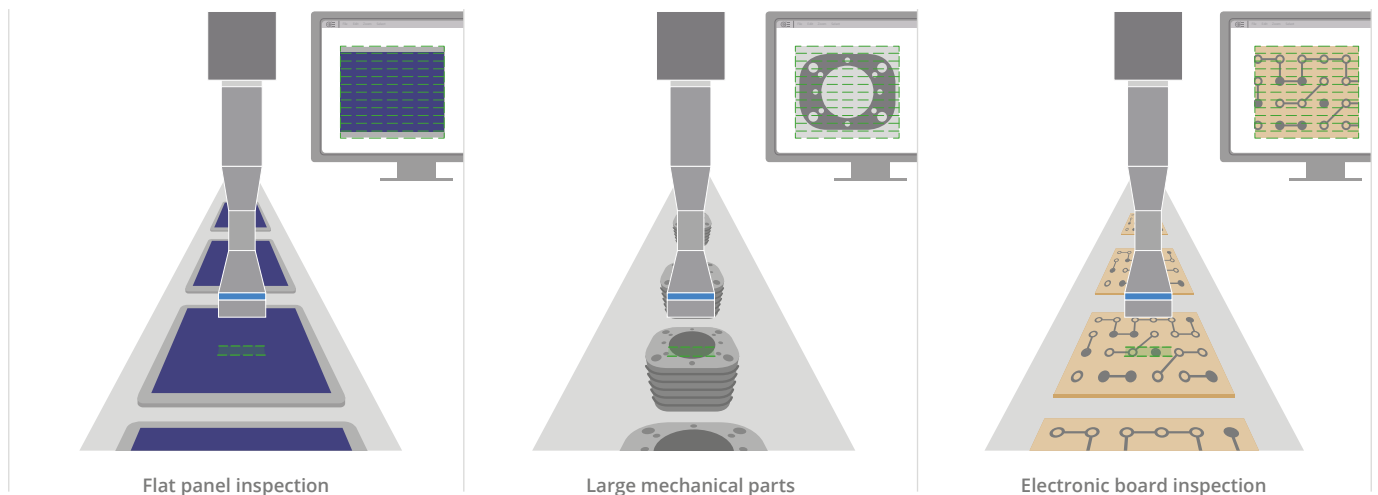
TC12K series telecentric lenses are designed to fit very large line detector cameras. An image circle diameter larger than 62 mm combined with very high resolution makes the TC12K series ideal for 12k and 16k resolution cameras.

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 to accurately measure large mechanical parts.

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 line scan cameras.

FULL RANGE OF COMPATIBLE ILLUMINATORS		
	LTBRDC series	p. 160
	LTCLHP CORE series	p. 130
FULL RANGE OF COMPATIBLE CLAMPING MECHANICS		
	CMHO TC12K series	p. 248
FULL RANGE OF COMPATIBLE CAMERAS		
	Line scan cameras	p. 206

Application examples





Wide image circle

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

SENSOR SIZE								UP TO 62.4 mm
2048 px x 10 μ m	2048 px x 14 μ m	4096 px x 7 μ m	4096 px x 10 μ m	7450 px x 4.7 μ m	6144 px x 7 μ m	8192 px x 7 μ m	12288 px x 5 μ m	
20.5 mm	28.6 mm	28.6 mm	35 mm	41 mm	43 mm	57.3 mm	62 mm	

TC12K

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.



Part number	Mag.	Max sensor size (mm)	Detector type			Optical specifications					Mechanical specifications			
			Line - 8k 8k x 7.5 μ m	Line - 16k 16k x 3.5 μ m	Line - 12k 12k x 5.2 μ m	WD (mm)	wF/#	Telecentricity typical (max) (deg)	Distortion typical (max) (%)	Field depth (mm)	CTF @50lp/mm (%)	Mount	Length (mm)	Diam. (mm)
	(x)		57.3 (mm)	57.3 (mm)	62.4 (mm)	1	2	3	4	5				
Object field of view (mm)														
TC12K 064	0.960	62.4	59.7	59.7	65.0	162.8	16	< 0.06 (0.08)	< 0.08 (0.10)	1.0	> 35	M72x0.75 FD 6.56	566.7	100
TC12K 080	0.698	62.4	82.2	82.2	89.5	157.4	16	< 0.06 (0.08)	< 0.08 (0.10)	2.0	> 35	M72x0.75 FD 6.56	541.9	116
TC12K 120	0.529	62.4	108.4	108.4	117.9	254	16	< 0.06 (0.08)	< 0.06 (0.08)	4.0	> 40	M72x0.75 FD 6.56	722.1	180
TC12K 144	0.439	62.4	130.6	130.6	142.2	237.9	16	< 0.06 (0.08)	< 0.07 (0.10)	5.5	> 40	M72x0.75 FD 6.56	743.3	200
TC12K 192	0.320	62.4	179.4	179.4	195.3	265.5	16	< 0.06 (0.08)	< 0.08 (0.10)	10.0	> 35	M72x0.75 FD 6.56	857.5	260
TC12K 240	0.260	62.4	220.5	220.5	240.0	492.8	16	< 0.06 (0.08)	< 0.08 (0.10)	15.4	> 35	M72x0.75 FD 6.56	1072.8	322

- 1 Working distance: distance between the front end of the mechanics and the object.
- 2 Working F-number: the real F-number of a lens in operating conditions.
- 3 Maximum angle between chief rays and optical axis on the object side.
- 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 μ m.

TC4K series

Flat telecentric lenses for 4k line scan cameras

Mag. 0.159-0.478 x



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° right angle attachment for easy integration in tight spaces.

Detailed test report with measured optical parameters.

TC4K series telecentric lenses have been designed for measurement applications using line scan cameras with detectors up to 28.7 mm (e.g. 4096 pixels with pixel size 7 μm).

Dimensional constraints are often a major issue when designing line scan 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 constraints. 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 line scan 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 the user to precisely position the linear FOV at 90° from the object movement direction.

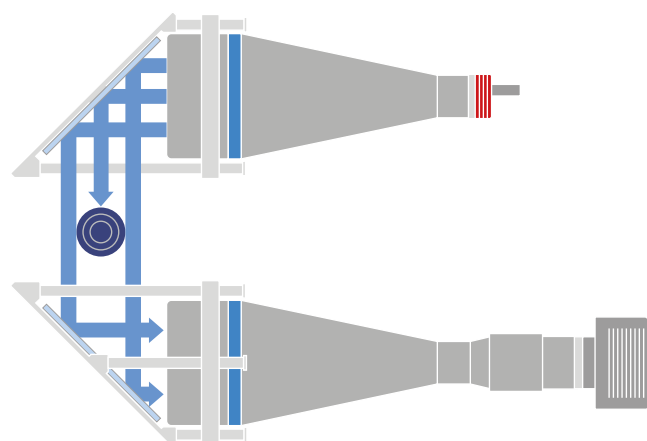





Mount F

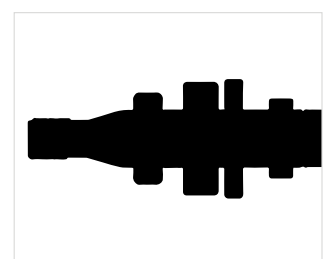
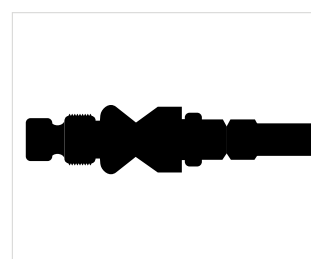


Mount N = M42x1

Application examples



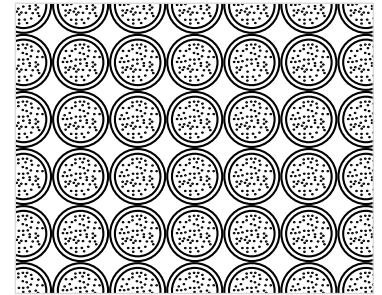
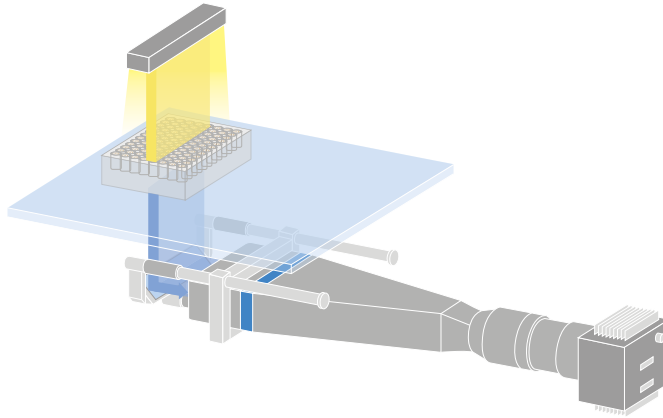
FULL RANGE OF COMPATIBLE ILLUMINATORS		
	LTCL4K series	p. 136
	LTBRDC series	p. 160
FULL RANGE OF COMPATIBLE MIRRORS		
	CMMR4K models	p. 235



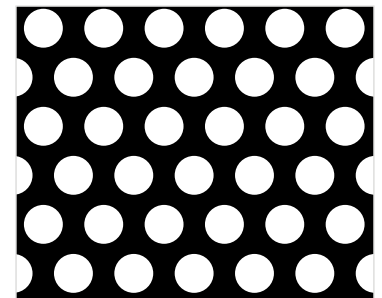
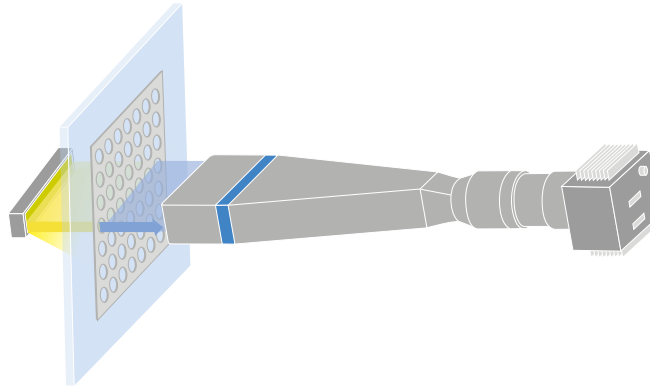
Engine shaft measurement performed with TC4K lens coupled to LTCL4K telecentric illuminator by means of two CMMR4K deflecting mirrors.



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.



Part number	Mag. (x)	Line width (mm)	Detector type		Optical specifications						Mechanical specifications			
			Line - 2k 2k x 10 µm (mm)	Line - 4k 4k x 7 µm (mm)	WD (mm)	wF/#	Telecentricity typical (max) (deg)	Distortion typical (max) (%)	Field depth (mm)	CTF @50lp/mm (%)	Mount	Length (mm)	Width (mm)	Height (mm)
			Object field of view (mm)		1	2	3	4	5					
TC4K 060-F	0.478	28.7	42.8	60.0	174	16	0.06 (0.10)	0.05 (0.08)	7.3	>30	F	319.2	83	64
TC4K 060-N	0.478	28.7	42.8	60.0	174	16	0.06 (0.10)	0.05 (0.08)	7.3	>30	M42X1 FD 10.6	355.2	83	52
TC4K 090-F	0.319	28.7	64.3	90.0	174	16	0.05 (0.10)	0.05 (0.08)	16.4	>30	F	360.7	114	64
TC4K 090-N	0.319	28.7	64.3	90.0	174	16	0.05 (0.10)	0.05 (0.08)	16.4	>30	M42X1 FD 10.6	396.6	114	52
TC4K 120-F	0.240	28.7	85.4	119.6	174	16	0.10 (0.12)	0.08 (0.10)	29.2	>25	F	337.3	144	64
TC4K 120-N	0.240	28.7	85.4	119.6	174	16	0.10 (0.12)	0.08 (0.10)	29.2	>25	M42X1 FD 10.6	373.2	144	52
TC4K 180-F	0.159	28.7	128.6	180.0	254	16	0.08 (0.10)	0.08 (0.10)	65.6	>30	F	522.4	208	64
TC4K 180-N	0.159	28.7	128.6	180.0	254	16	0.08 (0.10)	0.08 (0.10)	65.6	>30	M42X1 FD 10.6	558.4	208	52

- 1 Working distance: distance between the front end of the mechanics and the object.
- 2 Working F-number: the real F-number of a lens in operating conditions.
- 3 Maximum angle between chief rays and optical axis on the object side.
- 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.

Ordering information

It's easy to select the right lens for your application: our part numbers are coded as **TC4Kyyy-x** where **yyy** refers to the field of view (FOV) in millimetres and **-x** refers to the mount option:
 - **F** for F-mount
 - **N** for M42x1 mount (flange distance FD 10.56 mm).

For example, TC4K060-N refers to a TC4K060 with M42x1 mount.

TCEL series

Telecentric optics with liquid lenses technology

Mag. 0.25-3.5 x

NEW



KEY ADVANTAGES

Extended depth of field

Thanks to the integration of liquid lenses it is possible to significantly extend the DOF of telecentric optics.

Excellent optical performances

The optical design of the lenses allows to obtain very low distortion and superior optical performances.

Precise and quick autofocus

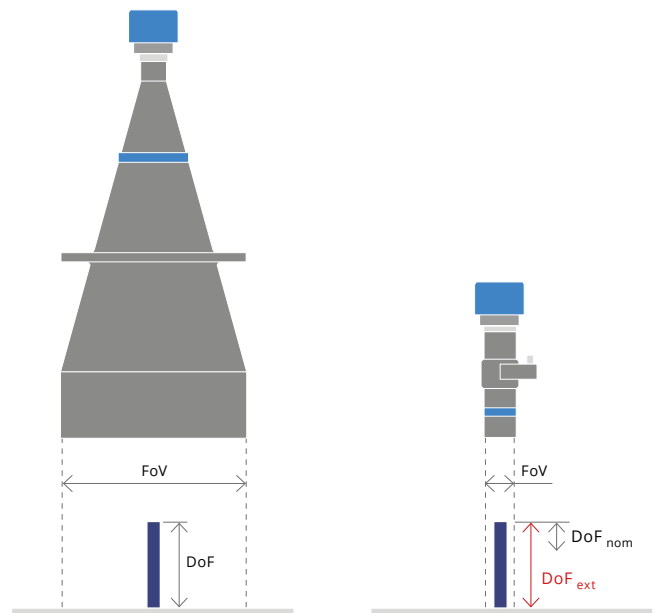
Electronically driven liquid lenses allows for extremely fast and precise changes of focus.

Detailed test report with measured optical parameters.

TCEL series by Opto Engineering® features a perfect combination of telecentric optics and liquid lenses technology allowing to significantly increase the depth of field (DOF). This is particularly important for small fields of view due to the proportionality of the DOF with the magnification.

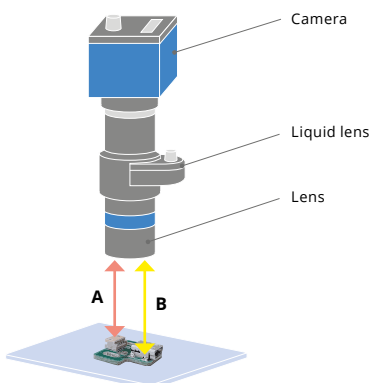
Thanks to their optical design, TCEL lenses ensure excellent optical performances both in terms of telecentricity and especially distortion throughout the entire operating range. This makes them a perfect choice for many inspection and measurement applications spanning from electronic and semicon segments to the automotive one, from pharmaceutical to fasteners. The electronically controlled liquid lenses enable to precisely tune the optical power of telecentric lenses adjusting the focus: this adjustment can be extremely fast with response times in the order of few milliseconds.

The driver comes as a compact USB-powered current source with free software and can be used as a stand-alone solution or integrated into OEM designs. Communication follows an open simple serial protocol, which can be implemented in any programming language on Windows or Linux (C#, Labview and Python source code available).

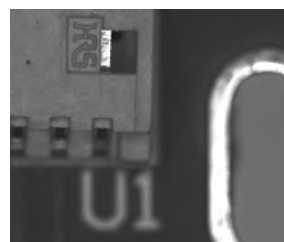


Instead of using a bigger lens (left) and a higher resolution camera to compensate, with TCEL series (right) it is possible to extend the DOF of a lens that is properly dimensioned for the sample.

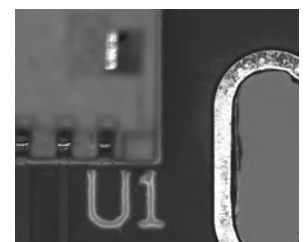
Application examples



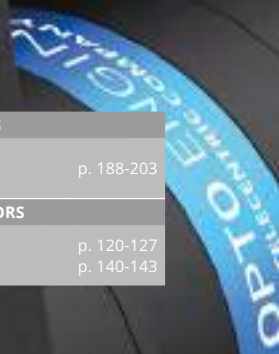
WD: A
Focus on top



WD: B
Focus on bottom



Focus in various objects with different height.



DIDNT FIND WHAT YOU WERE LOOKING FOR?

Don't worry! We can integrate liquid lenses into many other models: contact our Sales Engineers to check the feasibility.

FULL RANGE OF COMPATIBLE CAMERAS



Area scan cameras

p. 188-203

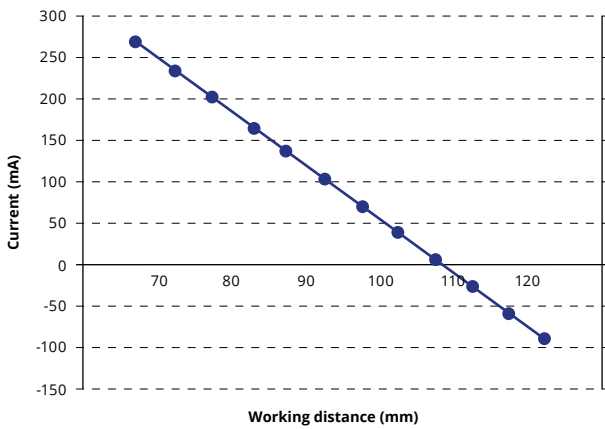
FULL RANGE OF COMPATIBLE ILLUMINATORS



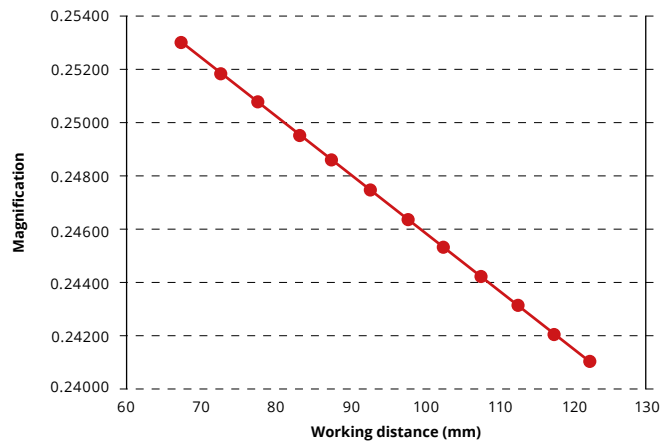
Backlights LTBP, LTBC, LTBF series
Ring lights LTRNDC, LTLA series

p. 120-127
p. 140-143

WD vs current



WD vs magnification



Both the driving current and the magnification are linearly proportional to the working distance, allowing to calibrate the system to compensate for the unavoidable changes of magnification due to the liquid lens.

Part number	Mag. Nominal	Max sensor size	Detector type			Optical specifications					Mechanical specs			
			1/3" 6.0 mm diag w x h	1/1.8" 8.9 mm diag w x h	2/3" - 5 MP 11.1 mm diag w x h	WD range	wF/#	Telecentricity typical (max)	Distortion typical (max)	Field depth	CTF @35lp/mm	Mount	Length	Diam.
	0 dpt (x)		4.80 x 3.60 (mm x mm)	7.13 x 5.33 (mm x mm)	8.50 x 7.09 (mm x mm)	(mm)		0 dpt (deg)	0 dpt (%)	(mm)	0 dpt (nm)		(mm)	(mm)
			Object field of view (mm x mm) 1			2	3	4	5	6		7	8	
TCEL23036 a	0.243	2/3"	19.75 x 14.81	29.34 x 21.93	34.98 x 29.18	122.8 - 73.3	8	< 0.08 (0.1)	< 0.04 (0.1)	7.0	> 65	C	166.1	76.5
TCELO50	0.500	2/3"	9.60 x 7.20	14.26 x 10.66	17.00 x 14.18	146.5 - 112.2	12	< 0.04 (0.08)	< 0.1 (0.2)	2.5	> 60	C	130.8	70.0
TCELO66	0.670	2/3"	7.16 x 5.37	10.64 x 7.96	12.69 x 10.58	146.0 - 112.3	12	< 0.04 (0.08)	< 0.1 (0.2)	1.4	> 58	C	149.3	70.0
TCELO75	0.750	2/3"	6.40 x 4.80	9.51 x 7.11	11.33 x 9.45	146.0 - 112.5	12	< 0.07 (0.1)	< 0.1 (0.2)	1.1	> 55	C	155.0	70.0
TCEL100	1.000	2/3"	4.80 x 3.60	7.13 x 5.33	8.50 x 7.09	142.1 - 117.9	12	< 0.08 (0.1)	< 0.05 (0.1)	0.6	> 60	C	126.0	70.0
TCEL150 b	1.500	2/3"	3.20 x 2.40	4.75 x 3.55	5.67 x 4.73	142.1 - 117.9	16	< 0.08 (0.1)	< 0.05 (0.1)	0.4	> 50	C	140.4	70.0
TCEL250 b	2.500	2/3"	1.92 x 1.44	2.85 x 2.13	3.40 x 2.84	142.2 - 117.8	20	< 0.08 (0.1)	< 0.05 (0.1)	0.2	> 40	C	157.0	70.0
TCEL350 b	3.500	2/3"	1.37 x 1.03	2.04 x 1.52	2.43 x 2.03	142.2 - 117.8	24	< 0.08 (0.1)	< 0.05 (0.1)	0.1	> 30	C	174.7	70.0

- 1 Field of views are calculated at 0 dpt power of the liquid lens.
- 2 Minimum and maximum working distance are reported at nominal range of the liquid lens; maximum excursion may be larger.
- 3 Working F-number: the real F-number of a lens in operating conditions.
- 4 Maximum angle between chief rays and optical axis on the object side.
- 5 Percent deviation of the real image compared to an ideal, undistorted image: typical (average production) values and maximum (guaranteed) values are listed.
- 6 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 3.45 µm.
- 7 Measured from the front end of the mechanics to the camera flange.
- 8 Maximum side dimension; the lens has an asymmetric shape.

- a Performances calculated with monochromatic light (LED emission); performance range in white light is smaller.
- b Performances guaranteed when used with vertical optical axis; when used with horizontal optical axis performances drops due to gravity induced aberration of the liquid lens.

Ordering information

- Hirose cables and Liquid Lens Driver sold separately.
- Coaxial lighting can be integrated in selected models: contact us to verify its feasibility.

TCDP PLUS series

Dual magnification telecentric lenses



KEY ADVANTAGES

Perfect measurement accuracy

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

Revolutionary flexibility

300 possible combinations allow you 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 increase in price or lead time.

Detailed test report with measured optical parameters.

TCDP PLUS series are dual magnification telecentric lenses supporting two cameras to measure objects with different magnifications. They are the perfect choice for measuring components of different sizes but also for applications where an entire sample and some of its smaller features have to be measured with the same accuracy. The fixed design of these lenses ensures perfect repeatability with no need to recalibrate after each magnification change.

TCDP PLUS lenses help cut the cost of your vision system: you only need to integrate one lens, one illuminator and one mount.

TCDP PLUS lenses are compatible with CMHO clamping mechanics and LTCLHP collimated illuminators, as well as LTRN ring illuminators designed for the standard TC series.

Application examples



TCDP23C4MC096 imaging an electronic board with two different cameras.



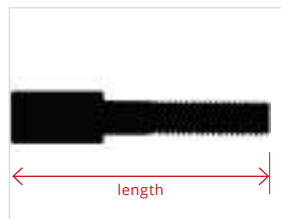
Full FOV image with lens lower magnification.



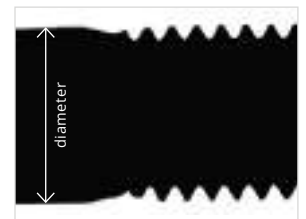
2x magnified image of the object central area.



TCDP23C4XC144 imaging a screw with two different cameras.



Full FOV image with lens lower magnification.



4x magnified image of the object central area.



TCDP23C4XC096 coupled with LTCLHP 096 telecentric illuminator and LTRN 096 NW ring light.





TCDP PLUS revolutionary design can easily meet any of your application needs: 300 possible combinations allow to create the perfect lens for you, also benefiting from the price and lead time of off-the-shelf components.

TCDP PLUS lenses come in 5 different sizes and can be configured with 2 different eyepieces out of the 7 available. They are compatible with several different camera sensors from 1/3" to 4/3" and are available with C-, F- or M42x1 (FD 16 mm) camera mounts.

In 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 based on your camera sensor and desired fields of view.



Built-in phase adjustment makes it easy to align the camera sensor.

FOR OTHER MULTI-MAGNIFICATION OPTICS SEE ALSO		
	TCZRS series	p. 60
FULL RANGE OF COMPATIBLE ILLUMINATORS		
	LTCLHP series collimated illuminators	p. 128
FULL RANGE OF COMPATIBLE ACCESSORIES		
	CMHO series	p. 248
FULL RANGE OF COMPATIBLE CAMERAS		
	Area scan cameras	p. 188-203

SETUP

There are more than 300 possible combinations: contact us and visit our website to discover more www.opto-e.com

TCDP PLUS series

Dual magnification telecentric lenses

Part number*	Mag. (x)	Max sensor size	Detector type			
			1/2" 8 mm diag w x h 6.40 x 4.80 (mm x mm)	2/3" - 5 MP 11.1 mm diag w x h 8.50 x 7.09 (mm x mm)	1" - IMX255 / IMX267 16.1 mm diag w x h 14.19 x 7.51 (mm x mm)	4/3" - IMX387 21.7 mm diag w x h 18.9 x 10.6 (mm x mm)
			Object field of view (mm x mm)			
TCDP 2MF 4MF 096	0.137	1"	46.7 x 35.0	62.0 x 51.8	103.6 x 54.8	∅ = 77.7
	0.186	4/3"	34.4 x 25.8	45.7 x 38.1	76.3 x 40.4	101.5 x 57.2
TCDP 23C 4XC 096	0.093	2/3"	68.8 x 51.6	91.4 x 76.2	∅ = 80.8	n.a.
	0.374	2/3"	17.1 x 12.8	22.7 x 19.0	∅ = 20.1	n.a.
TCDP 23C 4MC096	0.093	2/3"	68.8 x 51.6	91.4 x 76.2	∅ = 80.8	n.a.
	0.186	4/3"	34.4 x 25.8	45.7 x 38.1	76.3 x 40.4	101.5 x 57.2
TCDP 12C 23C 096	0.068	1/2"	∅ = 70.6	∅ = 104.3	∅ = 110.4	n.a.
	0.093	2/3"	68.8 x 51.6	91.4 x 76.2	∅ = 80.8	n.a.
TCDP 2MF 4MF 120	0.104	1"	61.5 x 46.2	81.7 x 68.2	136.4 x 72.2	∅ = 102.3
	0.143	4/3"	44.8 x 33.6	59.4 x 49.6	99.2 x 52.5	132.0 x 74.4
TCDP 23C 4XC 120	0.072	2/3"	88.9 x 66.7	118.1 x 98.5	∅ = 104.3	n.a.
	0.286	2/3"	22.4 x 16.8	29.7 x 24.8	∅ = 26.3	n.a.
TCDP 23C 4MC 120	0.072	2/3"	88.9 x 66.7	118.1 x 98.5	∅ = 104.3	n.a.
	0.143	4/3"	44.8 x 33.6	59.4 x 49.6	99.2 x 52.5	132.0 x 74.4
TCDP 12C 23C 120	0.052	1/2"	∅ = 92.3	∅ = 136.3	∅ = 144.4	n.a.
	0.072	2/3"	88.9 x 66.7	118.1 x 98.5	∅ = 104.3	n.a.
TCDP 2MF 4MF 144	0.089	1"	71.9 x 53.9	95.5 x 79.7	159.4 x 84.4	∅ = 119.5
	0.122	4/3"	52.5 x 39.3	69.7 x 58.1	116.3 x 61.6	154.7 x 87.2
TCDP 23C 4XC 144	0.061	2/3"	104.9 x 78.7	139.3 x 116.2	∅ = 123.1	n.a.
	0.244	2/3"	26.2 x 19.7	34.8 x 29.1	∅ = 30.8	n.a.
TCDP 23C 4MC 144	0.061	2/3"	104.9 x 78.7	139.3 x 116.2	∅ = 123.1	n.a.
	0.122	4/3"	52.5 x 39.3	69.7 x 58.1	116.3 x 61.6	154.7 x 87.2
TCDP 12C 23C 144	0.044	1/2"	∅ = 109.1	∅ = 161.1	∅ = 170.7	n.a.
	0.061	2/3"	104.9 x 78.7	139.3 x 116.2	∅ = 123.1	n.a.
TCDP 2MF 4MF 192	0.067	1"	95.5 x 71.6	126.9 x 105.8	211.8 x 112.1	∅ = 158.8
	0.092	4/3"	69.6 x 52.2	92.4 x 77.1	154.2 x 81.6	205.2 x 115.7
TCDP 23C 4XC 192	0.046	2/3"	139.1 x 104.3	184.8 x 154.1	∅ = 163.3	n.a.
	0.183	2/3"	35.0 x 26.2	46.4 x 38.7	∅ = 41.0	n.a.
TCDP 23C 4MC 192	0.046	2/3"	139.1 x 104.3	184.8 x 154.1	∅ = 163.3	n.a.
	0.092	4/3"	69.6 x 52.2	92.4 x 77.1	154.2 x 81.6	205.2 x 115.7
TCDP 12C 23C 192	0.033	1/2"	∅ = 145.5	∅ = 214.8	∅ = 227.6	n.a.
	0.046	2/3"	139.1 x 104.3	184.8 x 154.1	∅ = 163.3	n.a.
TCDP 2MF 4MF 240	0.053	1"	120.8 x 90.6	160.4 x 133.8	267.7 x 141.7	∅ = 200.8
	0.073	4/3"	87.7 x 65.8	116.4 x 97.1	194.4 x 102.9	258.6 x 145.8
TCDP 23C 4XC 240	0.037	2/3"	173.0 x 129.7	229.7 x 191.6	∅ = 203.0	n.a.
	0.147	2/3"	43.5 x 32.7	57.8 x 48.2	∅ = 51.1	n.a.
TCDP 23C 4MC 240	0.037	2/3"	173.0 x 129.7	229.7 x 191.6	∅ = 203.0	n.a.
	0.073	4/3"	87.7 x 65.8	116.4 x 97.1	194.4 x 102.9	258.6 x 145.8
TCDP 23C 2MC 240	0.037	2/3"	173.0 x 129.7	229.7 x 191.6	∅ = 203.0	n.a.
	0.053	1"	120.8 x 90.6	160.4 x 133.8	267.7 x 141.7	∅ = 200.8

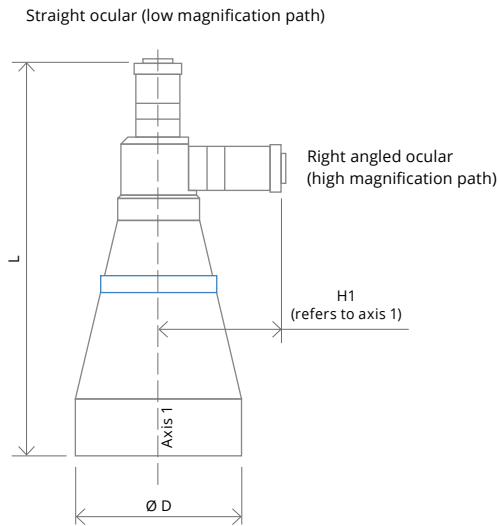
* This is only a selection of possible combinations: please contact us to discuss your specific needs.

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.

Part number*	Mag. (x)	Optical specifications						Mechanical specifications			
		WD	F/N	Telecentricity	Distortion	Field depth	CTF	Mount	Length	Diam.	
		(mm)		typical (max) (deg)	typical (max) (%)	(mm)	@70lp/mm (%)		L (mm)	H1 (mm)	D (mm)
		1	2	3	4	5					
TCDP 2MF 4MF 096	0.137	278.6	16	< 0.05 (0.10)	< 0.07 (0.10)	70	> 40	F	342	117	143
	0.186	278.6	16	< 0.05 (0.10)	< 0.04 (0.10)	38	> 35				
TCDP 23C 4XC 096	0.093	278.6	8	< 0.06 (0.08)	< 0.04 (0.08)	76	> 40	C	338	192	143
	0.374	278.6	12	< 0.06 (0.10)	< 0.07 (0.10)	7	> 40				
TCDP 23C 4MC096	0.093	278.6	8	< 0.06 (0.08)	< 0.04 (0.08)	76	> 40	C	338	146	143
	0.186	278.6	16	< 0.05 (0.10)	< 0.04 (0.10)	38	> 35				
TCDP 12C 23C 096	0.068	278.6	8	< 0.06 (0.08)	< 0.03 (0.08)	143	> 45	C	318	89	143
	0.093	278.6	8	< 0.06 (0.08)	< 0.04 (0.08)	76	> 40				
TCDP 2MF 4MF 120	0.104	334.5	16	< 0.07 (0.10)	< 0.07 (0.10)	122	> 40	F	427	119	180
	0.143	334.5	16	< 0.05 (0.10)	< 0.04 (0.10)	65	> 30				
TCDP 23C 4XC 120	0.072	334.5	8	< 0.07 (0.08)	< 0.04 (0.10)	127	> 35	C	423	192	180
	0.286	334.5	12	< 0.08 (0.10)	< 0.05 (0.08)	12	> 35				
TCDP 23C 4MC 120	0.072	334.5	8	< 0.07 (0.08)	< 0.04 (0.10)	127	> 35	C	423	148	180
	0.143	334.5	16	< 0.05 (0.10)	< 0.04 (0.10)	65	> 30				
TCDP 12C 23C 120	0.052	334.5	8	< 0.06 (0.08)	< 0.04 (0.10)	244	> 45	C	404	91	180
	0.072	334.5	8	< 0.07 (0.08)	< 0.04 (0.10)	127	> 35				
TCDP 2MF 4MF 144	0.089	396.0	16	< 0.05 (0.10)	< 0.05 (0.10)	167	> 40	F	487	119	200
	0.122	396.0	16	< 0.05 (0.10)	< 0.04 (0.10)	89	> 30				
TCDP 23C 4XC 144	0.061	396.0	8	< 0.05 (0.08)	< 0.04 (0.08)	177	> 40	C	483	192	200
	0.244	396.0	12	< 0.08 (0.10)	< 0.05 (0.08)	17	> 35				
TCDP 23C 4MC 144	0.061	396.0	8	< 0.05 (0.08)	< 0.04 (0.08)	177	> 40	C	483	148	200
	0.122	396.0	16	< 0.05 (0.10)	< 0.04 (0.10)	89	> 30				
TCDP 12C 23C 144	0.044	396.0	8	< 0.05 (0.08)	< 0.05 (0.08)	341	> 35	C	463	91	200
	0.061	396.0	8	< 0.05 (0.08)	< 0.04 (0.08)	177	> 40				
TCDP 2MF 4MF 192	0.067	527.0	16	< 0.05 (0.10)	< 0.04 (0.10)	294	> 40	F	627	119	260
	0.092	527.0	16	< 0.05 (0.10)	< 0.04 (0.10)	156	> 30				
TCDP 23C 4XC 192	0.046	527.0	8	< 0.06 (0.08)	< 0.05 (0.08)	312	> 35	C	623	192	260
	0.183	527.0	12	< 0.08 (0.10)	< 0.05 (0.08)	30	> 35				
TCDP 23C 4MC 192	0.046	527.0	8	< 0.06 (0.08)	< 0.05 (0.08)	312	> 35	C	623	148	260
	0.092	527.0	16	< 0.05 (0.10)	< 0.04 (0.10)	156	> 30				
TCDP 12C 23C 192	0.033	527.0	8	< 0.06 (0.08)	< 0.04 (0.08)	606	> 45	C	604	91	260
	0.046	527.0	8	< 0.06 (0.08)	< 0.05 (0.08)	312	> 35				
TCDP 2MF 4MF 240	0.053	492.8	16	< 0.05 (0.10)	< 0.04 (0.10)	470	> 40	F	789	95	322
	0.073	492.8	16	< 0.05 (0.10)	< 0.04 (0.10)	248	> 40				
TCDP 23C 4XC 240	0.037	492.8	8	< 0.03 (0.08)	< 0.04 (0.08)	482	> 45	C	785	192	322
	0.147	492.8	12	< 0.06 (0.10)	< 0.08 (0.10)	46	> 45				
TCDP 23C 4MC 240	0.037	492.8	8	< 0.03 (0.08)	< 0.04 (0.08)	482	> 45	C	785	148	322
	0.073	492.8	16	< 0.05 (0.10)	< 0.05 (0.10)	248	> 30				
TCDP 23C 2MC 240	0.037	492.8	8	< 0.03 (0.08)	< 0.04 (0.08)	482	> 45	C	785	124	322
	0.053	492.8	16	< 0.05 (0.10)	< 0.04 (0.10)	470	> 40				

- 1 Working distance: distance between the front end of the mechanics and the object.
- 2 Working F-number: the real F-number of a lens in operating conditions.
- 3 Maximum angle between chief rays and optical axis on the object side.
- 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.

TCZRS series

Bi-telecentric zoom lenses with motorized control



KEY ADVANTAGES

Perfect magnification constancy and parfocality

No need to re-calibrate or refocus after zooming thanks to an extremely precise positioning system.

Bi-telecentricity

For very accurate measurement.

Excellent image centre stability

Image centring is maintained at every magnification.

Full motorization control

Zoom magnification is set via software.

Fast and silent operations

Max 2 seconds to softly switch from one mag to another.

Detailed test report with measured optical parameters.

TCZRS 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.



An upgraded version of TCZR lenses, the newly designed TCZRS lenses feature an extremely precise positioning system with a bipolar stepper motor and an incremental magnetic encoder, delivering exceptional magnification repeatability. Moreover, focusing and image centring stability are guaranteed at every magnification position, thus avoiding recalibration at any given time. Four different magnifications, featuring a total zoom range of 8x, can be selected through a dedicated remote control software.

Bi-telecentricity, high resolution and low distortion make these zoom lenses able to perform the same measurement tasks as classic telecentric lenses.

Product combinations*



* To be ordered separately

FULL RANGE OF COMPATIBLE ILLUMINATORS		
	Backlights LT2BC, LTBP, LTBC, LTBFC series	p. 118-127
FULL RANGE OF COMPATIBLE CAMERAS		
	Area scan cameras	p. 188-203

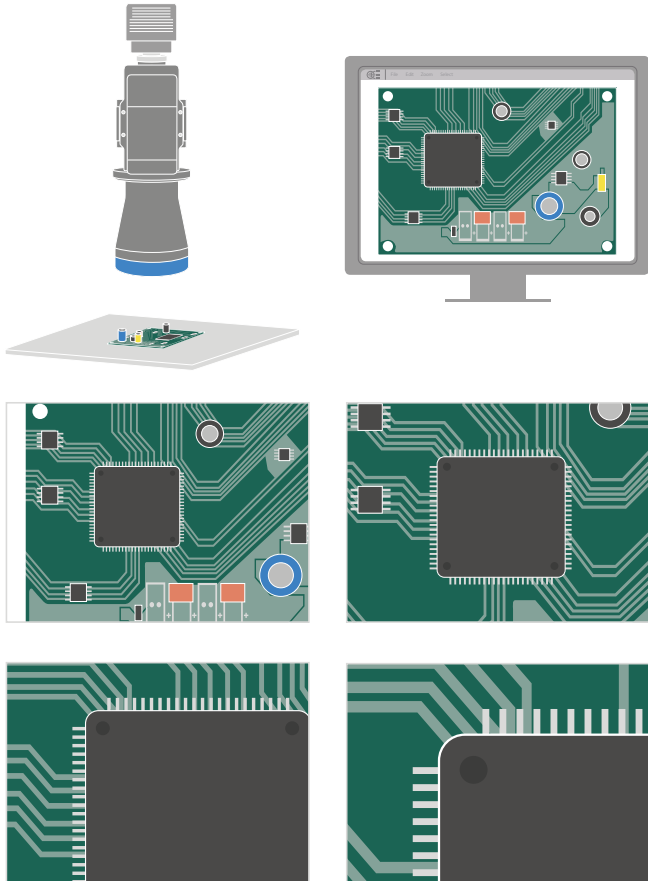
MANUAL AND SETUP

Please refer to our website for the updated TCZRS manual and for a complete technical documentation of the setup process.

www.opto-e.com



Application examples



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

Multiple lens surfaces can be used for direct mounting without clamps, thanks to the M6 threaded holes located on 3 sides.

Part number	Mag. (x)	Max sensor size	Detector type			Optical specifications					Mechanical specifications				
			1/3" 6.0 mm diag w x h	1/1.8" 8.9 mm diag w x h	2/3" - 5 MP 11.1 mm diag w x h	WD	wF/#	Telecentricity	Distortion	Field depth	CTF @70lp/mm	Mount	Length	Max height	Max width
			(mm x mm)	(mm x mm)	(mm x mm)	(mm)		(deg)	(%)	(mm)	(%)		(mm)	(mm)	(mm)
Object field of view (mm x mm)															
			1	2	3	4	5								
TCZR 036S	0.250	2/3"	19.2 x 14.4	28.5 x 21.3	34.0 x 28.4	74.0	16	< 0.05	< 0.05	13.2	> 40	C	212.0	144	103
	0.500		9.60 x 7.20	14.3 x 10.7	17.0 x 14.2				< 0.04	3.3	> 35				
	1.000		4.80 x 3.60	7.13 x 5.33	8.50 x 7.09				< 0.04	0.8	> 40				
	2.000		2.40 x 1.80	3.57 x 2.67	4.25 x 3.55				< 0.08	0.2	> 35				
TCZR 072S	0.125	2/3"	38.4 x 28.8	57.0 x 42.6	68.0 x 56.7	157.8	16	< 0.05	< 0.10	53.0	> 35	C	279.7	144	103
	0.250		19.2 x 14.4	28.5 x 21.3	34.0 x 28.4				< 0.08	13.2	> 40				
	0.500		9.60 x 7.20	14.3 x 10.7	17.0 x 14.2				< 0.05	3.3	> 40				
	1.000		4.80 x 3.60	7.13 x 5.33	8.50 x 7.09			< 0.07	0.8	> 35					

- 1 Working distance: distance between the front end of the mechanics and the object.
- 2 Working F-number: the real F-number of a lens in operating conditions.
- 3 Maximum angle between chief rays and optical axis on the object side.
- 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 3.45 µm.

TCBENCH series

Telecentric optical benches for precision measurements

Mag. 0.093-1 x

KEY ADVANTAGES

Pre-assembled setup

Just attach your camera, and the bench is ready for measurement.

Best optical performance

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

Tested system

The bench is quality tested as a whole system.

Detailed test report with measured optical parameters.



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 for use, 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 such as distortion, telecentricity and resolution. For this reason these benches feature unmatched image resolution and field depth.

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

DID YOU KNOW?

TCBENCH series is now also available with new LTSCHP1W-GZ **green** light source, suitable for any kind of sample and specifically tailored for measuring reflective objects and objects with sharp edges.

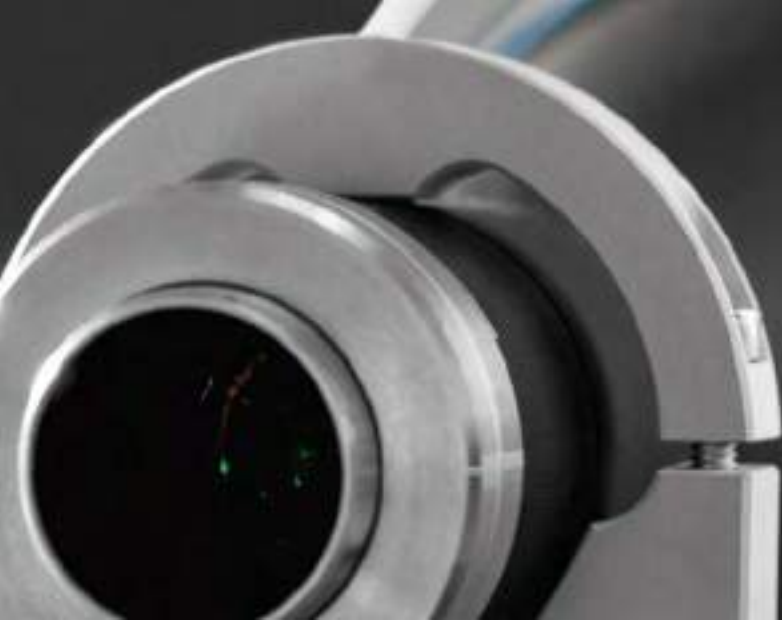
KEY FEATURES



- **Reduction of edge diffraction effects**
- Enhanced **illumination uniformity**, especially on large FOVs
- Less sensitive to **alignment**



Ordering information

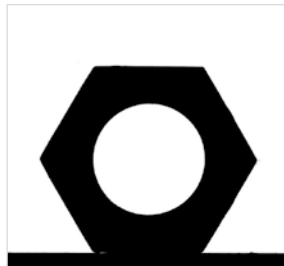
To order the version with the new green LED module use p/n **TCBENCH0xx-0-GZ** (i.e. TCBENCH064-0-GZ).



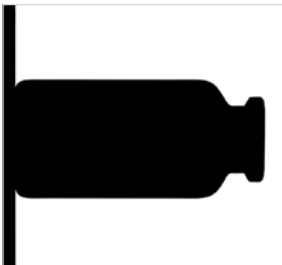
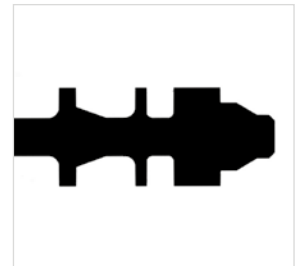
FULL RANGE OF COMPATIBLE ACCESSORIES		
	Optical filters	p. 228
FULL RANGE OF COMPATIBLE CAMERAS		
	Area scan cameras	p. 188-203



Mechanical



Automotive



Glass & pharma



Electronics



Part number	Mag. (x)	Max sensor size	Detector type			Optical specifications						Mechanical specifications				
			1/3" 6.0 mm diag w x h	1/1.8" 8.9 mm diag w x h	2/3" - 5 MP 11.1 mm diag w x h	Light color peak wavelength	WD (mm)	wF/#	Optical Accuracy	Optical Accuracy	Field Depth	CTF @70lp/mm	Mount	Length	Width	Height
			(mm x mm)	(mm x mm)	(mm x mm)	(nm)	(mm)		(μm)	(%)	(mm)	(%)		(mm)	(mm)	(mm)
			Field of view (mm x mm)													
TCBENCH 009	1.000	2/3"	4.80 x 3.60	7.13 x 5.37	8.44 x 7.06	green, 520 nm	62.2	11	< 5	< 0.06%	0.9	> 35	C	292.0	56.0	78.5
TCBENCH 016	0.528	2/3"	9.09 x 6.82	13.5 x 10.2	16.0 x 13.4	green, 520 nm	43.1	8	< 8	< 0.05%	2.4	> 40	C	315.0	65.5	81.2
TCBENCH 024	0.350	2/3"	13.7 x 10.3	20.4 x 15.3	24.1 x 20.2	green, 520 nm	67.2	8	< 13	< 0.05%	5.4	> 55	C	393.0	65.5	78.5
TCBENCH 036	0.243	2/3"	19.8 x 14.8	29.3 x 22.1	34.7 x 29.0	green, 520 nm	102.5	8	< 22	< 0.06%	11.2	> 50	C	549.0	103.0	140.5
TCBENCH 048	0.184	2/3"	26.1 x 19.6	38.8 x 29.2	46.0 x 38.4	green, 520 nm	132.9	8	< 31	< 0.06%	19.5	> 50	C	657.0	117.0	147.5
TCBENCH 056	0.157	2/3"	30.6 x 22.9	45.4 x 34.2	53.8 x 45.0	green, 520 nm	157.8	8	< 36	< 0.06%	26.8	> 55	C	715.0	122.0	150
TCBENCH 064	0.138	2/3"	34.8 x 26.1	51.9 x 39.1	61.4 x 51.4	green, 520 nm	181.8	8	< 40	< 0.06%	34.7	> 65	C	848.0	143.0	160.5
TCBENCH 080	0.110	2/3"	43.6 x 32.7	64.6 x 48.7	76.5 x 64.0	green, 520 nm	226.7	8	< 55	< 0.07%	54.5	> 55	C	936.0	158.0	168
TCBENCH 096	0.093	2/3"	51.6 x 38.7	76.3 x 57.5	90.4 x 75.6	green, 520 nm	278.6	8	< 70	< 0.07%	76.3	> 50	C	1087.0	206.5	185

- Working distance: distance between the front end of the lens mechanics and the object.
- Working F-number: the real F-number of a lens in operating conditions.
- Maximum measurement error without software calibration; standard image correction libraries yield close to zero measurement error.

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

TCBENCH CORE series

Compact telecentric optical benches for precision measurements

Mag. 0.093-0.184 x



KEY ADVANTAGES

Multi-level cost cutting

Saves money on manufacturing and transportation costs.

Downsized vision system

Allows you to reduce the length of your measurement system.

Pre-assembled setup

Just add a camera and measurement software and you're ready to go.

Best optical performance in a super tight space

A complete optical system designed for hassle free development of demanding precision measurement applications.

Detailed test report with measured optical parameters.

TCBENCH CORE series are complete and super compact optical systems offering superior performance 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 performance as our TCBENCH systems in a very reduced space.

FULL RANGE OF COMPATIBLE ACCESSORIES

	LTDV1CH-17V strobe controller	p. 252
	Optical filters	p. 228
FULL RANGE OF COMPATIBLE CAMERAS		
	Area scan cameras	p. 188-203

DID YOU KNOW?

TCBENCH CORE series is now also available with new LTSCHP1W-GZ **green** light source, suitable for any kind of sample and specifically tailored for measuring reflective objects and objects with sharp edges.

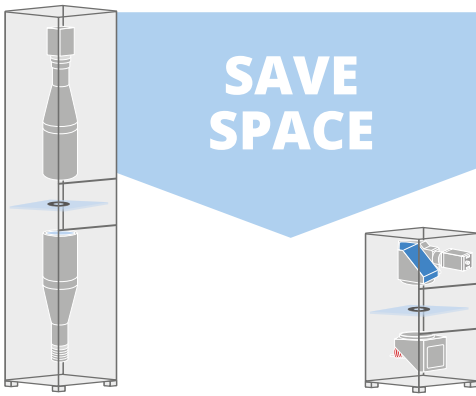
KEY FEATURES

- **Reduction of edge diffraction effects**
- Enhanced **illumination uniformity**, especially on large FOVs
- Less sensitive to **alignment**



Ordering information

To order the version with the new green LED module use p/n **TCCRBENCH0xx-0-GZ** (i.e. TCCRBENCH064-0-GZ).



SAVE SPACE

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

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

Application example:



Setup example:
2/3" sensor camera mounted on a bi-telecentric CORE lens TCCR23048, coupled with a LTCLCR048-G telecentric CORE illuminator and a robot holder clamp CMHORBCR048.

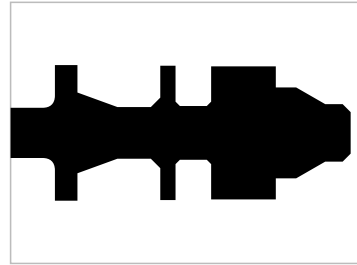


Image of the shaft presents very sharp edges and no reflections, allowing precise 2D measurement.

Technical information:

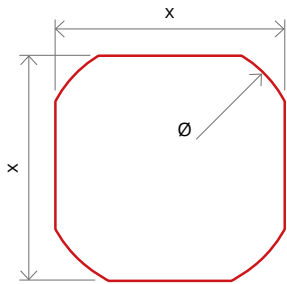


Image shape dimensions (Ø, x).

Non-contact measurement machine example

Technical specs	Standard components	TC BENCH CORE	Comparison
Camera sensor (mm)	8.50 x 7.09	8.50 x 7.09	
FOV (mm)	91.4 x 72.6	91.4 x 72.6	High-end performance 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 (m³)	0.30	0.14	

Part number	Mag.	Max sensor size (x)	Image shape dimensions (Ø, x=mm)	Detector type			Optical specifications				Mechanical specifications				
				1/3" w x h (mm x mm)	1/1.8" w x h (mm x mm)	2/3" - 5 MP w x h (mm x mm)	WD (mm)	wF/#	Accuracy (µm)	Field Depth (mm)	CTF @70lp/mm (%)	Mount	Length (mm)	Width (mm)	Height (mm)
Field of view (mm x mm)															
TCCRBENCH 048	0.184	2/3"	Ø=11.0, x=9.6	26.1 x 19.6	38.8 x 29.2	46.0 x 38.4	132.9	8	< 31	24	> 50	C	352	134	118
TCCRBENCH 056	0.157	2/3"	Ø=11.1, x=9.6	30.6 x 22.9	45.4 x 34.2	53.8 x 45.0	157.8	8	< 36	33	> 55	C	424	144	122
TCCRBENCH 064	0.138	2/3"	Ø=11.5, x=9.5	34.9 x 26.2	51.9 x 39.1	61.4 x 51.4	181.8	8	< 40	43	> 65	C	474	152	134
TCCRBENCH 080	0.110	2/3"	Ø=11.1, x=9.6	43.5 x 32.6	64.6 x 48.7	76.5 x 64.0	226.7	8	< 55	67	> 55	C	578	182	162
TCCRBENCH 096	0.093	2/3"	Ø=11.4, x=9.4	51.4 x 38.5	76.3 x 57.5	90.4 x 75.6	278.6	8	< 70	94	> 50	C	696	200	189

- 1 Working distance: distance between the front end of the lens mechanics and the object.
- 2 Working F-number: the real F-number of a lens in operating conditions.
- 3 Maximum measurement error without software calibration; standard image correction libraries yield close to zero measurement error.

- 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 considered. Pixel size used for calculation is 5.5 µm
- 5 Indicates the dimensions and shape of image, where "Ø =" stands for diameter and "x=" indicates the nominal image height and length (Tech Info for related drawing).

TCEDGEVIS

Telecentric system for defect detection on flat transparent materials

Mag. 0.093-0.243 x



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.

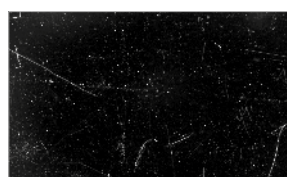
KEY ADVANTAGES

Revolutionary design

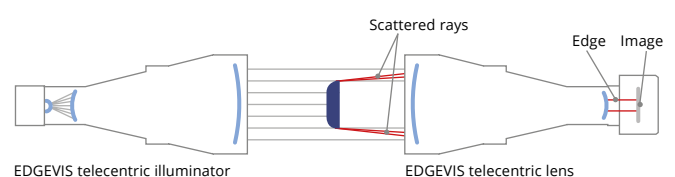
Innovative solution to inspect flat transparent surfaces (clear glass, plastic films) and for OCR/OCV applications:

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

Display inspection:



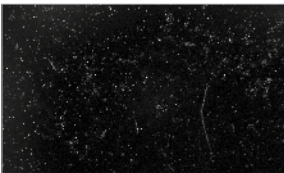
Detection of tiny scratches, bubbles and inclusions on smartphone glass screen.



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.

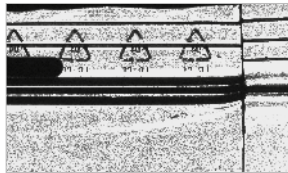


Particle analysis:



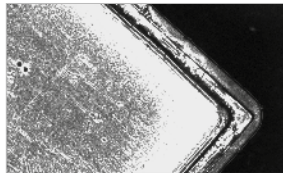
Checking dust deposits on a glass surface.

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. (x)	Max sensor size	Detector type			Optical specifications		Mechanical specifications			
			1/3" w x h (mm x mm)	1/1.8" w x h (mm x mm)	2/3" - 5 MP w x h (mm x mm)	WD (mm)	Light color, peak wavelength (nm)	Mount	Length (mm)	Width (mm)	Height (mm)
			Object field of view (mm x mm)			1					
TCEV 23 036-G	0.243	2/3"	19.7 x 14.8	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	2/3"	26.1 x 19.6	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	2/3"	30.6 x 22.9	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	2/3"	34.9 x 26.2	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	2/3"	43.5 x 32.6	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	2/3"	51.4 x 38.5	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.

TCUV series

UV bi-telecentric lenses

Mag. 0.11-0.175 x



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.

Application examples



Image captured with a lens operating in the visible range.

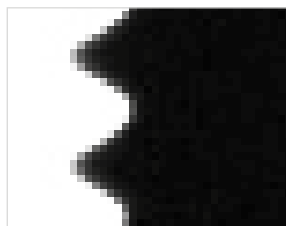


Image taken with a TCUV bi-telecentric lens.

KEY ADVANTAGES

Extremely high resolution for cameras with very small pixels.

High telecentricity for thick object imaging.

Nearly zero distortion for accurate measurements.

Detailed test report with measured optical parameters.

FULL RANGE OF COMPATIBLE ACCESSORIES



CMHO series

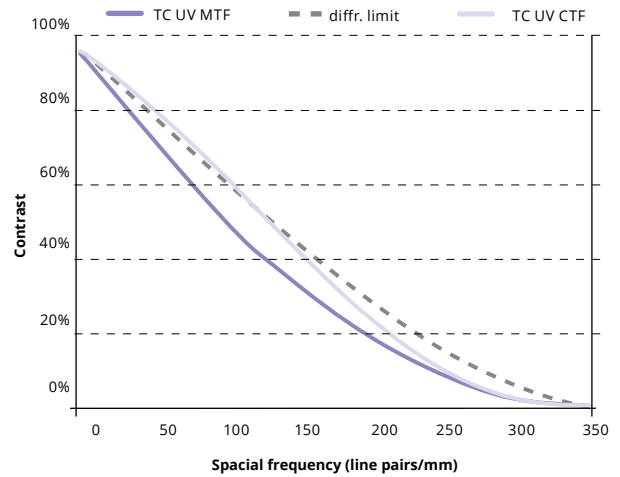
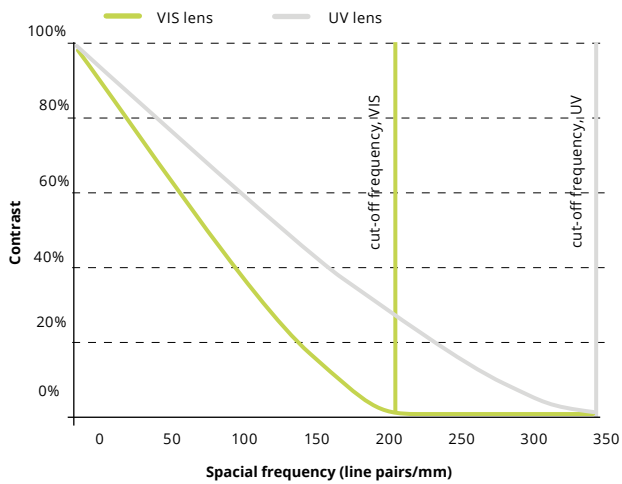
p. 248

FULL RANGE OF COMPATIBLE CAMERAS



Area scan cameras

p. 188-203



The graph shows the limit performance (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.

Part number	Mag. (x)	Max sensor size	Detector type			Optical specifications						Mechanical specs		
			1/3"	1/2"	2/3"	WD	wf/#	Telecentricity	Distortion	Field depth	CTF	Mount	Length	Diam.
			6.0 mm diag w x h 4.80 x 3.60 (mm x mm)	8.0 mm diag w x h 6.40 x 4.80 (mm x mm)	11.1 mm diag w x h 8.50 x 7.09 (mm x mm)	(mm)		typical (max) (deg)	typical (max) (%)	(mm)	@70lp/mm (%)		(mm)	(mm)
			Object field of view (mm x mm) ⁷			¹	²	³	⁴	⁵	⁶			
TCUV 12 036	0.175	1/2"	27.4 x 20.5	36.5 x 27.4	Ø = 37.6	98.7	8	< 0.1	< 0.08	21.6	> 40	C	142.3	61
TCUV 12 048	0.133	1/2"	36.0 x 27.0	47.9 x 36.0	Ø = 49.4	130.7	8	< 0.08	< 0.08	37.3	> 40	C	176.1	75
TCUV 12 056	0.114	1/2"	42.0 x 31.5	56.1 x 42.0	Ø = 57.8	154.0	8	< 0.1	< 0.08	50.8	> 40	C	198.4	80
TCUV 12 064	0.100	1/2"	48.0 x 36.0	64.0 x 48.0	Ø = 66.0	176.0	8	< 0.08	< 0.08	66.0	> 40	C	219.7	100
TCUV 12 080	0.080	1/2"	59.8 x 44.8	79.7 x 59.8	Ø = 82.2	221.0	8	< 0.08	< 0.08	103.1	> 40	C	264.3	116
TCUV 23 036	0.241	2/3"	19.9 x 14.9	26.6 x 19.9	36.5 x 27.4	98.7	8	< 0.1	< 0.08	11.4	> 40	C	160.4	61
TCUV 23 048	0.183	2/3"	26.2 x 19.6	34.9 x 26.2	48.0 x 36.0	130.7	8	< 0.08	< 0.08	19.7	> 40	C	194.5	75
TCUV 23 056	0.157	2/3"	30.6 x 22.9	40.8 x 30.6	56.1 x 42.1	154.0	8	< 0.1	< 0.08	26.8	> 40	C	216.8	80
TCUV 23 064	0.137	2/3"	34.9 x 26.2	46.6 x 34.9	64.1 x 48.0	176.0	8	< 0.08	< 0.08	35.2	> 40	C	238.2	100
TCUV 23 080	0.110	2/3"	43.5 x 32.6	58.0 x 43.5	79.7 x 59.8	221.0	8	< 0.08	< 0.08	54.5	> 40	C	283.0	116

- Working distance: distance between the front end of the mechanics and the object.
- Working F-number: the real F-number of a lens in operating conditions.
- Maximum angle between chief rays and optical axis on the object side.
- Percent deviation of the real image compared to an ideal, undistorted image: typical (average production) values and maximum (guaranteed) values are listed.
- 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.

- Nominal value.
- 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.

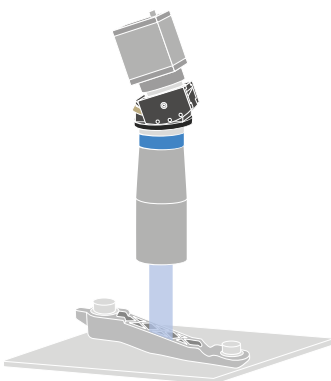
Compatible with any C-mount camera
C-mount standard compliant.

Detailed test report with measured optical parameters.

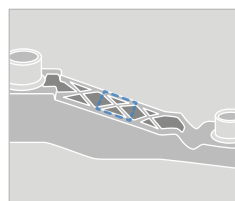
TCSM series is a unique family of bi-telecentric lenses for extremely accurate 3D dimensional measurement systems. All TCSM lenses are equipped with a high-precision Scheimpflug adjustment mechanism that fits any type of C-mount camera. Besides achieving very good focus at wide tilt angles, bi-telecentricity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

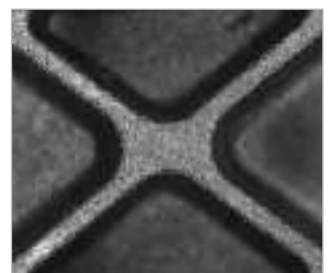
Examples of high-end 3D measurements



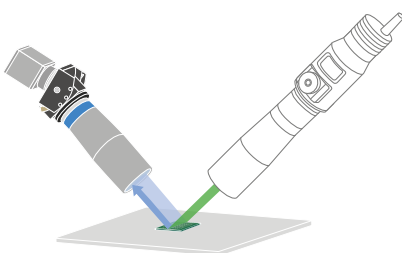
TCSM imaging and measuring sloped objects.



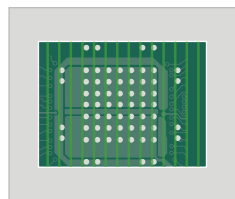
Without tilt adjustment, the object is not homogeneously focused.



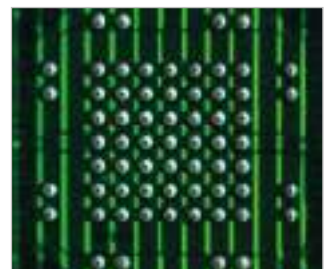
At the Scheimpflug angle, the image becomes sharp.



Scheimpflug telecentric lens and projector both at 45° relative to the object plane.



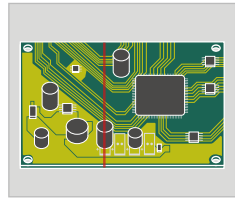
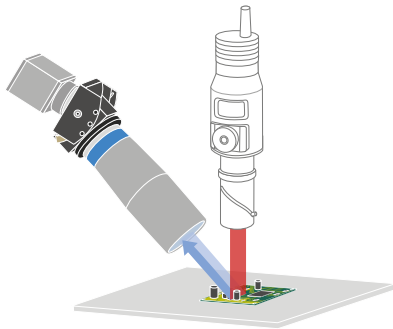
Without tilt adjustment, the object is not homogeneously focused.



At the Scheimpflug angle, the image becomes sharp.



SEE ALSO		
	MCSM1-01X	p. 90
FULL RANGE OF COMPATIBLE PRODUCTS FOR 3D APPLICATIONS		
	LED pattern projectors	p. 175
FULL RANGE OF COMPATIBLE ACCESSORIES		
	CMHO series	p. 246



TCSM series lens at 45° and telecentric pattern projector at 90° relative to the object plane.

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)	Horizontal mag (x)	Vertical mag (x)	Mount	Phase adj.	Long detector side horizontal			Long detector side vertical		
								1/3" w x h (mm x mm)	1/2" w x h (mm x mm)	2/3" w x h (mm x mm)	1/3" w x h (mm x mm)	1/2" w x h (mm x mm)	2/3" w x h (mm x mm)
								Field of view - w x h (mm x mm)			Field of view - w x h (mm x mm)		
TCSM 016	0.0	0.0	43.1	0.528	0.528	C	Yes	9.09 x 6.82	12.1 x 9.09	16.1 x 13.4	6.82 x 9.09	9.09 x 12.1	13.4 x 16.1
	10.0	5.3		0.528	0.522			9.09 x 6.89	12.1 x 9.19	16.1 x 13.6	6.82 x 9.19	9.09 x 12.3	13.4 x 16.3
	20.0	10.9		0.528	0.505			9.09 x 7.13	12.1 x 9.50	16.1 x 14.0	6.82 x 9.50	9.09 x 12.7	13.4 x 16.8
	30.0	17.0		0.528	0.478			9.09 x 7.53	12.1 x 10.0	16.1 x 14.8	6.82 x 10.0	9.09 x 13.4	13.4 x 17.8
TCSM 024	0.0	0.0	67.2	0.350	0.350	C	Yes	13.7 x 10.3	18.3 x 13.7	24.3 x 20.3	10.3 x 13.7	13.7 x 18.3	20.3 x 24.3
	15.0	5.4		0.350	0.340			13.7 x 10.6	18.3 x 14.1	24.3 x 20.9	10.3 x 14.1	13.7 x 18.8	20.3 x 25.0
	30.0	11.4		0.350	0.309			13.7 x 11.6	18.3 x 15.5	24.3 x 22.9	10.3 x 15.5	13.7 x 20.7	20.3 x 27.5
	45.0	19.3		0.350	0.262			13.7 x 13.7	18.3 x 18.3	24.3 x 27.0	10.3 x 18.3	13.7 x 24.4	20.3 x 32.4
TCSM 036	0.0	0.0	102.5	0.243	0.243	C	Yes	19.7 x 14.8	26.3 x 19.7	34.9 x 29.1	14.8 x 19.7	19.7 x 26.3	29.1 x 34.9
	15.0	3.7		0.243	0.235			19.7 x 15.3	26.3 x 20.4	34.9 x 30.1	14.8 x 20.4	19.7 x 27.2	29.1 x 36.1
	30.0	8.0		0.243	0.213			19.7 x 16.9	26.3 x 22.6	34.9 x 33.3	14.8 x 22.6	19.7 x 30.1	29.1 x 40.0
	45.0	13.6		0.243	0.177			19.7 x 20.3	26.3 x 27.1	34.9 x 40.1	14.8 x 27.1	19.7 x 36.2	29.1 x 48.0
TCSM 048	0.0	0.0	132.9	0.185	0.185	C	Yes	26.0 x 19.5	34.7 x 26.0	46.0 x 38.4	19.5 x 26.0	26.0 x 34.7	38.4 x 46.0
	15.0	2.8		0.185	0.179			26.0 x 20.2	34.7 x 26.9	46.0 x 39.7	19.5 x 26.9	26.0 x 35.8	38.4 x 47.6
	30.0	6.1		0.185	0.161			26.0 x 22.4	34.7 x 29.8	46.0 x 44.1	19.5 x 29.8	26.0 x 39.8	38.4 x 52.8
	45.0	10.5		0.185	0.133			26.0 x 27.1	34.7 x 36.1	46.0 x 53.4	19.5 x 36.1	26.0 x 48.2	38.4 x 64.0
TCSM 056	0.0	0.0	157.8	0.157	0.157	C	Yes	30.6 x 22.9	40.8 x 30.6	54.1 x 45.2	22.9 x 30.6	30.6 x 40.8	45.2 x 54.1
	15.0	2.4		0.157	0.152			30.6 x 23.7	40.8 x 31.6	54.1 x 46.7	22.9 x 31.6	30.6 x 42.2	45.2 x 56.0
	30.0	5.1		0.157	0.137			30.6 x 26.4	40.8 x 35.2	54.1 x 51.9	22.9 x 35.2	30.6 x 46.9	45.2 x 62.3
	45.0	8.8		0.157	0.112			30.6 x 32.0	40.8 x 42.7	54.1 x 63.1	22.9 x 42.7	30.6 x 57.0	45.2 x 75.7
TCSM 064	0.0	0.0	181.8	0.137	0.137	C	Yes	34.9 x 26.2	46.6 x 34.9	61.8 x 51.6	26.2 x 34.9	34.9 x 46.6	51.6 x 61.8
	15.0	2.1		0.137	0.133			34.9 x 27.1	46.6 x 36.1	61.8 x 53.4	26.2 x 36.1	34.9 x 48.2	51.6 x 64.0
	30.0	4.5		0.137	0.119			34.9 x 30.1	46.6 x 40.2	61.8 x 59.4	26.2 x 40.2	34.9 x 53.6	51.6 x 71.2
	45.0	7.8		0.137	0.098			34.9 x 36.7	46.6 x 48.9	61.8 x 72.3	26.2 x 48.9	34.9 x 65.2	51.6 x 86.6
TCSM 080	0.0	0.0	226.7	0.110	0.110	C	Yes	43.6 x 32.7	58.2 x 43.6	77.3 x 64.5	32.7 x 43.6	43.6 x 58.2	64.5 x 77.3
	15.0	1.7		0.110	0.106			43.6 x 33.9	58.2 x 45.2	77.3 x 66.7	32.7 x 45.2	43.6 x 60.2	64.5 x 80.0
	30.0	3.6		0.110	0.095			43.6 x 37.7	58.2 x 50.3	77.3 x 74.3	32.7 x 50.3	43.6 x 67.0	64.5 x 89.0
	45.0	6.3		0.110	0.078			43.6 x 46.0	58.2 x 61.3	77.3 x 90.6	32.7 x 61.3	43.6 x 81.8	64.5 x 108.6
TCSM 096	0.0	0.0	278.6	0.093	0.093	C	Yes	51.4 x 38.5	68.5 x 51.4	91.0 x 75.9	38.5 x 51.4	51.4 x 68.5	75.9 x 91.0
	15.0	1.4		0.093	0.090			51.4 x 39.9	68.5 x 53.2	91.0 x 78.6	38.5 x 53.2	51.4 x 70.9	75.9 x 94.2
	30.0	3.1		0.093	0.081			51.4 x 44.4	68.5 x 59.3	91.0 x 87.5	38.5 x 59.3	51.4 x 79.0	75.9 x 104.9
	45.0	5.3		0.093	0.066			51.4 x 54.3	68.5 x 72.4	91.0 x 106.9	38.5 x 72.4	51.4 x 96.5	75.9 x 128.1

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 Indicates the availability of an integrated camera phase adjustment feature.

Macro & Fixed focal length lenses

A wide range of solutions for every machine vision challenge.

Macro and fixed focal length lenses are the perfect optical solution for many applications in machine vision.

Macro lenses are the Opto Engineering® answer to the need for accurate close-up imaging, while fixed focal length lenses provide the flexibility needed for general purposes solutions.

Macro lenses can perform close-range inspection tasks very effectively with impressive optical performance in terms of resolution and distortion.

Like all our products, these optics are built to be deployed in industrial environments: their compact form factor, optical capabilities and excellent value make the Opto Engineering® macro lenses the ideal solution for a wide range of machine vision systems.

Opto Engineering® family of fixed focal length 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 length lenses for small, medium and large detectors.



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

UP TO 2/3" SENSORS	74 - 78
<i>FIXED FOCAL LENGTH LENSES</i>	74 - 77
<i>MACRO LENSES</i>	78

FROM 1" TO APS-C SENSORS	79 - 83
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OPTICS PARAMETERS

Focal length (mm)

Mag. Magnification range (x)



EN2MP series

Cost-effective 2 Megapixel fixed focal length lenses for sensors up to 2/3" Focal length 8-75 mm



KEY ADVANTAGES

Suitable for wide range of applications

Designed to satisfy simple vision tasks.

Wide product range

Covers the most popular focal lengths used in factory automation.

High quality / price ratio

High performance with reasonable cost.


Locking screws

Locking screws for fixing focus and iris.

EN2MP series is a series of fixed focal length lenses designed for use in factory automation. Its high quality to price ratio allows simple vision tasks to be achieved easily and efficiently. The lenses are designed to withstand harsh working environments.

The lenses are suitable for a wide range of vision tasks. E.g. Pattern matching, positioning, barcode recognition, packaging inspection, presence/absence, robot guide, pick and place, orientation check, 3D measurement...etc.

With many years of experience in the machine vision industry, Opto Engineering® can provide bundle solutions including a suitable lens, camera and illuminator that are optimized for your specific application requirements.

FULL RANGE OF COMPATIBLE CAMERAS		
	Area scan cameras	p. 188-203

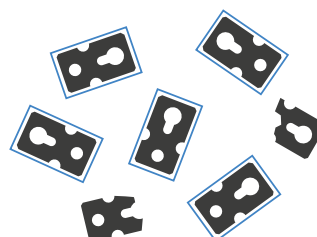
Application examples



Barcode recognition.



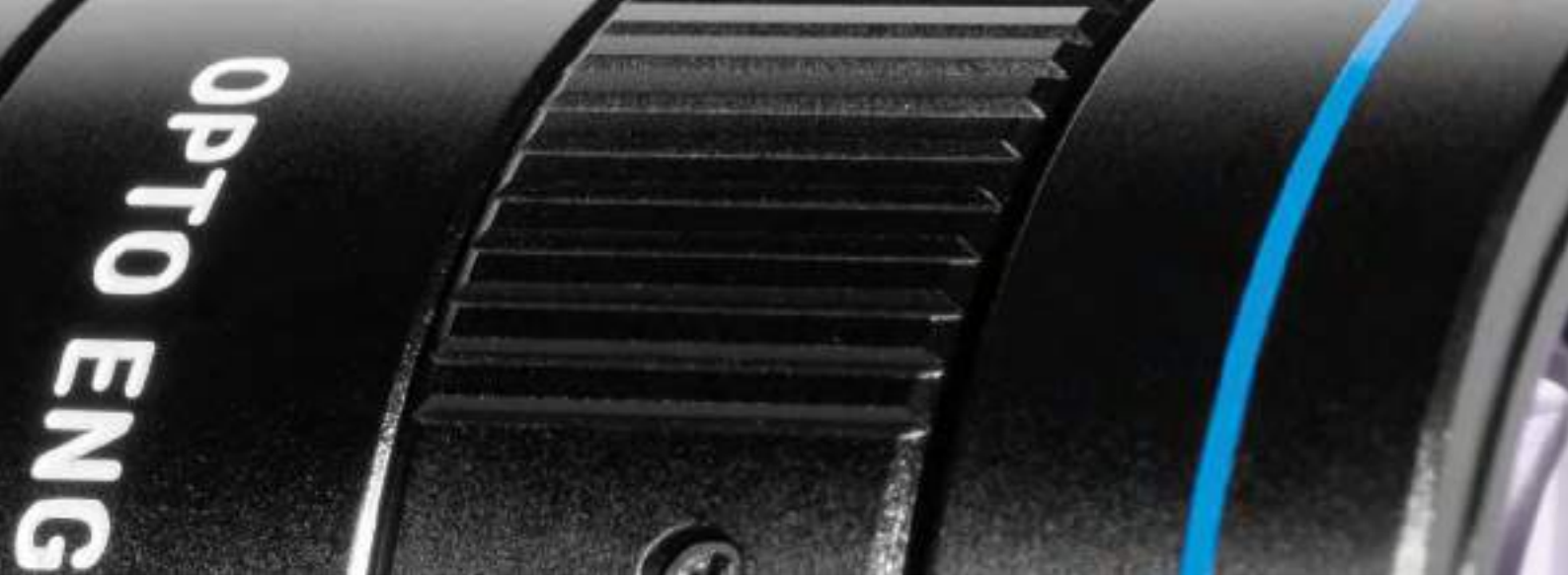
Color sorting.



Object identification.



Liquid level inspection.



Part number	Optical specifications							Dimensions			Filter mount (mm)
	Focal length (mm)	Image circle Ø (mm)	Max detector size	F/#	Angle of view (D x H x V) (°) ¹	Max Distortion (%) ²	Mount	Length (mm)	Diameter (mm)	Mass (g)	
EN2MP0814	8	11	2/3"	1.4 - C	-	2.81	C	40.5	40.9	77	M34.5 x 0.5
EN2MP1214	12	11	2/3"	1.4 - C	49.0 x 40.0 x 30.3	1.8	C	37.5	38.3	71	M30.5 x 0.5
EN2MP1614	16	11	2/3"	1.4 - 22	37.6 x 30.4 x 22.9	1.0	C	37.9	38.2	76	M30.5 x 0.5
EN2MP2514	25	11	2/3"	1.4 - C	24.7 x 19.9 x 15.0	0.27	C	40.5	38.0	83	M30.5 x 0.5
EN2MP3514	35	11	2/3"	1.4 - C	17.7 x 14.2 x 10.7	0.33	C	37.8	39.1	90	M30.5 x 0.5
EN2MP5018	50	11	2/3"	1.8 - C	12.5 x 9.1 x 7.5	0.22	C	40.1	45.5	98	M30.5 x 0.5
EN2MP7528	75	11	2/3"	2.8 - C	8.4 x 6.7 x 5.0	0.36	C	53.4	42.0	140	M30.5 x 0.5

¹ Angle of view while using max detector size.

² Max distortion while using max detector size.

Macro & Fixed focal length lenses

UP TO 2/3" SENSORS

FIXED FOCAL LENGTH LENSES

EN-2RT series

2 Megapixel fixed focal length lenses for sensors up to 2/3"



* RT

Focal length 5-75 mm

Part number	Optical specifications								Mechanical specifications				
	Focal length (mm)	Magnification (x)	Image circle Ø (mm)	Max detector size	WD (mm)	F/#	Horizontal angle of view (°) ¹	Max Distortion (%) ²	Mount	Length (mm)	Diameter (mm)	Mass (g)	Filter thread (mm)
RT-H0514-MP2	5	0.044 - 0	8	1/2"	100 - ∞	1.4 - 16C	65.5	0.5	C	45.5	44.5	102.0	M43 x 0.75
RT-M0814-MP2	8	0.075 - 0	11	2/3"	100 - ∞	1.4 - 16C	56.3	0.1	C	28.2	33.5	62.6	M30.5 x 0.5
RT-M1214-MP2	12	0.074 - 0	11	2/3"	150 - ∞	1.4 - 16C	40.4	0.1	C	28.2	33.5	62.0	M30.5 x 0.5
RT-M1614-MP2	16	0.052 - 0	11	2/3"	300 - ∞	1.4 - 16C	30.8	0.1	C	28.2	33.5	60.0	M30.5 x 0.5
RT-M2514-MP2	25	0.084 - 0	11	2/3"	300 - ∞	1.4 - 16C	20	0.3	C	36.0	33.5	71.0	M30.5 x 0.5
RT-M3514-MP	35	0.110 - 0	11	2/3"	300 - ∞	1.4 - 16C	13.9	0.8	C	38.2	33.5	87.0	M30.5 x 0.5
RT-M5018-MP2	50	0.100 - 0	11	2/3"	500 - ∞	1.8 - 16C	10.5	0.3	C	38.2	33.5	85.0	M30.5 x 0.5
RT-M7528-MP	75	0.214 - 0	11	2/3"	300 - ∞	2.8 - 16C	6.8	0.4	C	57.8	35.0	113.0	M30.5 x 0.5

¹ Horizontal angle of view while using max detector size.

² Max distortion while using max detector size.

EN5MP series

Cost-effective 5 Megapixel fixed focal length lenses for sensors up to 2/3"

Focal length 8-75 mm



KEY ADVANTAGES

High resolution

Designed for high resolution cameras up to 5 Megapixel with 2/3" sensor.

Suitable for more complex applications

Ideal to achieve complex vision tasks.

Cost saving solution

High optical performance with reasonable cost.

Robust design

Designed for use in machine vision applications.


Wide product range

Covers the most popular focal lengths used.

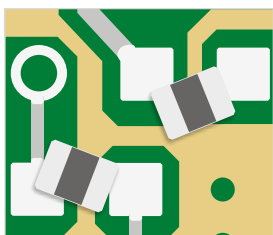
EN5MP series is a series of high resolution fixed focal length lenses designed for use in machine vision applications. A wide range of focal lengths provides more choices of field of view and working distance for many different system configurations.

Together with high resolution cameras and proper illumination, EN5MP lenses allow you to design high resolution vision systems to solve complex or critical tasks. E.g. OCR/OCV, robot guidance...etc. and for the inspection of critical samples like connectors, electronic components, vials...etc.

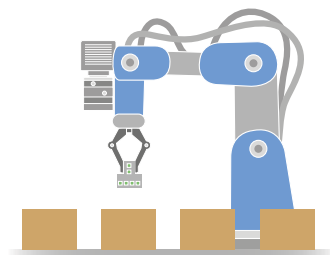
Opto Engineering® can save you time and money by providing bundle solutions including a suitable lens, camera and illuminator, optimized for your applications requirements and type of samples.

FULL RANGE OF COMPATIBLE CAMERAS		
	Area scan cameras	p. 188-203

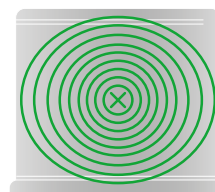
Application examples



PCB parts inspection.



Robot guidance for fast pick and place.



3D measurement.



Packaging / labelling inspection.



Part number	Optical specifications							Dimensions			Filter mount
	Focal length (mm)	Image circle Ø (mm)	Max detector size	F/#	Angle of view (D x H x V) (°) ¹	Max Distortion (%) ²	Mount	Length (mm)	Diameter (mm)	Mass (g)	
EN5MP0816	8	11	2/3"	1.6 - 22	66.8 x 55.8 x 43.3	0.73	C	58.7	49.5	170	M40.5 x 0.5
EN5MP1216	12	11	2/3"	1.6 - 22	48.6 x 39.8 x 30.4	0.35	C	64.6	47.7	178	M37.5 x 0.5
EN5MP1616	16	11	2/3"	1.6 - 22	38.0 x 30.8 x 23.4	0.07	C	69.2	47.7	181	M37.5 x 0.5
EN5MP2514	25	11	2/3"	1.4 - 22	24.8 x 20.0 x 15.0	0.19	C	59.7	47.5	148	M37.5 x 0.5
EN5MP3514	35	11	2/3"	1.4 - 22	17.9 x 14.3 x 10.8	0.06	C	62.2	47.1	156	M37.5 x 0.5
EN5MP5018	50	11	2/3"	1.8 - 22	12.6 x 10.1 x 7.6	0.03	C	63.2	46.2	173	M37.5 x 0.5
EN5MP7520	75	11	2/3"	2.0 - 22	8.4 x 6.7 x 5.0	0.02	C	76.7	49.5	223	M40.5 x 0.5

¹ Angle of view while using max detector size.

² Max distortion while using max detector size.

Macro & Fixed focal length lenses

UP TO 2/3" SENSORS

FIXED FOCAL LENGTH LENSES

EN-5RT series

5 Megapixel fixed focal length lenses for sensors up to 2/3"

UPGRADED MODELS
AVAILABLE SOON,
CHECK OUR WEBSITE!



* RT

Focal length 8-50 mm

Part number	Optical specifications									Mechanical specifications				
	Focal length (mm)	Magnification (x)	Image circle Ø (mm)	Max detector size	WD (mm)	F/# ³	Horizontal angle of view (°) ¹	Max Distortion (%) ²	Mount	Length (mm)	Diameter (mm)	Mass (g)	Filter thread (mm)	
RT-M0824-MPW2	8	0.100 - 0	11	2/3"	50 - ∞	2.4 - 16	57.8	1.9	C	45.7	32.0	80	M30.5 x 0.5	
RT-M1224-MPW2	12	0.100 - 0	11	2/3"	100 - ∞	2.4 - 16	39.8	0.35	C	42.7	29.0	72	M27 x 0.5	
RT-M1620-MPW2	16	0.075 - 0	11	2/3"	200 - ∞	2.0 - 16	30.7	0.1	C	33.5	29.0	53	M27 x 0.5	
RT-M2518-MPW2	25	0.081 - 0	11	2/3"	300 - ∞	1.8 - 16	19.9	0.03	C	36.3	29.0	60	M27 x 0.5	
RT-M3520-MPW2	35	0.190 - 0	11	2/3"	200 - ∞	2.0 - 22	14.3	0.01	C	37.3	29.0	59	M27 x 0.5	
RT-M5028-MPW2	50	0.138 - 0	11	2/3"	400 - ∞	2.8 - 32	27.7	0.027	C	45.3	29.0	69	M27 x 0.5	
EN-5RT -Ruggedized series to minimize image aberrations after shock and vibration														
RT-M0824-MPW2-R	8	0.100 - 0	11	2/3"	50 - ∞	2.4, 4.0, 5.6, 8.0, 11.0	57.8	1.9	C	45.7	32.0	80	M30.5 x 0.5	
RT-M1224-MPW2-R	12	0.100 - 0	11	2/3"	100 - ∞	2.4, 4.0, 5.6, 8.0, 11.0	39.8	0.35	C	42.7	29.0	72	M27 x 0.5	
RT-M1620-MPW2-R	16	0.075 - 0	11	2/3"	200 - ∞	2.0, 4.0, 5.6, 8.0, 11.0	30.7	0.1	C	33.5	29.0	53	M27 x 0.5	
RT-M2518-MPW2-R	25	0.081 - 0	11	2/3"	300 - ∞	1.8, 4.0, 5.6, 8.0, 11.0	19.9	0.03	C	36.3	29.0	60	M27 x 0.5	
RT-M3520-MPW2-R	35	0.190 - 0	11	2/3"	200 - ∞	2.0, 4.0, 5.6, 8.0, 11.0	14.3	0.01	C	37.3	29.0	59	M27 x 0.5	
RT-M5028-MPW2-R	50	0.138 - 0	11	2/3"	400 - ∞	2.8, 4.0, 5.6, 8.0, 11.0	27.7	0.027	C	45.3	29.0	69	M27 x 0.5	

¹ Horizontal angle of view while using max detector size.

² Max distortion while using max detector size.

³ For the ruggedized series, the aperture is fixed. The available apertures are indicated.

HIGH RESOLUTION EN-5RT SERIES MATCH SMALL PIXEL SIZE DETECTORS:

In order to effectively create a high resolution image a lens must be capable of resolving the detector pixel size. Take full advantage of high resolution detectors with EN-5RT series featuring MTFs in excess of 120 lp/mm! For further details about how to match optics and sensor resolution check the BASICS section of our website under Optics / Image quality / Optics and sensor resolution

FULL RANGE OF COMPATIBLE PRODUCTS

	Area scan cameras	p. 188-203
	Optical filters	p. 228
	LTRNDC LED direct ring lights	p. 140

MC series

Zero distortion macro lenses for sensors up to 2/3"

Mag. 0.3-3 x



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.

Application examples



FOR HIGHER MAGNIFICATION TELECENTRIC LENSES SEE ALSO		
	TCHM series	p. 23
FULL RANGE OF COMPATIBLE ILLUMINATORS		
	LTRNST series	p. 138
	LTLA series	p. 142
	LTRNOB series	p. 148
	Backlights LT2BC, LTBP, LTBC, LTBFC series	p. 118-127
FULL RANGE OF COMPATIBLE CAMERAS		
	Area scan cameras	p. 188-203

Part number	Mag. (x)	Max sensor size	Detector type			Optical specifications					Mechanical specifications			
			1/3" w x h (mm x mm)	1/1.8" w x h (mm x mm)	2/3" - 5 MP w x h (mm x mm)	WD (mm)	Focal length (mm)	F/# (wF/#)	Distortion (%)	Field depth (mm)	Length (mm)	Diameter (mm)	Height (mm)	Mount
			Object field of view (mm x mm)			1	2	3						
MC 300X	3.00	2/3"	1.6 x 1.2	2.4 x 1.8	2.8 x 2.4	29	28.2	5.0 (20)	< 0.01	0.09	106.5	15	30	C
MC 200X	2.00	2/3"	2.4 x 1.8	3.6 x 2.7	4.2 x 3.5	33	28.2	5.3 (16)	< 0.01	0.16	78.1	15	30	C
MC 150X	1.50	2/3"	3.2 x 2.4	4.8 x 3.6	5.6 x 4.7	38	28.2	5.2 (13)	< 0.01	0.23	63.9	15	30	C
MC 100X	1.00	2/3"	4.8 x 3.6	7.1 x 5.4	8.4 x 7.1	47	28.2	5.0 (10)	< 0.01	0.40	49.9	15	30	C
MC 075X	0.75	2/3"	6.4 x 4.8	9.5 x 7.2	11.3 x 9.4	58	28.2	5.1 (9)	< 0.02	0.63	42.8	15	30	C
MC 050X	0.50	2/3"	9.6 x 7.2	14.3 x 10.7	16.9 x 14.1	75	28.2	5.3 (8)	< 0.02	1.27	35.7	15	30	C
MC 033X	0.33	2/3"	14.4 x 10.8	21.4 x 16.1	25.4 x 21.2	102	28.2	5.3 (7)	< 0.05	2.50	31.0	15	30	C

- 1 Working distance: distance between the front end of the mechanics and the object.
- 2 Working F-number: the real F-number of a lens in operating conditions.
- 3 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

EN8MP series

8 Megapixel fixed focal length lenses for sensors up to 1"

Focal length 8-50 mm



KEY ADVANTAGES

Compact and Anti-Vibration design

Designed for factory automation, the EN8MP lenses are among the most compact fixed focal length lenses on the market for sensor format up to 1".

High resolution

Suitable with cameras with sensors up to 1", e.g. the Sony 9 MP and 20 MP, and the Sony Pregius IMX174 and IMX249 with 1/1.2" format.

High quality / price ratio

High performance with reasonable cost.

Low distortion

Even down to 0.01%.

Wide product range


6 focal length covers from 8 mm to 50 mm.

EN8MP series is a series of fixed focal length lenses that has a very compact design for a high resolution 1" lens. Its anti-shock design responds to current market need in factory automation.

While the accuracy request increased in the industry, the resolution and the size of the sensors are increasing, a correspondent high resolution lens for larger format is needed in order to accomplish much complex vision tasks. Together with COE cameras, EN8MP series can resolve high resolution inspection such as hairline defect on reflective material, printing inspection and also collaborative robot guide...etc

Opto Engineering® has wide experience in different industries, our global tech support team would support you on provide the most suitable machine vision components based on the customer need including where the high resolution requires.

FULL RANGE OF COMPATIBLE CAMERAS



Area scan cameras p. 188-203

Part number	Optical specifications							Dimensions			Filter mount
	Focal length	Image circle	Max detector size	F/#	Angle of view (D x H x V)	Max Distortion	Mount	Length	Diameter	Mass	
	(mm)	Ø (mm)			(°) ¹	(%) ²		(mm)	(mm)	(g)	
EN8MPL0818	8	16	1"	1.8 - C	90.06 x 77.16 x 61.30	4.12	C	67.0	56.8	76.6	-
EN8MPL1220	12	16	1"	2.0 - 22	69.63 x 60.71 x 44.33	4.10	C	52.9	44.2	-	M35.5 x 0.5
EN8MPL1620	16	16	1"	2.0 - 22	53.74 x 43.89 x 33.43	2.22	C	50.8	43.9	112.6	M34.0 x 0.5
EN8MPL2518	25	16	1"	1.8 - C	36.01 x 28.99 x 21.85	1.53	C	43.3	39.8	93.0	M30.5 x 0.5
EN8MPL3520	35	16	1"	2.0 - C	25.74 x 20.74 x 15.64	0.30	C	43.6	40.3	74.4	M30.5 x 0.5
EN8MPL5020	50	16	1"	2.0 - 22	18.18 x 14.60 x 10.96	0.01	C	52.3	47.6	120.4	M37.5 x 0.5

¹ Angle of view while using max detector size.

² Max distortion while using max detector size.

EN-9RT series

9 Megapixel fixed focal length lenses for sensors up to 1"



* RT

Focal length 8-75 mm

Part number	Optical specifications								Mechanical specifications				
	Focal length (mm)	Image circle Ø (mm)	Max detector size (mm)	WD (mm)	F/#	Horizontal angle of view (°) ¹	Max Distortion (%)	Nominal resolution (lp/mm)	Mount	Length (mm)	Diameter (mm)	Mass (mm)	Filter thread (mm)
RT-FL-BC2518-9M	25	16	1"	100 - ∞	1.8 - 16	14.1	n.a.	135 lp/mm (9 MP)	C	57.5	42	149	M40.5 x 0.5
RT-FL-BC3518-9M	35	16	1"	150 - ∞	1.8 - 22	16.8	n.a.	135 lp/mm (9 MP)	C	60.0	42	150	M40.5 x 0.5
RT-FL-BC5024-9M	50	16	1"	200 - ∞	2.4 - 22	18.8	n.a.	135 lp/mm (9 MP)	C	69.0	42	166	M40.5 x 0.5
RT-FL-BC7528-9M	75	16	1"	250 - ∞	2.8 - 32	21.3	n.a.	135 lp/mm (9 MP)	C	81.0	42	189	M40.5 x 0.5

¹ Horizontal angle of view while using max detector size.

FULL RANGE OF COMPATIBLE PRODUCTS	
	Area scan cameras p. 188-203
	Optical filters p. 228
	LTRNDC LED direct ring lights p. 140

EN-10RT series

10 Megapixel fixed focal length lenses for sensors up to 1.1"




* RT

Focal length 8-50 mm

Part number	Optical specifications								Mechanical specifications			
	Image circle Ø (mm)	Focal length (mm)	Max detector size (mm)	WD (mm)	F/#	Horizontal angle of view (°) ¹	Max distortion (%) ²	Nominal resolution (lp/mm)	Mount	Length (mm)	Diameter (mm)	Filter thread (mm) ³
RT-V0828-MPY2	17.6	8	1.1"	200 - ∞	2.8 - 16.0	83.0	< 0.6	12 MP	C	54	75	M72 x 0.75 or M67 x 0.75
RT-V1228-MPY2	17.6	12	1.1"	300 - ∞	2.8 - 16.0	60.5	< 0.5	12 MP	C	36.1	42	M34.5 x 0.5
RT-V1628-MPY2	17.6	16	1.1"	300 - ∞	2.8 - 16.0	48.2	< 0.5	12 MP	C	35.2	39.5	M34.5 x 0.5
RT-V2528-MPY	17.6	25	1.1"	300 - ∞	2.8 - 16.0	31.7	< 0.3	12 MP	C	34	39.5	M34.5 x 0.5
RT-V3528-MPY	17.6	35	1.1"	300 - ∞	2.8 - 16.0	22.9	< 0.1	12 MP	C	45.1	39.5	M34.5 x 0.5
RT-V5028-MPY	17.6	50	1.1"	500 - ∞	2.8 - 16.0	16.2	< 0.1	12 MP	C	45.1	39.5	M34.5 x 0.5

¹ Horizontal angle of view while using max detector size.² Max distortion while using max detector size.³ For RT-V0828-MPY2, need to use RT-VM0811 mount adapter for using M72 x 0.75 filter mount for 1.1" detector. Or need to use RT-VM0810 for using M67 x 0.75 filter mount for 1" detector.

FULL RANGE OF COMPATIBLE CAMERAS	
	Area scan cameras p. 188-203

EN10MP series

10 Megapixel fixed focal length lenses for sensors up to 4/3"

Focal length 12-50 mm



KEY ADVANTAGES

Designed for the new high resolution Sony Pregius sensors

Suitable with the Sony Pregius 12 MP IMX304 and IMX253 sensors with 1.1" format, and the new Sony Pregius 7.1 MP IMX420 and IMX428 with 1.1" format.

High quality / price ratio

High performance with reasonable cost.

Low distortion

Even down to 0.14%.

EN10MP series is a series of powerful fixed focal length lenses designed for the high sensitivity and precise high-speed imaging of the new 1.1" and 4/3" Sony Pregius sensors.

The ever-increasing complexity of vision tasks, requires lenses with extremely competitive performance.

The EN10MP series are designed to meet the high accuracy coupled with large format for high resolution sensors.

Opto Engineering® has wide experience in different industries, our global sales team would support you on provide the most suitable machine vision components based on your needs.

FULL RANGE OF COMPATIBLE CAMERAS



Area scan cameras

p. 188-203

Part number	Optical specifications							Dimensions			
	Focal length	Image circle	Max detector size	F/#	Angle of view	Max Distortion	Mount	Length	Diameter	Mass	Filter mount
	(mm)	Ø (mm)			(D x H x V) (°) 1	(%) 2		(mm)	(mm)	(g)	(mm)
EN10MPL1220	12	23	4/3"	2 - 22	89.02 x 75.46 x 61.08	2.40	C	88.4	80.0	447	M77.0 x 0.75
EN10MPL1620	16	23	4/3"	2 - 22	72.92 x 60.92 x 47.28	2.81	C	89.9	59.8	338	M58.0 x 0.75
EN10MPL2520	25	23	4/3"	2 - 22	49.7 x 40.6 x 31.0	0.66	C	86.7	52.8	251	M46.0 x 0.75
EN10MPL3520	35	23	4/3"	2 - 22	36.6 x 29.6 x 22.4	0.56	C	58.9	49.9	173	M40.5 x 0.5
EN10MPL5020	50	23	4/3"	2 - 22	25.9 x 20.9 x 15.7	0.14	C	57.9	48.8	170	M40.5 x 0.5

1 Angle of view while using max detector size.

2 Max distortion while using max detector size.

EN-A5MX series

5 Megapixel fixed focal length lenses for sensors up to 4/3"



* RT

Focal length 12-35 mm

Part number	Optical specifications								Mechanical specifications			
	Image circle	Focal length	Max detector size	WD	F/#	Horizontal angle of view	Max distortion	Nominal resolution	Mount	Length	Diameter	Filter thread
	Ø (mm)	(mm)		(mm)		(°) 1	(%) 2	(lp/mm)		(mm)	(mm)	(mm)
RT-A-1224MX5M	22	12	4/3"	300 - ∞	2.4 - 32	58.72	< 3.7	100 lp/mm (5 MP)	C	104.41	80	M77 x 0.75
RT-A-1620MX5M	22	16	4/3"	100 - ∞	2.0 - 32	45.75	< 0.6	150 lp/mm (5 MP)	C	102.41	76	M72 x 0.75
RT-A-2520MX5M	22	25	4/3"	150 - ∞	2.0 - 32	30.22	< 0.2	150 lp/mm (5 MP)	C	103.43	38.5	M35.5 x 0.5
RT-A-3520MX5M	22	35	4/3"	200 - ∞	2.0 - 22	21.83	< 1	120 lp/mm (5 MP)	C	103.37	42	M37.5 x 0.5

1 Horizontal angle of view while using max detector size.

2 Max distortion while using max detector size.

MC4K series

Macro lenses for 4k line scan cameras and APS-C sensors

Mag. 0.25-2 x



KEY ADVANTAGES

Macro design

Achieve unmatched resolution in critical applications: these lenses 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 line scan cameras and matrix detector cameras over 4/3". These lenses are specifically designed for macro imaging, as opposed to infinite conjugate lenses with added spacers, a common alternative unable to deliver the same optical performance. MC4K lenses feature fixed aperture 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 more robust build quality, 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.



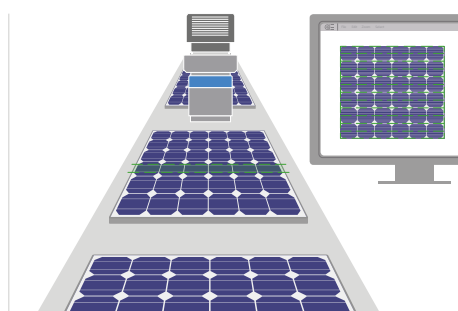
Mount F



Mount N = M42x1

FULL RANGE OF COMPATIBLE ILLUMINATORS		
	Line lights, LTLNC, LTLNM, LTLNE series	p. 166-171
	Bar lights LTBRC series	p. 160
	Backlights LT2BC, LTBP, LTBC, LTBFC series	p. 118-127
FULL RANGE OF COMPATIBLE CAMERAS		
	Area scan cameras	p. 188-203

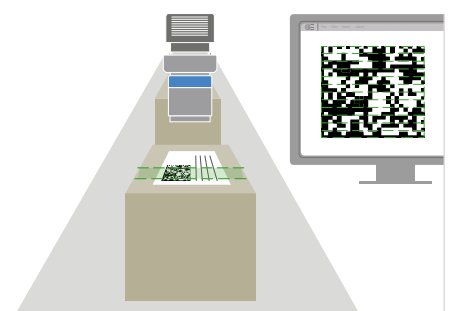
Application examples



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.



Part number	Focusing	Mag.	Max sensor size	Detector type			Optical specifications					Mechanical specs					
				Line -2k	APS-C IMX342	Line -4k	WD	Focal length	F/#	Distortion	Field depth	CTF	Mount	Length	Diam.		
				2k x 10 μ m	27.9 mm diag	4k x 7 μ m	(mm)	(mm)	(wF/#)	typical (max)	(mm)	@50 lp/mm		(mm)	(mm)		
		(x)															
	1						2		3		4	5					
				Object field of view (mm x mm)													
MC4K 025X-F	near	0.295	4K APS-C	69.49	75.78 x 56.85	97.29	298.5					7.72					
	nominal	0.250		82.00	89.42 x 67.08	114.80	346.1	88.0	6.4 (8)	< 0.08 (0.10)	10.75	> 60	F	80.0	64		
	far	0.205		100.00	109.05 x 81.80	140.00	414.3				15.99						
MC4K 025X-N	near	0.295	4K APS-C	69.49	75.78 x 56.85	97.29	298.5					7.72					
	nominal	0.250		82.00	89.42 x 67.08	114.80	346.1	88.0	6.4 (8)	< 0.08 (0.10)	10.75	> 60	M42x1 FD 10.56	115.9	52		
	far	0.205		100.00	109.05 x 81.80	140.00	414.3				15.99						
MC4K 050X-F	near	0.545	4K APS-C	37.61	41.02 x 30.77	52.66	177.0					2.37					
	nominal	0.500		41.00	44.71 x 33.54	57.40	189.9	88.0	6.7 (10)	< 0.04 (0.08)	2.81	> 50	F	99.5	64		
	far	0.455		45.05	49.13 x 36.86	63.08	205.2				3.40						
MC4K 050X-N	near	0.545	4K APS-C	37.61	41.02 x 30.77	52.66	177.0					2.37					
	nominal	0.500		41.00	44.71 x 33.54	57.40	189.9	88.1	6.7 (10)	< 0.04 (0.08)	2.81	> 50	M42x1 FD 10.56	135.4	52		
	far	0.455		45.05	49.13 x 36.86	63.08	205.2				3.40						
MC4K 075X-F	near	0.795	4K APS-C	25.79	28.12 x 21.09	36.10	131.4					1.05					
	nominal	0.750		27.33	29.81 x 22.36	38.27	137.3	77.1	6.3 (11)	< 0.04 (0.08)	1.18	> 50	F	113.6	64		
	far	0.704		29.12	31.76 x 23.82	40.77	143.9				1.33						
MC4K 075X-N	near	0.795	4K APS-C	25.79	28.12 x 21.09	36.10	131.4					1.05					
	nominal	0.750		27.33	29.81 x 22.36	38.27	137.3	77.1	6.3 (11)	< 0.04 (0.08)	1.18	> 50	M42x1 FD 10.56	149.5	52		
	far	0.704		29.12	31.76 x 23.82	40.77	143.9				1.33						
MC4K 100X-F	near	1.045	4K APS-C	19.62	21.39 x 16.05	27.46	108.2					0.62					
	nominal	1.000		20.50	22.36 x 16.77	28.70	111.6	77.1	6.5 (13)	< 0.01 (0.03)	0.68	> 50	F	132.9	64		
	far	0.954		21.49	23.43 x 17.58	30.08	115.2				0.75						
MC4K 100X-N	near	1.045	4K APS-C	19.62	21.39 x 16.05	27.46	108.2					0.62					
	nominal	1.000		20.50	22.36 x 16.77	28.70	111.6	77.1	6.5 (13)	< 0.01 (0.03)	0.68	> 50	M42x1 FD 10.56	168.8	52		
	far	0.954		21.49	23.43 x 17.58	30.08	115.2				0.75						
MC4K 125X-F	near	1.295	4K APS-C	15.83	17.26 x 12.95	22.16	94.0					0.42					
	nominal	1.250		16.40	17.88 x 13.42	22.96	96.1	77.1	6.7 (15)	< 0.01 (0.03)	0.45	> 40	F	152.2	64		
	far	1.204		17.03	18.57 x 13.93	23.84	98.5				0.49						
MC4K125X-N	near	1.295	4K APS-C	15.83	17.26 x 12.95	22.16	94.0					0.42					
	nominal	1.250		16.40	17.88 x 13.42	22.96	96.1	77.2	6.7 (15)	< 0.01 (0.03)	0.45	> 40	M42x1 FD 10.56	188.1	52		
	far	1.204		17.03	18.57 x 13.93	23.84	98.5				0.49						
MC4K 150X-F	near	1.543	4K APS-C	13.29	14.49 x 10.87	18.60	89.9					0.30					
	nominal	1.500		13.67	14.90 x 11.18	19.13	91.4	79.8	6.8 (17)	< 0.01 (0.03)	0.32	> 35	F	178.6	64		
	far	1.455		14.09	15.36 x 11.53	19.73	93.0				0.34						
MC4K 150X-N	near	1.543	4K APS-C	13.29	14.49 x 10.87	18.60	89.9					0.30					
	nominal	1.500		13.67	14.90 x 11.18	19.13	91.4	79.8	6.8 (17)	< 0.01 (0.03)	0.32	> 35	M42x1 FD 10.56	214.5	52		
	far	1.455		14.09	15.36 x 11.53	19.73	93.0				0.34						
MC4K 175X-F	near	1.793	4K APS-C	11.43	12.47 x 9.35	16.01	82.7					0.21					
	nominal	1.750		11.71	12.77 x 9.58	16.40	83.8	79.8	6.5 (18)	< 0.01 (0.03)	0.22	> 35	F	198.5	64		
	far	1.705		12.02	13.11 x 9.84	16.83	85.0				0.23						
MC4K 175X-N	near	1.793	4K APS-C	11.43	12.47 x 9.35	16.01	82.7					0.21					
	nominal	1.750		11.71	12.77 x 9.58	16.40	83.8	79.8	6.5 (18)	< 0.01 (0.03)	0.22	> 35	M42x1 FD 10.56	234.5	52		
	far	1.705		12.02	13.11 x 9.84	16.83	85.0				0.23						
MC4K 200X-F	near	2.042	4K APS-C	10.04	10.95 x 8.21	14.05	77.3					0.17					
	nominal	2.000		10.25	11.18 x 8.39	14.35	78.1	79.8	6.7 (20)	< 0.01 (0.03)	0.18	> 30	F	218.5	64		
	far	1.955		10.49	11.44 x 8.58	14.68	79.0				0.18						
MC4K 200X-N	near	2.042	4K APS-C	10.04	10.95 x 8.21	14.05	77.3					0.17					
	nominal	2.000		10.25	11.18 x 8.39	14.35	78.1	79.9	6.7 (20)	< 0.01 (0.03)	0.18	> 30	M42x1 FD 10.56	254.5	52		
	far	1.955		10.49	11.44 x 8.58	14.68	79.0				0.18						

- Maximum and minimum magnification changes when focusing.
- Working distance: distance between the front end of the mechanics and the object.
- Working F-number: the real F-number of a lens in operating conditions.
- Percent deviation of the real image compared to an ideal, undistorted image: typical (average production) values and maximum (guaranteed) values are listed.
- 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 μ m.

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.

EN-MAX series

Fixed focal length lenses for APS-H, Full Frame and up to 43 mm sensors



* RT

Focal length 24-50 mm

Part number	Optical specifications									Mechanical specifications			
	Focal length (mm)	Magnification (x)	Image circle Ø (mm)	Max detector size	WD (mm)	F/#	Back focal length (°)	Distortion (%)	Nominal resolving power (lp/mm)	Mount	Length (mm)	Diameter (mm)	Filter thread (mm)
RT-A-2428MF	24	0.16 - 0	43	Full frame - 35 mm	150 - ∞	2.8 - 22	36.0	< -4	30 lp/mm (5 MP)	F	40.21	60	M52x 0.75
RT-A-2428MT	24	0.16 - 0	43	Full frame - 35 mm	150 - ∞	2.8 - 22	36.0	< -4	30 lp/mm (5 MP)	M42x1 FD 46.5	40.21	60	M52x 0.75
RT-A-2828MF	28	0.09 - 0	43	Full frame - 35 mm	300 - ∞	2.8 - 22	35.7	< -3	30 lp/mm (5 MP)	F	34.17	60	M52x 0.75
RT-A-2828MT	28	0.09 - 0	43	Full frame - 35 mm	300 - ∞	2.8 - 22	35.7	< -3	30 lp/mm (5 MP)	M42x1 FD 46.5	34.17	60	M52x 0.75
RT-A-3525MF	35	0.11 - 0	43	Full frame - 35 mm	300 - ∞	2.5 - 22	34.35	- 3	30 lp/mm (5 MP)	F	43.73	60	M52x 0.75
RT-A-3525MT	35	0.11 - 0	43	Full frame - 35 mm	300 - ∞	2.5 - 22	34.35	-3	30 lp/mm (5 MP)	M42x1 FD 46.5	43.73	60	M52x 0.75
RT-FL-YFL3528	35	0.18 - 0	45	Full frame - 35 mm	190 - ∞	2.8 - 22	33.22	n.a.	85 lp/mm (9 MP)	F	56.8	72	M62X0.75
RT-A-5018MF	50	0.12 - 0	43	Full frame - 35 mm	400 - ∞	1.8 - 22	36.33	< 1	30 lp/mm (5 MP)	F	39.04	60	M52x 0.75
RT-A-5018MT	50	0.12 - 0	43	Full frame - 35 mm	400 - ∞	1.8 - 22	36.33	< 1	30 lp/mm (5 MP)	M42x1 FD 46.5	39.04	60	M52x 0.75
RT-FL-YFL5028	50	0.2 - 0	45	Full frame - 35 mm	250 - ∞	2.8 - 22	36.99	n.a.	85 lp/mm (9 MP)	F	56.8	72	M62X0.75

FULL RANGE OF COMPATIBLE CAMERAS



HR Area scan cameras

p. 198-203

MC12K series

Macro lenses for 16k line scan cameras and sensors up to 62 mm

Mag. 0.08-2 x



KEY ADVANTAGES

Exceptional low distortion

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

Optimized for high resolution line scan 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.

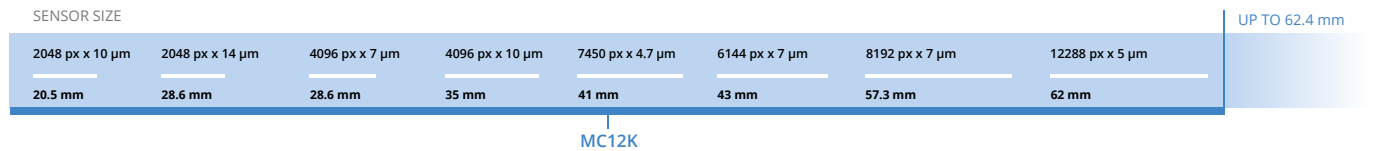
MC12K series are macro lenses specifically optimized to work with high resolution line scan cameras with sensor size up to 62 mm. Infinite conjugate lenses, like photographic optics, will offer poor performance when used to observe objects from up close: MC12K series are macro by design, enabling unmatched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

MC12K series lenses 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 line scan cameras.

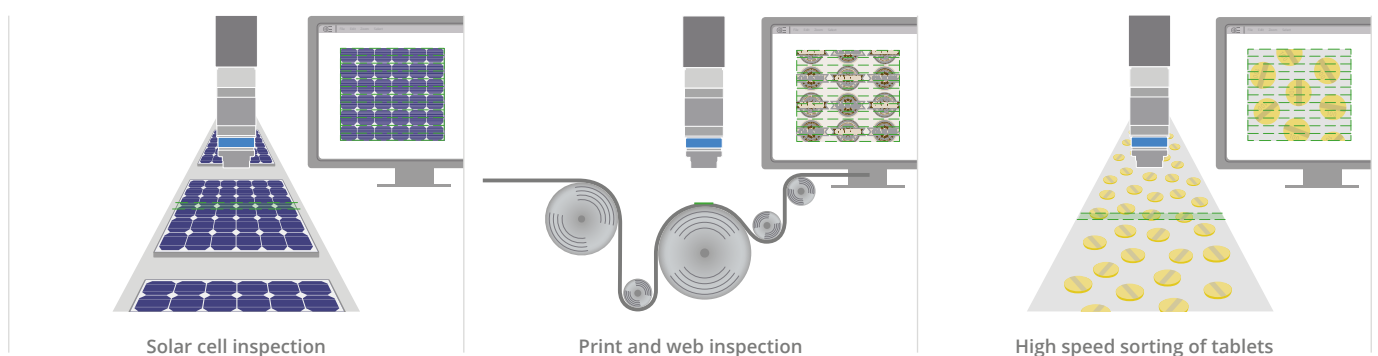
FULL RANGE OF COMPATIBLE ILLUMINATORS		
	Line lights, LTLNC, LTLNM, LTLNE series	p. 166-171
	Bar lights LTRDC series	p. 160
	Backlights LT2BC, LTBP, LTBC, LTBCF series	p. 118-127
FULL RANGE OF COMPATIBLE CLAMPING MECHANICS		
	CMHOMC12Kxxx	p. 248
FULL RANGE OF COMPATIBLE CAMERAS		
	HR Area scan cameras	p. 198-203
	HR Line scan cameras	p. 207

Wide image circle

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



Application examples



MC12K series

- Macro lenses for 16k line scan cameras and sensors up to 62 mm

Part number	Focusing	Mag.	Max sensor size	Detector type			Optical specifications					Mechanical specification			
				Line - 16k	Line - 8k	Line - 12k	WD	Focal length	F/#	Distortion	Field depth	CTF	Mount	Length	Diam.
				16k x 3.5 μm w x h (mm)	8k x 7.5 μm w (mm)	12k x 5.2 μm w (mm x mm)	(mm)	(mm)	(wF/#)	typical (max) (%)	(mm)	@50 lp/mm (%)		(mm)	(mm)
Object field of view (mm x mm)				2	3	4	5								
MC12K 200X-F	near	2.017	62.4	28.41	30.44	30.94	93.6	88.2	6.0 (18)	< 0.01 (0.02)	0.15	> 30	F	237.9	76
	nominal	2.000		28.65	30.70	31.20	94.0								
	far	1.983		28.90	30.96	31.47	94.4								
MC12K 200X-I	near	2.017	62.4	28.41	30.44	30.94	93.6	88.2	6.0 (18)	< 0.01 (0.02)	0.15	> 30	M58x0.75 FD 11.48	272.9	76
	nominal	2.000		28.65	30.70	31.20	94.0								
	far	1.983		28.90	30.96	31.47	94.4								
MC12K 200X-R	near	2.017	62.4	28.41	30.44	30.94	93.6	88.2	6.0 (18)	< 0.01 (0.02)	0.16	> 30	M72x0.75 FD 6.56	277.8	76
	nominal	2.000		28.65	30.70	31.20	94.0								
	far	1.983		28.90	30.96	31.47	94.4								
MC12K 200X-K	near	2.017	62.4	28.41	30.44	30.94	93.6	88.2	6.0 (18)	< 0.01 (0.02)	0.16	> 30	M58x0.75 FD 12.96	271.4	76
	nominal	2.000		28.65	30.70	31.20	94.0								
	far	1.983		28.90	30.96	31.47	94.4								
MC12K 150X-F	near	1.517	62.4	37.77	40.47	41.13	109.3	89.9	6.0 (15)	< 0.01 (0.02)	0.27	> 40	F	198.5	76
	nominal	1.500		38.20	40.93	41.60	110.0								
	far	1.484		38.61	41.37	42.05	110.7								
MC12K 150X-I	near	1.517	62.4	37.77	40.47	41.13	109.3	89.9	6.0 (15)	< 0.01 (0.02)	0.28	> 40	M58x0.75 FD 11.48	233.6	76
	nominal	1.500		38.20	40.93	41.60	110.0								
	far	1.484		38.61	41.37	42.05	110.7								
MC12K 150X-R	near	1.517	62.4	37.77	40.47	41.13	109.3	89.9	6.0 (15)	< 0.01 (0.02)	0.27	> 40	M72x0.75 FD 6.56	238.5	76
	nominal	1.500		38.20	40.93	41.60	110.0								
	far	1.484		38.61	41.37	42.05	110.7								
MC12K 150X-K	near	1.517	62.4	37.77	40.47	41.13	109.3	89.9	6.0 (15)	< 0.01 (0.02)	0.28	> 40	M58x0.75 FD 12.96	232.1	76
	nominal	1.500		38.20	40.93	41.60	110.0								
	far	1.484		38.61	41.37	42.05	110.7								
MC12K 100X-F	near	1.018	62.4	56.29	60.31	61.30	134.0	88.3	6.0 (12)	< 0.01 (0.02)	0.61	> 50	F	151.1	76
	nominal	1.000		57.30	61.40	62.40	135.5								
	far	0.984		58.23	62.40	63.41	137.0								
MC12K 100X-I	near	1.018	62.4	56.29	60.31	61.30	134.0	88.3	6.0 (12)	< 0.01 (0.02)	0.63	> 50	M58x0.75 FD 11.48	186.1	76
	nominal	1.000		57.30	61.40	62.40	135.5								
	far	0.984		58.23	62.40	63.41	137.0								
MC12K 100X-R	near	1.018	62.4	56.29	60.31	61.30	134.0	88.3	6.0 (12)	< 0.01 (0.02)	0.61	> 50	M72x0.75 FD 6.56	191.0	76
	nominal	1.000		57.30	61.40	62.40	135.5								
	far	0.984		58.23	62.40	63.41	137.0								
MC12K 100X-K	near	1.018	62.4	56.29	60.31	61.30	134.0	88.3	6.0 (12)	< 0.01 (0.02)	0.63	> 50	M58x0.75 FD 12.96	184.6	76
	nominal	1.000		57.30	61.40	62.40	135.5								
	far	0.984		58.23	62.40	63.41	137.0								
MC12K 067X-F	near	0.684	62.4	83.77	89.77	91.23	179.7	89.9	6.0 (10)	< 0.01 (0.02)	1.35	> 60	F	125.7	76
	nominal	0.667		85.91	92.05	93.55	183.0								
	far	0.650		88.15	94.46	96.00	186.4								
MC12K 067X-I	near	0.684	62.4	83.77	89.77	91.23	179.7	89.9	6.0 (10)	< 0.01 (0.02)	1.42	> 60	M58x0.75 FD 11.48	160.7	76
	nominal	0.667		85.91	92.05	93.55	183.0								
	far	0.650		88.15	94.46	96.00	186.4								
MC12K 067X-R	near	0.684	62.4	83.77	89.77	91.23	179.7	89.9	6.0 (10)	< 0.01 (0.02)	1.35	> 60	M72x0.75 FD 6.56	165.6	76
	nominal	0.667		85.91	92.05	93.55	183.0								
	far	0.650		88.15	94.46	96.00	186.4								
MC12K 067X-K	near	0.684	62.4	83.77	89.77	91.23	179.7	89.9	6.0 (10)	< 0.01 (0.02)	1.42	> 60	M58x0.75 FD 12.96	159.2	76
	nominal	0.667		85.91	92.05	93.55	183.0								
	far	0.650		88.15	94.46	96.00	186.4								
MC12K 050X-F	near	0.517	62.4	110.83	118.76	120.70	217.1	88.2	6.0 (9)	< 0.01 (0.02)	2.36	> 50	F	109.2	76
	nominal	0.500		114.60	122.80	124.80	223.0								
	far	0.483		118.63	127.12	129.19	229.1								
MC12K 050X-I	near	0.517	62.4	110.83	118.76	120.70	217.1	88.2	6.0 (9)	< 0.01 (0.02)	2.52	> 50	M58x0.75 FD 11.48	144.2	76
	nominal	0.500		114.60	122.80	124.80	223.0								
	far	0.483		118.63	127.12	129.19	229.1								
MC12K 050X-R	near	0.517	62.4	110.83	118.76	120.70	217.1	88.2	6.0 (9)	< 0.01 (0.02)	2.36	> 50	M72x0.75 FD 6.56	149.2	76
	nominal	0.500		114.60	122.80	124.80	223.0								
	far	0.483		118.63	127.12	129.19	229.1								
MC12K 050X-K	near	0.517	62.4	110.83	118.76	120.70	217.1	88.2	6.0 (9)	< 0.01 (0.02)	2.52	> 50	M58x0.75 FD 12.96	142.8	76
	nominal	0.500		114.60	122.80	124.80	223.0								
	far	0.483		118.63	127.12	129.19	229.1								
MC12K 025X-F	near	0.266	62.4	215.41	230.83	234.59	393.6	92.1	6.4 (8)	< 0.05 (0.1)	9.50	> 50	F	95.0	76
	nominal	0.250		229.20	245.60	249.60	415.5								
	far	0.234		244.87	262.39	266.67	441.8								
MC12K 025X-I	near	0.266	62.4	215.41	230.83	234.59	393.6	92.1	6.4 (8)	< 0.05 (0.1)	10.75	> 50	M58x0.75 FD 11.48	130.0	76
	nominal	0.250		229.20	245.60	249.60	415.5								
	far	0.234		244.87	262.39	266.67	441.8								
MC12K 025X-R	near	0.266	62.4	215.41	230.83	234.59	393.6	92.1	6.4 (8)	< 0.05 (0.1)	9.50	> 50	M72x0.75 FD 6.56	134.9	76
	nominal	0.250		229.20	245.60	249.60	415.5								
	far	0.234		244.87	262.39	266.67	441.8								
MC12K 025X-K	near	0.266	62.4	215.41	230.83	234.59	393.6	92.1	6.4 (8)	< 0.05 (0.1)	10.75	> 50	M58x0.75 FD 12.96	128.5	76
	nominal	0.250		229.20	245.60	249.60	415.5								
	far	0.234		244.87	262.39	266.67	441.8								
MC12K 012X-I	near	0.142	62.4	403.52	432.39	439.44	678.5	89.8	6.2 (7)	< 0.05 (0.1)	41.66	> 50	M58x0.75 FD 11.48	116.4	76
	nominal	0.125		458.40	491.20	499.20	762.0								
	far	0.108		530.56	568.52	577.78	873.2								
MC12K 012X-R	near	0.142	62.4	403.52	432.39	439.44	678.5	89.8	6.2 (7)	< 0.05 (0.1)	41.66	> 50	M72x0.75 FD 6.56	121.3	76
	nominal	0.125		458.40	491.20	499.20	762.0								
	far	0.108		530.56	568.52	577.78	873.2								
MC12K 012X-K	near	0.142	62.4	403.52	432.39	439.44	678.5	89.8	6.2 (7)	< 0.05 (0.1)	41.66	> 50	M58x0.75 FD 12.96	114.9	76
	nominal	0.125		458.40	491.20	499.20	762.0								
	far	0.108		530.56	568.52	577.78	873.2								
MC12K 008X-I	near	0.100	62.4	573.00	614.00	624.00	924.1	88.5	6.5 (7)	< 0.05 (0.1)	99.07	> 50	M58x0.75 FD 11.48	112.1	76
	nominal	0.083		690.36	739.76	751.81	1102.5								
	far	0.067		855.22	916.42	931.34	1370.9								
MC12K 008X-R	near	0.100	62.4	573.00	614.00	624.00	924.1	88.5	6.5 (7)	< 0.05 (0.1)	99.07	> 50	M72x0.75 FD 6.56	117.0	76
	nominal	0.083		690.36	739.76	751.81	1102.5								
	far	0.067		855.22	916.42	931.34	1370.9								
MC12K 008X-K	near	0.100	62.4	573.00	614.00	624.00	924.1	88.5	6.5 (7)	< 0.05 (0.1)	99.07	> 50	M58x0.75 FD 12.96	110.6	76
	nominal	0.083		690.36	739.76	751.81	1102.5								
	far	0.067		855.22	916.42	931.34	1370.9								

- 1 Maximum and minimum magnification changes when focusing.
- 2 Working distance: distance between the front end of the mechanics and the object.
- 3 Working F-number: the real F-number of a lens in operating conditions.
- 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.

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)
- I for M58x0.75 mount (flange distance FD 11.48 mm).
- F for F-mount

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

MC16K series

Macro lenses for 16k line scan cameras and sensors up to 82 mm



* RT

Mag. 0.50-3 x

Part number	Mag.	Max sensor size	Detector type				Optical specifications				Mechanical specification		
			KAI-47051	Line - 16k	Line - 12k	Line - 16k	WD	Focal length	F/#	Distortion	Mount	Length	Diam.
			56.7 mm diag w x h 48.71 x 29.04 (mm x mm)	16k x 3.5 μm w x h 57.30 (mm)	12k x 5.2 μm w 61.40 (mm)	16k x 5.2 μm w 81.90 (mm)	(mm)	(mm)		(%)		(mm)	(mm)
Object field of view (mm x mm)													
RT-OPKE16-050M95	0.5	66	97.4 x 58.1	114.6	122.8	-	296.9 ±5	116	3.8	<0.01	M95X1 FD 10	189.1	100
RT-OPKE16-070M95	0.7	66	69.6 x 41.5	81.9	87.7	-	229.4 ±5	116	3.8	<0.01	M95X1 FD 10	207.9	100
RT-OPKE16-100M95	1.0	66	48.7 x 29.0	57.3	61.4	-	184.2 ±5	116	3.8	<0.01	M95X0.75 FD 10	245.3	100
RT-OPKE16-150M95	1.5	82	32.5 x 19.4	38.2	40.9	54.6	143.9 ±5	116	3.8	<0.25	M95X1 FD 10	299.8	100
RT-OPKE16-200M95	2.0	82	24.4 x 14.5	28.7	30.7	41.0	127.2 ±5	116	3.8	<0.01	M95X1 FD 10	358.8	100
RT-OPKE16-300M95	3.0	82	16.2 x 9.7	19.1	20.5	27.3	111.4 ±5	116	4.2	<0.01	M95X1 FD 10	470.0	100

FULL RANGE OF COMPATIBLE ILLUMINATORS		
	Line lights, LTLNC, LTLNM, LTLNE series	p. 166-171
	Bar lights LTBRDC series	p. 160
	Backlights LT2BC, LTBP, LTBC, LTBFC series	p. 118-127

ENVF series

Varifocal lenses for sensors up to 2/3"



Focal length 12-36 mm

Part number	Optical specifications								Mechanical specifications				
	Focal length (mm)	Magnification (x)	Image circle Ø (mm)	Max detector size	WD (mm)	F/#	Horizontal angle of view (°) ¹	Max distortion (%) ²	Mount	Length (mm)	Diameter (mm)	Mass (g)	Filter thread (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	105	M35 x 0.5

1 Horizontal angle of view while using max detector size.

2 Max distortion while using max detector size.

FULL RANGE OF COMPATIBLE PRODUCTS		
	Area scan cameras	p. 188-203
	Optical filters	p. 228
	LTRNDC LED direct ring lights	p. 140

MC3-03X series

Zero distortion multi-configuration macro lens

Mag. 0.10-3 x



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 the 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 are always optimized.

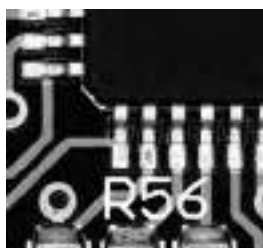
MC3-03X is a multi-configuration macro lens suitable for the inspection of objects whose size varies from a few millimetres to some centimetres. Magnification and focus can be tuned by adjusting a lockable rotating knob.

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. 23
FULL RANGE OF COMPATIBLE ILLUMINATORS		
	LTRNST series	p. 138
	LTLA series	p. 142
	LTRNOB series	p. 148
	Backlights LT2BC, LTBP, LTBC, LTBFC series	p. 118-127
FULL RANGE OF COMPATIBLE CAMERAS		
	Area scan cameras	p. 188-203

MC3-03X macro FOV and WD selection chart

Number of spacers	Mag. (x)	WD (mm)	F/# (wF/#)	Field depth (mm)	Detector type					Dimensions		
					1/3"	1/2.5"	1/2"	1/1.8"	2/3" - 5 MP	Mount	Length (mm)	Diam. (mm)
					6.0 mm diag w x h 4.80 x 3.60 (mm x mm)	7.1 mm diag w x h 5.70 x 4.28 (mm x mm)	8.0 mm diag w x h 6.40 x 4.80 (mm x mm)	8.9 mm diag w x h 7.13 x 5.33 (mm x mm)	11.1 mm diag w x h 8.50 x 7.09 (mm x mm)			
Object field of view (mm x mm)												
0	0.1	275.0	5.5 (6)	23.8	48.0 x 36.0	57.0 x 42.8	64.0 x 48.0	71.3 x 53.3	85.0 x 70.9	C	50.5	28
	0.2	136.0	5.0 (6)	5.95	24.0 x 18.0	28.5 x 21.4	32.0 x 24.0	35.7 x 26.7	42.5 x 35.5			
	0.3	92.0	5.4 (7)	3.09	16.0 x 12.0	19.0 x 14.3	21.3 x 16.0	23.8 x 17.8	28.3 x 23.6			
	0.4	71.0	5.0 (7)	1.74	12.0 x 9.0	14.3 x 10.7	16.0 x 12.0	17.8 x 13.3	21.3 x 17.7			
	0.5	60.0	5.3 (8)	1.27	9.6 x 7.2	11.4 x 8.6	12.8 x 9.6	14.3 x 10.7	17.0 x 14.2			
	0.6	54.0	5.6 (9)	0.99	8.0 x 6.0	9.5 x 7.1	10.7 x 8.0	11.9 x 8.9	14.2 x 11.8			
	0.7	50.0	5.3 (9)	0.73	6.9 x 5.1	8.1 x 6.1	9.1 x 6.9	10.2 x 7.6	12.1 x 10.1			
	0.8	47.0	5.6 (10)	0.62	6.0 x 4.5	7.1 x 5.4	8.0 x 6.0	8.9 x 6.7	10.6 x 8.9			
	0.9	46.0	5.3 (10)	0.49	5.3 x 4.0	6.3 x 4.8	7.1 x 5.3	7.9 x 5.9	9.4 x 7.9			
	1.0	46.0	5.5 (11)	0.44	4.8 x 3.6	5.7 x 4.3	6.4 x 4.8	7.1 x 5.3	8.5 x 7.1			
1	0.7	31.0	5.3 (9)	0.73	6.9 x 5.1	8.1 x 6.1	9.1 x 6.9	10.2 x 7.6	12.1 x 10.1	C	69.0	28
	0.8	29.0	5.6 (10)	0.62	6.0 x 4.5	7.1 x 5.4	8.0 x 6.0	8.9 x 6.7	10.6 x 8.9			
	0.9	28.0	5.3 (10)	0.49	5.3 x 4.0	6.3 x 4.8	7.1 x 5.3	7.9 x 5.9	9.4 x 7.9			
	1.0	27.0	5.5 (11)	0.44	4.8 x 3.6	5.7 x 4.3	6.4 x 4.8	7.1 x 5.3	8.5 x 7.1			
	1.1	28.0	5.2 (11)	0.36	4.4 x 3.3	5.2 x 3.9	5.8 x 4.4	6.5 x 4.8	7.7 x 6.4			
	1.2	28.0	5.5 (12)	0.33	4.0 x 3.0	4.8 x 3.6	5.3 x 4.0	5.9 x 4.4	7.1 x 5.9			
	1.3	29.0	5.2 (12)	0.28	3.7 x 2.8	4.4 x 3.3	4.9 x 3.7	5.5 x 4.1	6.5 x 5.5			
	1.4	31.0	5.4 (13)	0.26	3.4 x 2.6	4.1 x 3.1	4.6 x 3.4	5.1 x 3.8	6.1 x 5.1			
	1.5	32.0	5.2 (13)	0.23	3.2 x 2.4	3.8 x 2.9	4.3 x 3.2	4.8 x 3.6	5.7 x 4.7			
	1.6	34.0	5.4 (14)	0.22	3.0 x 2.3	3.6 x 2.7	4.0 x 3.0	4.5 x 3.3	5.3 x 4.4			
2	1.4	12.0	5.4 (13)	0.26	3.4 x 2.6	4.1 x 3.1	4.6 x 3.4	5.1 x 3.8	6.1 x 5.1	C	87.5	28
	1.5	14.0	5.2 (13)	0.23	3.2 x 2.4	3.8 x 2.9	4.3 x 3.2	4.8 x 3.6	5.7 x 4.7			
	1.6	15.0	5.4 (14)	0.22	3.0 x 2.3	3.6 x 2.7	4.0 x 3.0	4.5 x 3.3	5.3 x 4.4			
	1.7	17.0	5.2 (14)	0.19	2.8 x 2.1	3.4 x 2.5	3.8 x 2.8	4.2 x 3.1	5.0 x 4.2			
	1.8	19.0	5.4 (15)	0.18	2.7 x 2.0	3.2 x 2.4	3.6 x 2.7	4.0 x 3.0	4.7 x 3.9			
	1.9	21.0	5.2 (15)	0.16	2.5 x 1.9	3.0 x 2.3	3.4 x 2.5	3.8 x 2.8	4.5 x 3.7			
	2.0	23.0	5.3 (16)	0.16	2.4 x 1.8	2.9 x 2.1	3.2 x 2.4	3.6 x 2.7	4.3 x 3.5			
	2.1	25.0	5.2 (16)	0.14	2.3 x 1.7	2.7 x 2.0	3.0 x 2.3	3.4 x 2.5	4.0 x 3.4			
	2.2	27.0	5.3 (17)	0.14	2.2 x 1.6	2.6 x 1.9	2.9 x 2.2	3.2 x 2.4	3.9 x 3.2			
	2.3	30.0	5.5 (18)	0.14	2.1 x 1.6	2.5 x 1.9	2.8 x 2.1	3.1 x 2.3	3.7 x 3.1			
3	2.1	7.0	5.2 (16)	0.14	2.3 x 1.7	2.7 x 2.0	3.0 x 2.3	3.4 x 2.5	4.0 x 3.4	C	106.0	28
	2.2	9.0	5.3 (17)	0.14	2.2 x 1.6	2.6 x 1.9	2.9 x 2.2	3.2 x 2.4	3.9 x 3.2			
	2.3	11.0	5.5 (18)	0.14	2.1 x 1.6	2.5 x 1.9	2.8 x 2.1	3.1 x 2.3	3.7 x 3.1			
	2.4	14.0	5.3 (18)	0.12	2.0 x 1.5	2.4 x 1.8	2.7 x 2.0	3.0 x 2.2	3.5 x 3.0			
	2.5	16.0	5.4 (19)	0.12	1.9 x 1.4	2.3 x 1.7	2.6 x 1.9	2.9 x 2.1	3.4 x 2.8			
	2.6	18.0	5.3 (19)	0.11	1.8 x 1.4	2.2 x 1.6	2.5 x 1.8	2.7 x 2.1	3.3 x 2.7			
	2.7	21.0	5.4 (20)	0.11	1.8 x 1.3	2.1 x 1.6	2.4 x 1.8	2.6 x 2.0	3.1 x 2.6			
	2.8	23.0	5.3 (20)	0.10	1.7 x 1.3	2.0 x 1.5	2.3 x 1.7	2.5 x 1.9	3.0 x 2.5			
	2.9	26	5.4 (21)	0.10	1.7 x 1.2	2.0 x 1.5	2.2 x 1.7	2.5 x 1.8	2.9 x 2.4			
	3.0	28	5.3 (21)	0.09	1.6 x 1.2	1.9 x 1.4	2.1 x 1.6	2.4 x 1.8	2.8 x 2.4			

- 1 Working distance: distance between the front end of the mechanics and the object.
- 2 Working F-number: the real F-number of a lens in operating conditions.
- 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 3.45 µm.

MCSM1-01X series

Variable macro lens with Scheimpflug adjustment

Mag. 0.25-2 x



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.

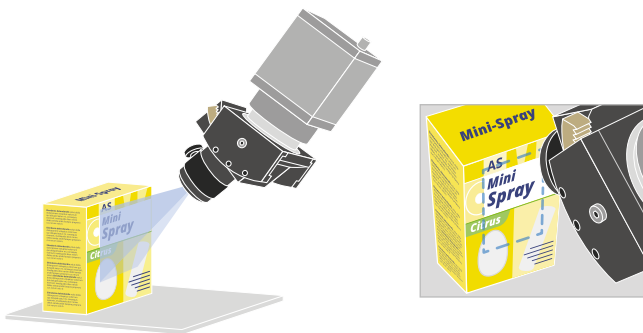
Application flexibility

Supports a wide range of magnification factors and viewing angles.

MCSM1-01X is a variable 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 the lens 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



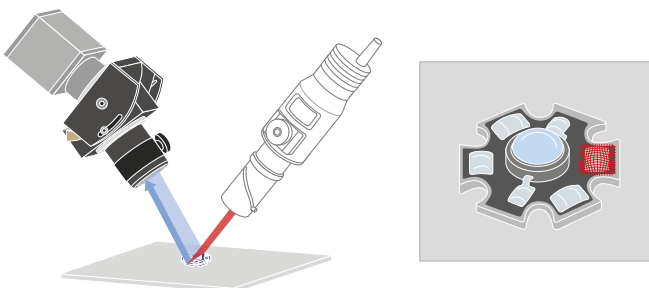
MCSM1-01X imaging a sample from an angled point of view.



Without tilt adjustment, the object is not homogeneously focused.



At the Scheimpflug angle, the image becomes sharp.



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



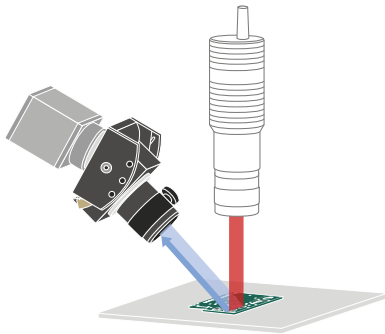
Without tilt adjustment, the image of the surface is not homogeneously focused.



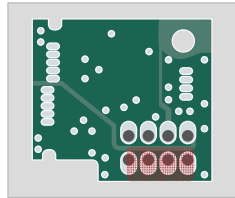
At the Scheimpflug angle, the image is sharp over the entire surface where the paste has been deposited.



FOR TELECENTRIC LENSES WITH SCHEIMPLUG ADJUSTMENT SEE ALSO		
	TCSM series	p. 70
FULL RANGE OF COMPATIBLE PRODUCTS FOR 3D APPLICATIONS		
	LED pattern projectors	p. 175
FULL RANGE OF COMPATIBLE CAMERAS		
	Area scan cameras	p. 188-203



MCSM1-01X combined with LTPRHP3W-R.



Without tilt adjustment, the image is out of focus.



At the Scheimpflug angle, the entire surface becomes focused.

FOV and WD selection chart

Mag. (x)	Object tilt (deg)	Mount tilt (deg)	WD (mm)	F/# (wF/#) 1 2	Long detector side horizontal			Long detector side vertical		
					1/3" 6.0 mm diag w x h (mm x mm)	1/2" 8.0 mm diag w x h (mm x mm)	2/3" 11.1 mm diag w x h (mm x mm)	1/3" 6.0 mm diag w x h (mm x mm)	1/2" 8.0 mm diag w x h (mm x mm)	2/3" 11.1 mm diag w x h (mm x mm)
					Field of view - w (W) x h - (mm x mm)			Field of view - w (W) x h - (mm x mm)		
1	0.0	0.0	43.0	6.3 (12.5)	4.80 (4.80) x 3.60	6.40 (6.40) x 4.80	8.50 (8.50) x 7.09	3.60(3.60) x 4.80	4.80 (4.80) x 6.4	7.09 (7.09) x 8.50
	5.0	5.0			4.75 (4.85) x 3.61	6.33 (6.47) x 4.81	8.41 (8.59) x 7.10	3.55(3.65) x 4.81	4.73 (4.87) x 6.4	6.99 (7.19) x 8.51
	10.0	10.0			4.70 (4.90) x 3.61	6.27 (6.53) x 4.81	8.33 (8.67) x 7.10	3.51(3.70) x 4.81	4.68 (4.93) x 6.4	6.91 (7.28) x 8.51
0.75	0.0	0.0	47.8	6.2 (10.9)	4.64 (4.95) x 3.61	6.18 (6.60) x 4.81	8.21 (8.77) x 7.10	3.46(3.75) x 4.81	4.61 (5.00) x 6.4	6.81 (7.39) x 8.51
	7.5	5.7			6.43 (6.43) x 4.82	8.57 (8.57) x 6.42	11.4 (11.4) x 9.49	4.82(4.82) x 6.43	6.42 (6.42) x 8.6	9.49 (7.62) x 11.4
	15.0	11.4			6.33 (6.63) x 4.84	8.44 (8.70) x 6.45	11.2 (11.6) x 9.53	4.72(4.92) x 6.45	6.29 (6.56) x 8.6	9.29 (9.69) x 11.4
0.5	0.0	0.0	59.6	6.3 (9.4)	6.17 (6.70) x 4.95	8.23 (8.9) x 6.60	10.9 (11.9) x 9.75	4.57(5.10) x 6.61	6.09 (6.80) x 8.8	9.0 (10.0) x 11.7
	10.0	5.0			9.63 (9.63) x 7.23	12.8 (12.8) x 9.64	17.1 (17.1) x 14.3	7.23(7.23) x 9.63	9.64 (9.64) x 13.0	14.3 (14.3) x 17.1
	20.0	10.4			9.44 (9.83) x 7.31	12.6 (13.1) x 9.75	16.7 (17.4) x 14.4	7.03(7.43) x 9.74	9.37 (9.91) x 13.0	13.9 (14.6) x 17.3
0.33	0.0	0.0	83.8	6.2 (8.3)	9.25 (10.1) x 7.58	12.3 (13.4) x 10.1	16.4 (17.8) x 14.9	6.84(7.65) x 10.1	9.12 (10.2) x 13.0	13.5 (15.0) x 18.0
	15.0	5.1			9.04 (10.3) x 8.05	12.1 (13.7) x 10.7	16.0 (18.3) x 15.9	6.65(7.91) x 10.8	8.87 (10.5) x 14.0	13.1 (15.6) x 19.0
	30.0	10.8			14.6 (14.6) x 10.9	19.4 (19.4) x 14.6	25.8 (25.8) x 20.1	10.9(10.9) x 14.5	14.6 (14.6) x 19.0	21.6 (21.6) x 25.7
0.2	0.0	0.0	135.3	6.3 (7.5)	14.1 (14.9) x 11.3	18.9 (19.9) x 15.1	25.0 (26.5) x 22.2	10.5(11.4) x 15.1	14.0 (15.2) x 20.0	20.7 (22.5) x 26.7
	15.0	3.0			13.7 (15.6) x 12.5	18.2 (20.8) x 16.6	24.2 (27.6) x 24.5	10.0(12.0) x 16.7	13.4 (16.0) x 22.0	19.8 (23.6) x 29.6
	30.0	6.7			13.1 (16.4) x 14.9	17.5 (21.9) x 19.8	23.3 (29.1) x 29.3	9.52(12.9) x 20.0	12.7 (17.1) x 27.0	18.8 (25.4) x 35.4
0.1	0.0	0.0	271.0	6.3 (6.9)	24.0 (24.0) x 18.0	32.0 (32.0) x 24.0	42.5 (42.5) x 35.5	18.0(18.0) x 24.0	24.0 (24.0) x 32.0	35.5 (35.5) x 42.5
	15.0	1.6			23.3 (24.8) x 18.6	31.0 (33.0) x 24.8	41.2 (43.9) x 40.8	17.3(18.8) x 24.9	23.0 (25.1) x 33.0	34.1 (37.1) x 44.0
	30.0	3.4			22.5 (25.7) x 20.7	30.0 (34.3) x 27.7	39.8 (45.6) x 49.8	16.5(19.8) x 27.8	22.0 (26.4) x 37.0	32.5 (39.0) x 49.2
	45.0	5.8			21.5 (27.1) x 25.3	28.7 (36.2) x 33.7	38.2 (48.0) x 29.3	15.6(21.3) x 34.1	20.8 (28.4) x 45.0	30.7 (41.9) x 60.4
					47.6 (47.6) x 35.7	63.5 (63.5) x 47.6	84.3 (84.3) x 70.4	35.7(35.7) x 47.7	47.6 (47.6) x 64.0	70.4 (70.4) x 84.4
					46.2 (49.2) x 37.0	61.6 (65.6) x 49.4	81.8 (87.1) x 72.9	34.3(37.3) x 49.4	45.7 (49.7) x 66.0	712.1 (73.5) x 87.5
					44.6 (51.1) x 41.4	59.5 (68.1) x 55.2	79.0 (90.5) x 81.4	32.8(39.3) x 55.4	43.7 (52.4) x 74.0	64.6 (77.3) x 98.0
					42.7 (53.9) x 51.0	56.9 (71.9) x 68.0	75.5 (95.5) x 100.3	30.9(42.3) x 68.7	41.2 (56.4) x 92.0	60.9 (83.4) x 121.6

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

MCZM series

Macro zoom lenses for sensors up to 2/3"



*** RT**

Mag. 0.30-1 x

Part number	Magnification	Max sensor size	Optical specifications					Dimensions	
			Working distance (mm) ¹	Focal length (mm)	f/#	Back focal length	Distortion (%)	Length (mm)	Diam. (mm)
RT-MLM-3XMP	0.300 - 1.000	2/3"	89.9	-	4.5	20.4	1.8	36.5	79.5
RT-MLH-10X-C	0.084 - 0.840	1/2"	152 - 457	-	5.6	23.3	-	48.0	98.5
RT-TEC-M55	0.011 - 0.486	2/3"	140 - 5000	55	2.8	29.8	0.6	53.0	92.9

¹ Working distance: distance between the front end of the mechanics and the object.

FULL RANGE OF COMPATIBLE ILLUMINATORS	
	Backlights LT2BC, LTBP, LTBC, LTBFC series p. 118-127
	Dome lights LTDMC, LTDM series p. 152-155
FULL RANGE OF COMPATIBLE CAMERAS	
	Area scan cameras p. 188-203

360° View lenses

OUTER INSPECTION LENSES 94 - 99

INNER INSPECTION LENSES 100 - 103

MULTI-VIEW LENSES 104 - 109

The perfect solution for your machine vision inspection challenges.

One of the most recurring needs in the machine vision industry is to be able to fully inspect an object with as few cameras as possible. This request is becoming more and more common in a variety of markets, like the beverage, pharmaceutical and automotive industries.

Opto Engineering® designed a line of incredible 360° optics where one image is enough to view the top and side of an object or the inside of a cavity.

Most of these special optics are unique designs patented by Opto Engineering®, with exceptional build quality and unmatched optical performance.



Refer to specific datasheets available at www.opto-e.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 optics designed to perform complete inspection of objects up to 60 mm in diameter, quickly and reliably.

The innovative design allows one camera to see **the top and lateral surfaces** of an object in perfect focus all in one image. This allows you to greatly simplify the layout of the vision system, with no need for multiple cameras, lenses or mirrors.

The term pericentric comes from the specific path of the light rays: the lateral surface of the object appears to be wrapped around the top face, making the PC series ideal for cylindrical objects which are very common in the beverage and pharmaceutical industry.

Typical applications include bottleneck thread inspection, and data matrix reading - the code will always be properly imaged regardless of its position.

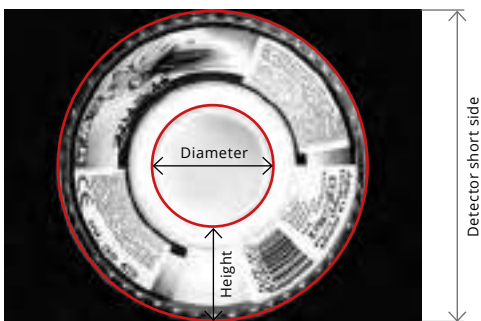
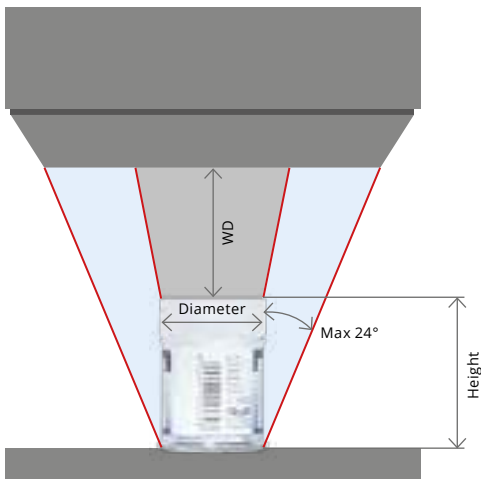
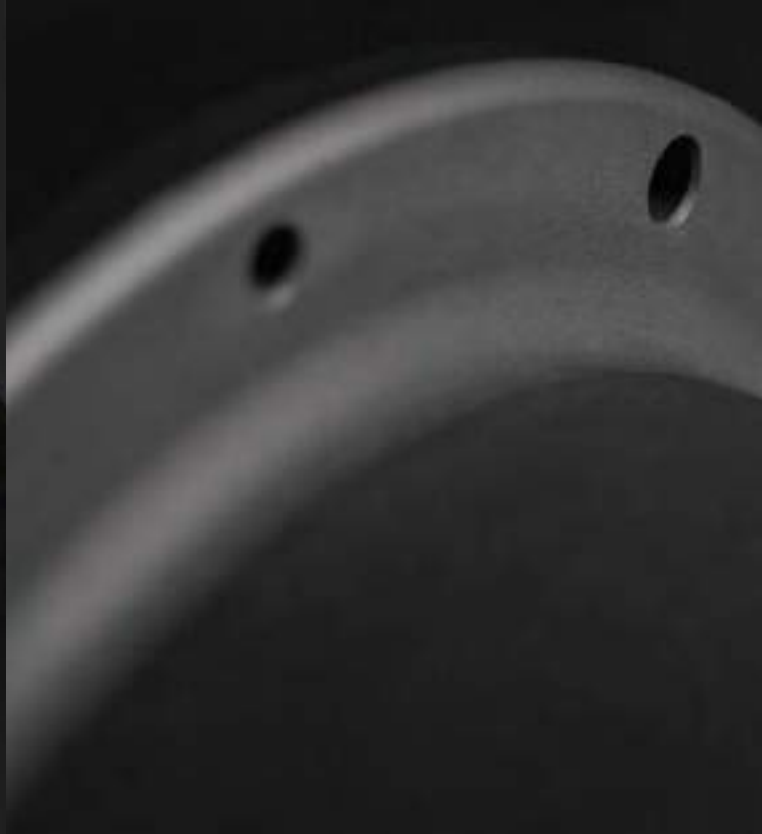
Sample images taken with PC optics



FULL RANGE OF COMPATIBLE CAMERAS		
	Area scan cameras	p. 188-203
DEDICATED COMPATIBLE OBLIQUE RING LIGHTS		
	LTRN 210x20, LTRN 245x25 <i>NEW</i> - High power version: LTRNHP210x20, LTRNHP245x25	p. 138 p. 150
DEDICATED CLAMPING MECHANICS FOR PCxx030XS		
	CMHO080	p. 248
FULL RANGE OF COMPATIBLE STROBE CONTROLLERS		
	LTDV series	p. 252

SETUP

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



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



Unwrapped image.

PC optics are designed to work with 1/3", 1/2" and 2/3" detectors. These detectors ensure 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 short 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 the "r" value, 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"
Image circle	Ø (mm)	3.6	4.8	3.6	4.8	6.6
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



PC23030XS + compatible LTRN210x20 ring light and CMHO080 clamping mechanics.



Field of view selection chart

PC 13030HP field of view

Diam.	Height	WD	F/#	r	Height	WD	F/#	r	Height	WD	F/#	r	Height	WD	F/#	r	Height	WD	F/#	r	Height	WD	F/#	r
(mm)	(mm)	(mm)		(%)	(mm)	(mm)		(%)	(mm)	(mm)		(%)	(mm)	(mm)		(%)	(mm)	(mm)		(%)	(mm)	(mm)		(%)
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.	Height	WD	F/#	r	Height	WD	F/#	r	Height	WD	F/#	r	Height	WD	F/#	r	Height	WD	F/#	r	Height	WD	F/#	r
mm	(mm)	(mm)		(%)	(mm)	(mm)		(%)	(mm)	(mm)		(%)	(mm)	(mm)		(%)	(mm)	(mm)		(%)	(mm)	(mm)		(%)
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.	Height	WD	F/#	r	Height	WD	F/#	r	Height	WD	F/#	r	Height	WD	F/#	r	Height	WD	F/#	r	Height	WD	F/#	r
(mm)	(mm)	(mm)		(%)	(mm)	(mm)		(%)	(mm)	(mm)		(%)	(mm)	(mm)		(%)	(mm)	(mm)		(%)	(mm)	(mm)		(%)
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.	Height	WD	F/#	r	Height	WD	F/#	r	Height	WD	F/#	r	Height	WD	F/#	r
mm	(mm)	(mm)		(%)	(mm)	(mm)		(%)	(mm)	(mm)		(%)	(mm)	(mm)		(%)
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.	Height	WD	F/#	r	Height	WD	F/#	r	Height	WD	F/#	r	Height	WD	F/#	r
mm	(mm)	(mm)		(%)	(mm)	(mm)		(%)	(mm)	(mm)		(%)	(mm)	(mm)		(%)
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 view angle

Object sides are viewed at an angle approaching 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 manufactured by Opto Engineering® to enable the 360° side view 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.

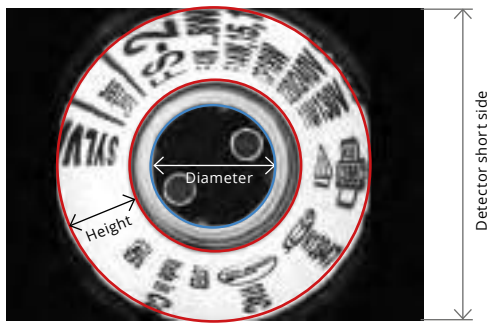
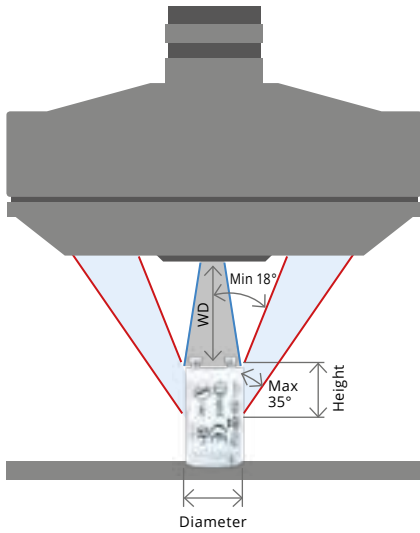
The sides of the object are imaged through the catadioptric system, while the top surface is directly imaged onto the centre of the detector.

The compactness and high resolution of these lenses make them ideal to inspect components like pharmaceutical containers, plastic caps, pre-forms, bottlenecks, 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 from a convenient perspective.

Part number		PCCD 013	PCCD 012	PCCD 023
Detector type		1/3"	1/2"	2/3"
Image circle	∅ (mm)	3.6	4.8	6.6
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





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



Unwrapped image.

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

FULL RANGE OF COMPATIBLE CAMERAS		
	Area scan cameras	p. 188-203
DEDICATED COMPATIBLE OBLIQUE RING LIGHTS		
	LTRN165x45, LTRN245x35	p. 148
	NEW - High power version: LTRNHPP165x45	p. 150
FULL RANGE OF COMPATIBLE STROBE CONTROLLERS		
	LTDV series	p. 252

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.

PCCD accessories



PCCD optics are complemented by a full set of accessories, including:

CMHO PCCD: dedicated clamping mechanics designed to securely hold catadioptric lenses.

LTRNOB series: specific LED ring illuminators (LTRN165x45).



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.

PCHI series

Hole inspection lenses for 360° inside view in perfect focus

NEW MODELS



EXTENDED RANGE

New PCHI models now available with improved manual focusing and liquid-lens based refocusing!

KEY ADVANTAGES

Perfect focusing of holed objects

Both the walls and the bottom of cavities are imaged in high resolution.

Inside 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 view angle

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

New focusing ring version available

Manually adjusting the focus is never been easier!

New integration with liquid lens technology

PCHI AF allows for an extremely fast and repeatable change in focus.

PCHI optics have been developed by Opto Engineering® to easily inspect holes, 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.

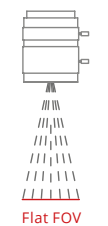
Thanks to the large view angle (>82°) and innovative optical design, these lenses are compatible with a wide range of object diameters

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.

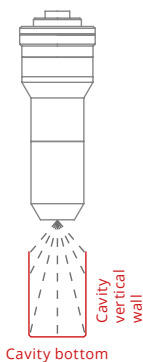
New and improved models are now available, providing the ease-of-use of an upgraded focusing mechanism (PCHI MF) and the flexibility of an immediate focusing thanks to the integration of liquid lens technology into the lens' optical design (PCHI AF).

PCHI SERIES VS FIXED FOCAL LENGTH LENSES

Common lens

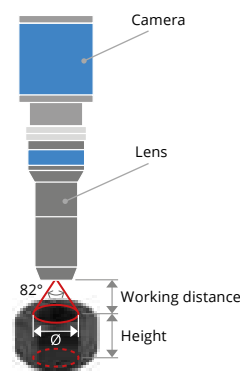


Hole inspection optics

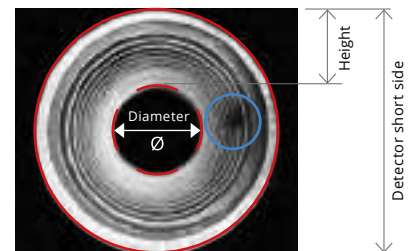


The inner walls of cavities are in perfect focus thanks to PCHI unique optical design.

Working principle



PCHI series features 82° view angle and can image both the inner walls and the bottom of cavities.



Defective threaded nut imaged with PCHI lens. Damaged threads can be easily detected.



Unwrapped image. 360LIB-01 dedicated software library is available to easily and accurately unwrap the images.

Application examples



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



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



Conical cavity inspection is possible from both sides.



PCHI023 + compatible LTRN075x45 ring light.

FULL RANGE OF COMPATIBLE CAMERAS		
	Area scan cameras	p. 188-203
DEDICATED COMPATIBLE RING LIGHTS		
	LTRN 075 x45 <i>NEW</i> - High power version: LTRNHP075x45	p. 148 p. 150
	LTLAB2-x	p. 142
FULL RANGE OF COMPATIBLE STROBE CONTROLLERS		
	LTDV series	p. 252

Part number	Detector size	Image circle Ø (mm)	Field of view (diam x height) 1		Wavelength range (nm)	Optical specifications			Mechanical specifications			
			Min (mm x mm)	Max (mm x mm)		Working distance (mm)	CTF @50mm Ip/mm (%)	wf/#	Diameter (mm)	Length (mm)	Weight (g)	Mount
PCHI013	1/3"	3.6	10 x 6	120 x 190	450 .. 650	5 .. 62	> 40	4.7	40	102.0	250	C
PCHI012	1/2"	4.8	10 x 6	120 x 190	450 .. 650	5 .. 62	> 40	5.8	40	104.0	250	C
PCHI023	2/3"	6.6	10 x 6	120 x 190	450 .. 650	5 .. 62	> 30	8.3	40	108.5	250	C
PCHI023-MF 3	2/3"	6.6	10 x 6	120 x 190	450 .. 650	5 .. 62	> 30	8.3	37.7	108.5	250	C
PCHI023-AF 3	2/3"	6.6	10 x 6	120 x 190	450 .. 650	5 .. 62	> 30	8.3	40 x 65	115.2	250	C

1 Cameras with CS- to C-mount adapters, filters or protective windows in front of the sensor or other mechanical constraints in the C-mount can limit the focus range of PCHI0xx lenses. 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.
3 Additional models for 1/2" sensors available upon request.

Field of view selection chart

PCHI 013, PCHI 012 and PCHI 023 field of view

Hole diameter (mm)	High res. imaging		Normal res. imaging		WD (mm)
	Cavity height (mm)	r (%)	Cavity height (mm)	r (%)	
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.

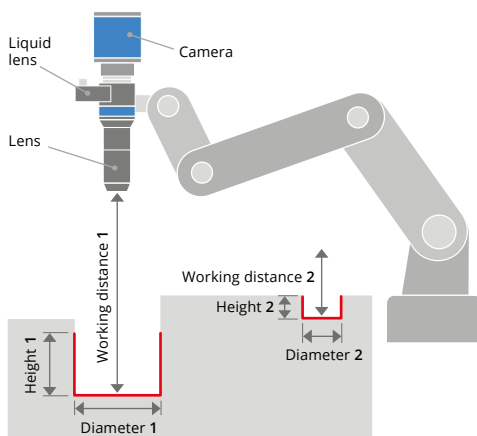
For a given hole diameter, the table on the left lists the maximum cavity height allowed for both high resolution imaging (small pixel sizes) and normal resolution imaging (>5 micron pixels) applications; the "r" ratio indicates how much of the detector area gets covered by the image of the hole inner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

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

PCHI WITH LIQUID LENS FOR FAST REFOCUSING

Working principle



PCHI023-AF with integrated liquid lens allows to quickly and remotely change the focus.

Application examples



PCHI023-AF can be mounted onto a robotic arm and quickly refocused to inspect various cavities different diameters in complex mechanical parts.



PCHI023-AF can be used to inspect in rapid sequence the neck and bottom/sides of a bottle. A working distance change might be necessary to achieve best results.

PCBP series

Boroscopic probes for panoramic cavity imaging and measurement from inside

NEW MODELS



EXTENDED RANGE

New PCBP models now available for diameters down to 5.5 mm!

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.

Small diameter inspection

Now down to 5.5 mm.

FULL RANGE OF COMPATIBLE CAMERAS



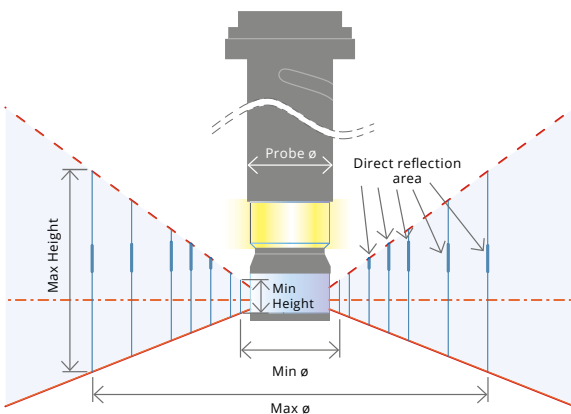
Area scan cameras

p. 188-203

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 the

complete 360° inner view of the entire cavity. 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.

Working principle



Working principle and FoV of PCBP lenses.

An integrated LED source (for PCBPOxx and PCBPN013-WG) illuminates the cavity with diffused illumination. The diagram shows the imaged heights for different diameters (cf. Table "Inspection area").

If the surface is highly reflective, total reflection can be also obtained in specific regions of the image, indicated in the diagram as «direct reflection area». Total reflection can be used to increase contrast on surface deformation, scratches, and other similar surface defects. The image of the cavity covers around 50% of the detector height: the continuous red line indicates the bottom view of the cavity, the dashed line shows the upper view and the dash-dotted line refers to the undercut view on the cavity.

PCBP probes can image cavities whose diameter ranges from 5.5 mm to 100 mm and over: the table below shows the inspection range allowed.

Diameter (mm)	Inspection area	
	Height (mm)	Suggested P/N model
5.5	3	PCBPN013
10	6	PCBPN013, PCBPN013-WG
15	9	PCBPN013, PCBPN013-WG
20	12	PCBPN013, PCBPN013-WG
25	9	PCBP0xx
30	12	PCBP0xx
40	18	PCBP0xx
50	23	PCBP0xx
60	29	PCBP0xx
80	41	PCBP0xx
100	53	PCBP0xx



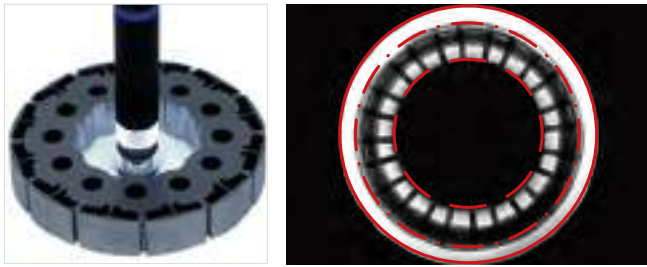
PCBP023 mounted onto a robotic arm.



The optical tip of the probe **PCBPTIP** (for PCBPOxx) can be easily replaced in case of damage.



The best focus in PCBP and PCBPN lenses is achieved by means of a lockable focusing ring. Power supply cables exit the device nearby the C-mount.



Rotor part imaged with PCBP lens. Internal walls can be completely inspected.



Unwrapped image. 360LIB-01 dedicated software library is available to easily and accurately unwrap the images.

Part number	Detector size	Image circle Ø (mm)	Field of view (diam x height)		Optical specifications				Mechanical specifications					Electrical specifications						
			Min	Max	Wave-length range (nm)	Viewing angle (°)	CTF @50mm lp/mm (%)	wF/#	Probe diameter (mm)	Probe length (mm)	Total length (mm)	Weight (g)	Mount	Continuous mode 1			Pulse mode 2			
			(mm x mm)												LED voltage (V)	LED current (mA)	LED power (W)	LED voltage (V)	LED current (mA)	LED power (W)
PCBP013	1/3"	3.4	25 x 11	100 x 55	450 .. 650	60	> 35	14	21	158	167	113	C	16 .. 24	-	< 2.0	N.A.	N.A.	N.A.	
PCBP012	1/2"	4.6	25 x 11	100 x 55	450 .. 650	60	> 30	16	21	128	137	92	C	16 .. 24	-	< 2.0	N.A.	N.A.	N.A.	
PCBP023	2/3"	7	25 x 11	100 x 55	450 .. 650	60	> 20	18	21	99	113	80	C	16 .. 24	-	< 2.0	N.A.	N.A.	N.A.	
PCBPN013	1/3"	3.4	5.5 x 2.8	25 x 15	450 .. 650	65	> 20 @35 lp/mm	30	4	67	78 - 81	70	C	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	
PCBPN013-WG	1/3"	3.4	8.0 x 4.4	25 x 15	450 .. 650	65	> 20 @35 lp/mm	30	7	57.5	78 - 81	75	C	16 .. 24	150	3.5	16 (typ.)	2800	45	

1 Constant voltage operation.

2 Constant current operation, max Ton = 1 ms, max duty cycle = 1%.

Application examples

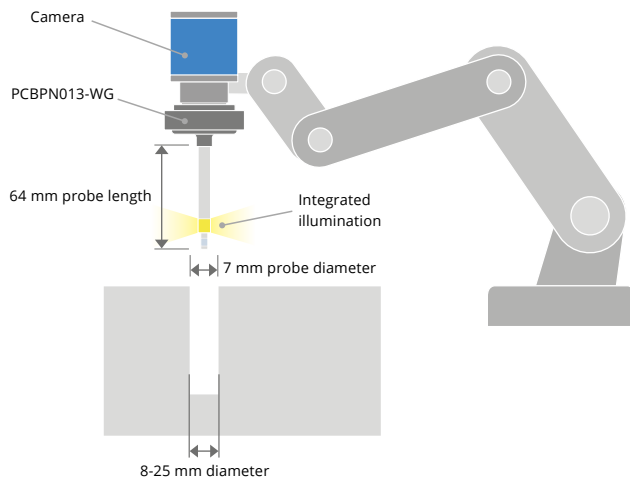


Tube scanning for integrity inspection.

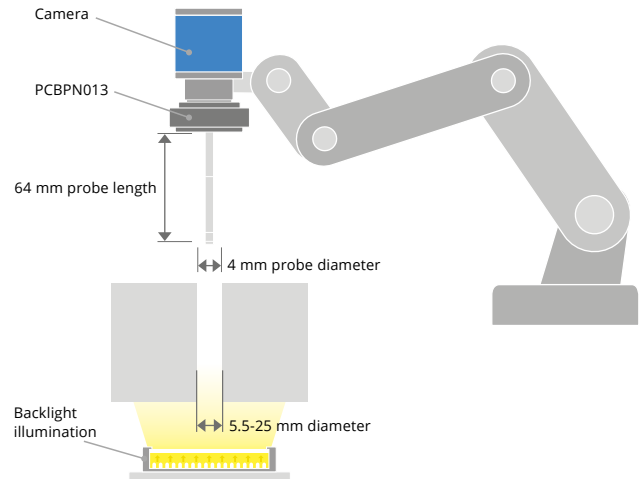
Defect and impurities detection inside containers.

Inspection of holed parts of an engine.

PCBPN for inspection of holes with diameters between 5 and 25 mm



PCBPN013-WG features an integrated powerful waveguide illumination with a 64 mm long probe for extra freedom and can inspect diameters down to 8 mm.



PCBPN013 allows to reach focusing on 5.5 mm diameters with a 64 mm long probe for extra freedom. Illumination is provided externally, e.g. using a matching backlight.

PCPW series

Polyview optics for multiple side views in one image



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.

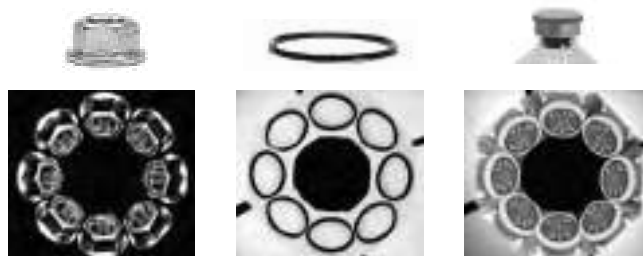
PCPW optics provide eight different views of the side and top surfaces of an object.

The wide view 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




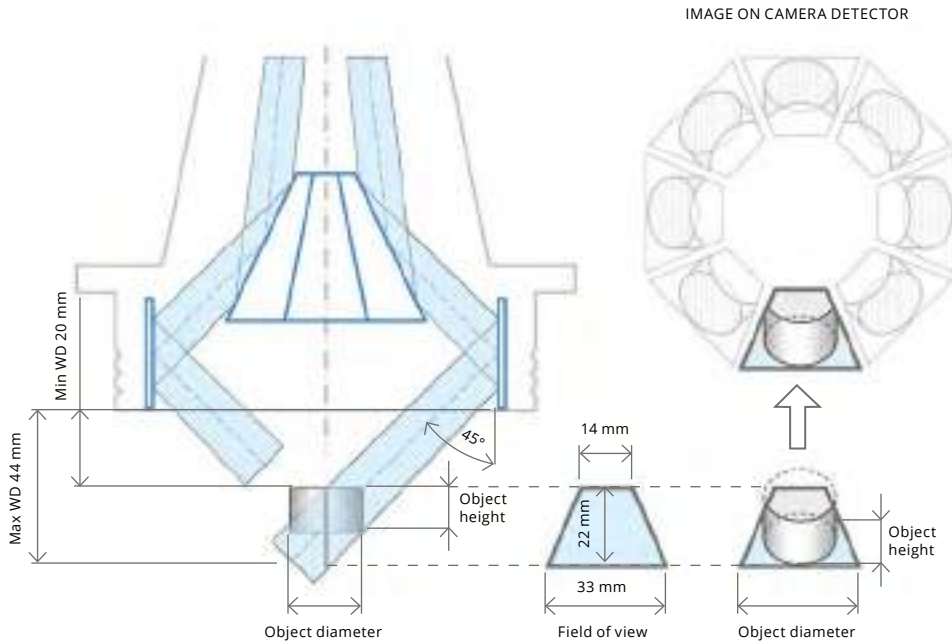
Part number		PCPW 013	PCPW 012	PCPW 023
Detector type		1/3"	1/2"	2/3"
Image circle	Ø (mm)	3.6	4.8	6.6
Max object diameter for SIDE inspection				
Height 20 mm	(mm)	30	30	30
Height 5 mm	(mm)	50	50	50
Max object diameter for SIDE + TOP inspection				
Height 10 mm	(mm)	30	30	30
Optical specifications				
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

DEDICATED COMPATIBLE OBLIQUE RING LIGHTS

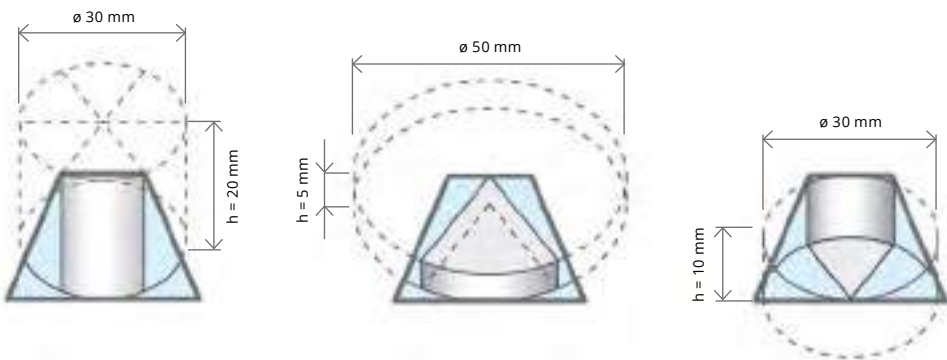
	LTRN 050 x45	p. 148
	LTRN 245 x45	p. 148

FULL RANGE OF COMPATIBLE CAMERAS

	Area scan cameras	p. 188-203
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The diagram shows how PCPW optics image a cylindrical object. The object is observed at 45° 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. The 45° view angle allows both the sides and the top of a cylindrical object to be imaged. 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 side 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 neighbouring image portions.

Part number		LTRN 050 W 45
Light color		white, 6300k
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-mechanical components. 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 centre 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.

The PCMP series integrates LED illumination optimized for this specific assembly.

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"
Image circle	Ø (mm)	4.8	6.6
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 focus 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 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 calibrate.

FULL RANGE OF COMPATIBLE CAMERAS



Area scan cameras

p. 188-203

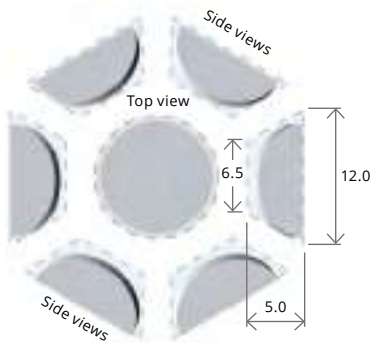
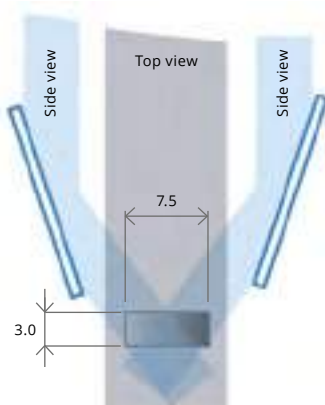
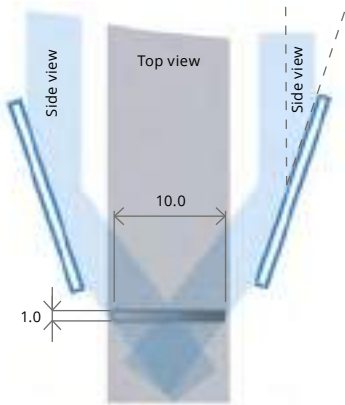


IMAGE ON CAMERA DETECTOR

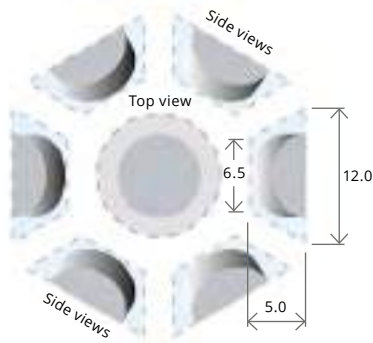


IMAGE ON CAMERA DETECTOR

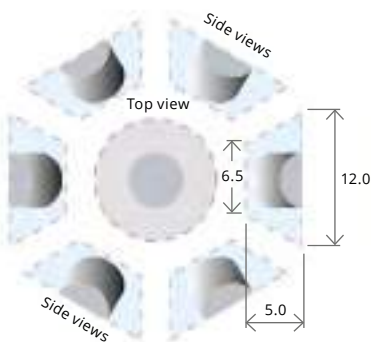
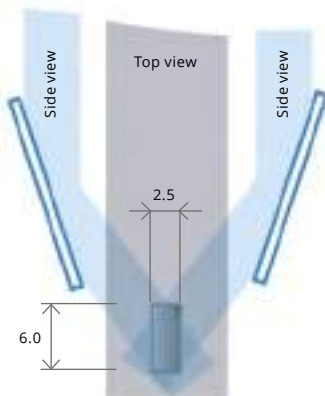
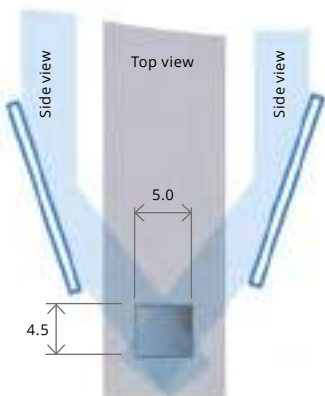


IMAGE ON CAMERA DETECTOR

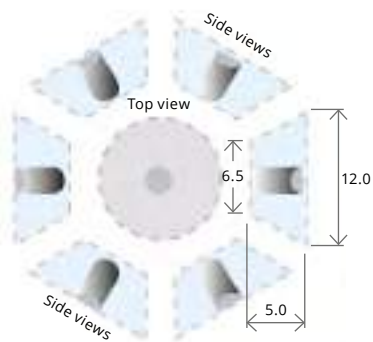


IMAGE ON CAMERA DETECTOR

Application examples

Mechanical components inspection

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



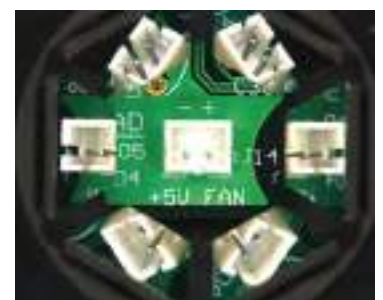
SMD components inspection

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°

NEW MODELS



KEY ADVANTAGES

90° lateral imaging

The four orthonormal views allow you to see object features that are hidden from the top.

Long and thin object inspection

The characteristic aspect 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

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 the side without any need of rotation. Four orthonormal views of an object are provided by a bi-telecentric lens through an array of mirrors.

Each view is exactly at 90° with respect to the neighbouring views; this optical layout ensures complete coverage of the object lateral surface.

Furthermore, telecentric imaging makes the system insensitive to off-centred 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.

EXTENDED RANGE

New TCCAGE models now available with higher resolution and high power illumination!

FULL RANGE OF COMPATIBLE CAMERAS



Area scan cameras

p. 188-203

Bi-telecentric multi-mirror system

Part number	Detector size	Image size Ø (mm x mm)	Max object diam. (mm)	Max object height (mm)	Optical specifications			Mechanical specifications					Electrical specifications				
					Wavelength range (nm)	CTF @ 50 lp/mm	wF/# ¹	Width (mm)	Length (mm)	Height (mm)	Weight (g)	Mount	Phase adj. ²	Ring illumination voltage (V, DC)	Ring illumination power (watt)	Coaxial illumination voltage (V, DC)	Coaxial illumination power (watt)
					1	2											
TCCAGE 12 048	1/2"	6.4 x 4.8	8	32	450 .. 650	> 60	8	111	192,8	248	2700	C	Yes	24	3	24	9
TCCAGE 23 048	2/3"	8.5 x 7.1	8	32	450 .. 650	> 55	8	111	192,8	248	2750	C	Yes	24	3	24	9
TCCAGE 2MHR 048-C	1"	14.2 x 7.5	7	32	450 .. 650	> 30	16	111	192,8	280	2750	C	Yes	24	3	24	9
TCCAGE 3MHR 048-C	1.1"	14.2 x 10.4	5	32	450 .. 650	> 40	16	111	192,8	271	2720	C	Yes	24	3	24	9
TCCAGE 12 096	1/2"	6.4 x 4.8	16	68	450 .. 650	> 60	8	179	347	405	9111	C	Yes	24	3	24	15
TCCAGE 23 096	2/3"	8.5 x 7.1	16	68	450 .. 650	> 50	8	179	347	424	9154	C	Yes	24	3	24	15
TCCAGE 2MHR 096-C	1"	14.2 x 7.5	16	68	450 .. 650	> 40	16	179	347	457	9223	C	Yes	24	3	24	15
TCCAGE 3MHR 096-C	1.1"	14.2 x 10.4	16	68	450 .. 650	> 40	16	179	347	441	9165	C	Yes	24	3	24	15
TCCAGE 4MHR 096-C	4/3"	18.1 x 13.6	16	68	450 .. 650	> 35	16	179	347	480	9292	C	Yes	24	3	24	15

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

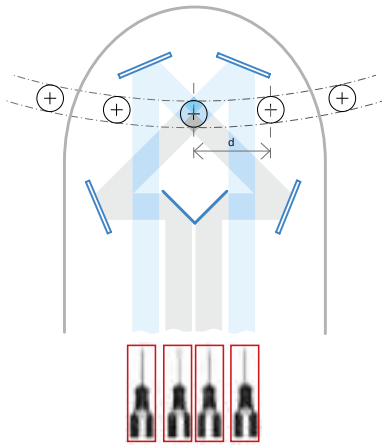
High-power Bi-telecentric multi-mirror system

Part number	Detector size	Image size Ø (mm x mm)	Max object diam. (mm)	Max object height (mm)	Optical specifications			Mechanical specifications					Electrical specifications 3						
					Wave-length range (nm)	CTF @ 50 lp/mm	wF/# 1	Width (mm)	Length (mm)	Height (mm)	Weight (g)	Mount	Phase adj. 2	Ring light			Coaxial light		
														LED voltage (V)	LED current (mA)	LED power (W)	LED voltage (V)	LED current (mA)	LED power (W)
TCCAGE 120 48 HP	1/2"	6.4 x 4.8	8	32	450 .. 650	> 60	8	111	192,8	248	2700	C	Yes	< 25 (typ.)	4000	100	< 30 (typ.)	6000	180
TCCAGE 23 048 HP	2/3"	8.5 x 7.1	8	32	450 .. 650	> 55	8	111	192,8	248	2750	C	Yes	< 25 (typ.)	4000	100	< 30 (typ.)	6000	180
TCCAGE 2MHR 048 HP-C	1"	14.2 x 7.5	7	32	450 .. 650	> 30	16	111	192,8	280	2750	C	Yes	< 25 (typ.)	4000	100	< 30 (typ.)	6000	180
TCCAGE 3MHR 048 HP-C	1.1"	14.2 x 10.4	5	32	450 .. 650	> 40	16	111	192,8	271	2720	C	Yes	< 25 (typ.)	4000	100	< 30 (typ.)	6000	180
TCCAGE 12 096 HP	1/2"	6.4 x 4.8	16	68	450 .. 650	> 60	8	179	347	405	9111	C	Yes	< 30 (typ.)	4000	120	< 30 (typ.)	10000	300
TCCAGE 23 096 HP	2/3"	8.5 x 7.1	16	68	450 .. 650	> 50	8	179	347	424	9154	C	Yes	< 30 (typ.)	4000	120	< 30 (typ.)	10000	300
TCCAGE 2MHR 096 HP-C	1"	14.2 x 7.5	16	68	450 .. 650	> 40	16	179	347	457	9223	C	Yes	< 30 (typ.)	4000	120	< 30 (typ.)	10000	300
TCCAGE 3MHR 096 HP-C	1.1"	14.2 x 10.4	16	68	450 .. 650	> 40	16	179	347	441	9165	C	Yes	< 30 (typ.)	4000	120	< 30 (typ.)	10000	300
TCCAGE 4MHR 096 HP-C	4/3"	18.1 x 13.6	16	68	450 .. 650	> 35	16	179	347	480	9292	C	Yes	< 30 (typ.)	4000	120	< 30 (typ.)	10000	300

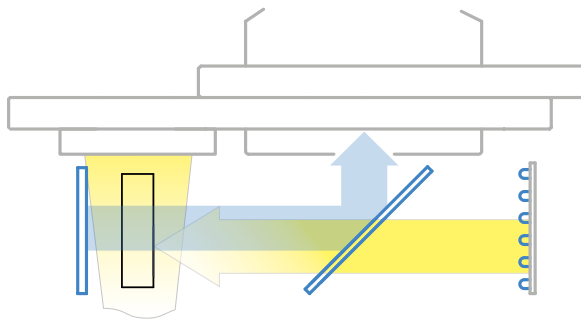
1 Working distance: distance between the front end of the mechanics and the object. Set this distance within +/- 3% of the nominal value for maximum resolution and minimum distortion.

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

3 Strobe only, constant current driving, Max Ton = 1 ms, max duty cycle 1%.



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 by 90° and partially overlapped, obtaining complete coverage of the object lateral surfaces.

The system can thus tolerate off-centred 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

$$\begin{aligned} \text{TCCAGE xx048} & \quad d \text{ (mm)} \cong 25 + \varnothing_{\text{object}}/2 \\ \text{TCCAGE xx096} & \quad d \text{ (mm)} \cong 50 + \varnothing_{\text{object}}/2 \end{aligned}$$

Illumination geometry

TCCAGE series integrates both direct and backlight illumination. 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 diffuse 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 house other types of illuminators.



Infrared & UV lenses



SHORT WAVE INFRARED LENSES	111
MEDIUM WAVE INFRARED LENSES	112
LONG WAVE INFRARED LENSES	112
ULTRA VIOLET LENSES	113

Beyond the visible range, for advanced optical applications.

Illumination outside the visible spectrum is used in a wide variety of sectors including defense, security/surveillance, industrial, medical and R&D. Applications include tracking/targeting systems, predictive maintenance, monitoring of high temperature industrial processes, thermography, flame detection, quality control/inspection.

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 interfaces.

MWIR and LWIR thermal series also include HCAR coating for use in harsh environments.

Our offer also includes C-mount lenses for up to 1" detectors, optimized to work with ultraviolet illumination (365 nm) for high quality reflected UV imaging application.



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

OPTICS PARAMETER

Focal length (mm)

SWIR series

SWIR fixed focal length lenses for InGaAs sensors up to 21 mm Focal length 35-75 mm



SWIR series is a range of **short-wave infrared lenses** specifically designed to operate in the 0.9-1.7 μm wavelength region. This series 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.

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 performance.

Part number	Optical specifications										Mechanical specifications						
	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)	(%)	(deg)	(mm)	(mm)	(%)	(%)					(mm)	(mm)	(mm)	(g)
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.

- 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 fixed focal length lenses up to 2/3" sensors



* RT

Focal length 16-50 mm

Part number	Optical specifications									Mechanical specifications		
	Focal length	Magnification	Image circle	Max detector size	WD	F/#	Back focal length	Distortion	Mount	Length	Diameter	
	(mm)		\emptyset (mm)		(mm)		(mm)	(%)		(mm)	(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

MWIR fixed focal length lenses for InSb sensors up to 21 mm Focal length 35-100 mm



MWIR series is a range of **medium-wave infrared lenses** specifically designed to operate in the 3-5 μm wavelength 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.

Part number	Optical specifications										Mechanical specifications						
	Focal length (mm)	F/#	Wave length (μm)	Average trans. (%)	Circular FOV (deg)	WD (mm)	Image Diagonal (mm)	Distortion (%)	CTF @30lp/mm (%)	Image side NA	Mount	Focus type	Locking screw	Back focal length (mm)	Length (mm)	Diam. (mm)	Mass (g)
			1				2	3						4			5
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 Measured from the front end of the mechanics to the camera flange.
- 5 Given with no mount attached. See layout drawings.

LWIR series

LWIR fixed focal length lenses for uncooled sensors up to 21 mm Focal length 8-75 mm



LWIR series is a range of **long-wave infrared lenses** specifically designed to operate in the 8-14 μm wavelength 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.

Part number	Optical specifications										Mechanical specifications						
	Focal length (mm)	F/#	Wave length (μm)	Average trans. (%)	Circular FOV (deg)	WD (mm)	Image Diagonal (mm)	Distortion (%)	CTF @30lp/mm (%)	Image side NA	Mount	Focus type	Locking screw	Back focal length (mm)	Length (mm)	Diam. (mm)	Mass (g)
			1				2	3						4			5
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 Measured from the front end of the mechanics to the camera flange.
- 5 Given with no mount attached. See layout drawings.

KEY ADVANTGES OF MWIR AND LWIR SERIES

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 performance.

HCAR coating

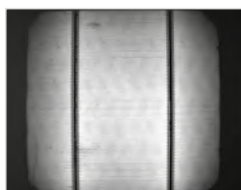
For applications exposing optical elements to harsh environments.

Application examples of infrared lenses

Short wave infrared lenses

A large number of applications that are difficult or impossible to perform using visible light are possible using SWIR InGaAs based cameras: nondestructive identification of materials, their composition, coatings and other characteristics, Electronic Board Inspection, Solar cell inspection, Identifying and Sorting, Surveillance, Anti-Counterfeiting, Process Quality Control, etc...

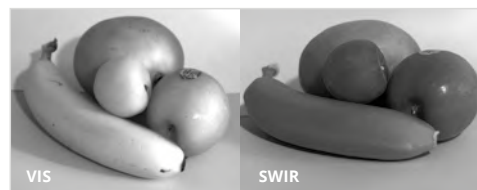
When imaging in SWIR, water vapour, fog, and certain materials such as silicon are transparent. Additionally, colors that appear almost identical in what is visible may be easily differentiated using SWIR.



Solar cell inspection.



Liquid level inspection.

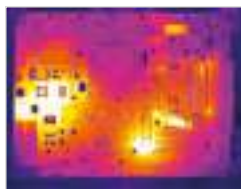


Fruit sorting.

Medium and long wave infrared lenses

For example, the emissive peak of hot engines and exhaust gasses occurs in the MWIR band, so these cameras are especially sensitive to vehicles and aircraft. LWIR systems applications include thermography/temperature control, predictive maintenance,

gas leak detection, imaging of scenes which span a very wide temperature range (and require a broad dynamic range), imaging through thick smoke, etc...



Electronic boards inspection.



Thermal imaging.



Automotive.

ENUV2M series

UV fixed focal length lenses for sensors up to 1"

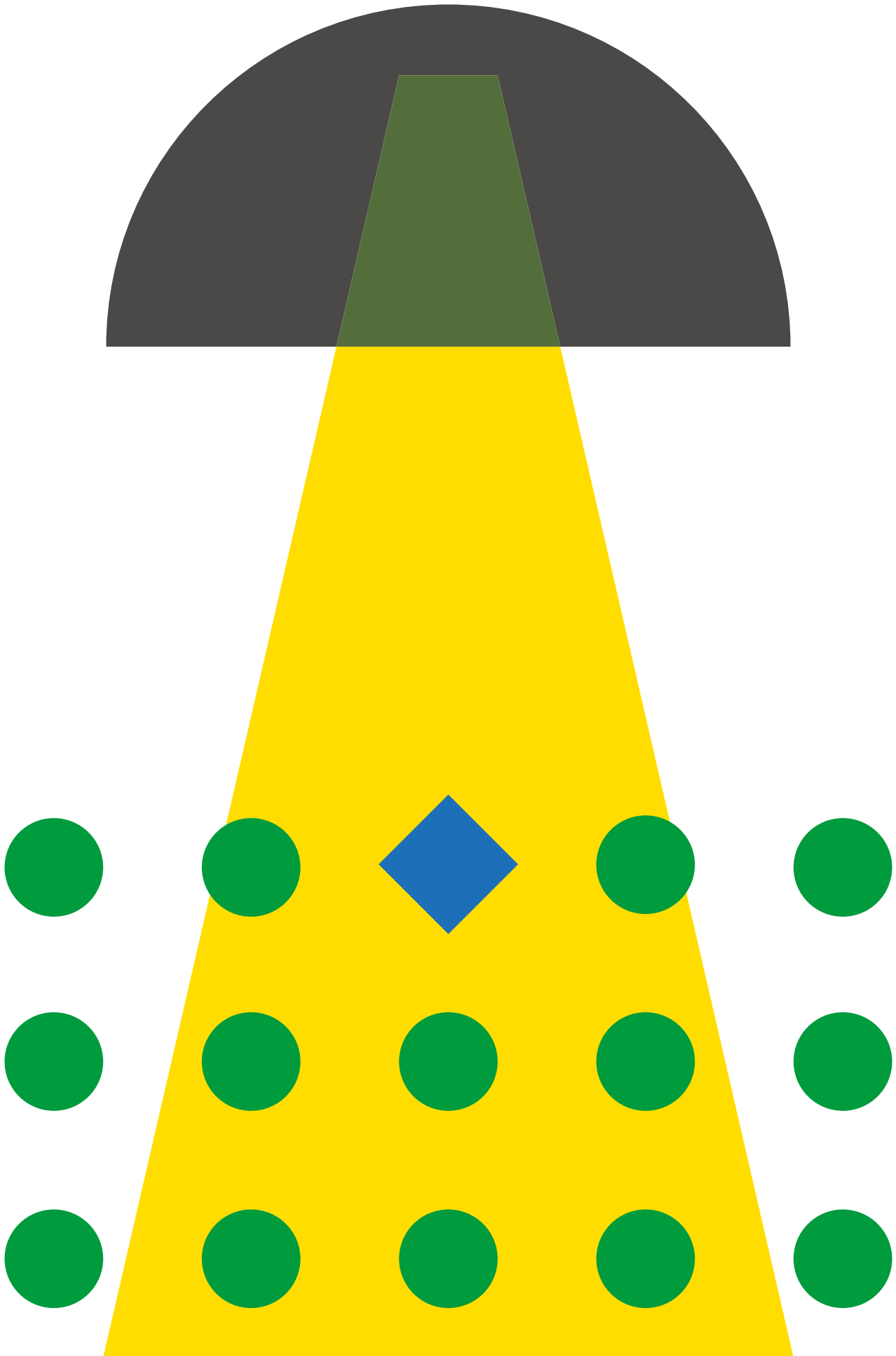


* RT

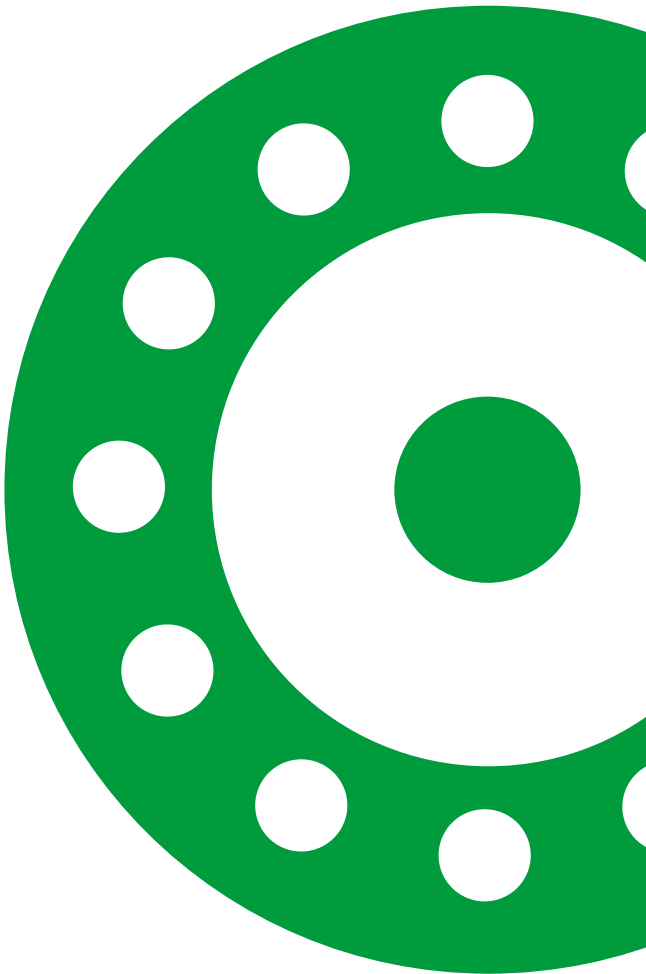
Focal length 25-78 mm

Part number	Optical specifications								Mechanical specifications				
	Focal length (mm)	Magnification (x)	Image circle Ø (mm)	Max detector size	WD (mm)	F/#	Horizontal angle of view (°) ¹	Max Distortion (%)	Mount	Length (mm)	Diameter (mm)	Mass (g)	Filter thread (mm)
RT-FL-BC2528-VGUV	25	0.10 - 0	16	1"	230 - ∞	2.8-16	29.7	n.a.	C	58.7	60.0	33	M25 x 0.5
RT-FL-BC7838-VGUV	78	0.15 - 0	16	1"	440 - ∞	3.8-16	9.5	n.a.	C	109.3	62.5	446	M49 x 0.75

¹ Horizontal angle of view while using max detector size.



LIGHTING



Lighting is one of the most critical elements in a vision system and is in fact key to achieving stable and repeatable results. Incorrect illumination may result in extensive and time consuming image processing or, in the worst case, in the loss of crucial information.

Opto Engineering® lighting solutions, from standard to custom products, are the result of our optical knowledge and are designed with our guiding principle in mind: “simple works better”.

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: this approach allows making the most out of our lighting products and greatly simplifies vision system integration, since our products are truly optimised both optically and mechanically.

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

LED illuminators **116**

LED pattern projectors **175**

LED illuminators

Advanced lighting solutions.

Illumination is a critical part of every machine vision setup:
proper choice of lighting color and geometry can effectively suppress or reveal specific features of an object, leading to simple and accurate image processing.

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



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

BACKLIGHTS	118 - 127
TELECENTRIC LIGHTS	128 - 137
RING LIGHTS	138 - 151
DOME LIGHTS	152 - 157
BAR LIGHTS	158 - 161
COAXIAL LIGHTS	162 - 163
TUNNEL LIGHTS	164 - 165
LINE LIGHTS	166 - 171
SPECIALTIES	172 - 174

LIGHTING PARAMETERS

H High power: suggested for high speed applications

α Light angle (°)

LIGHTING TYPES

COLLIMATED

DIRECT

FOCUSED

DIFFUSED

INDIRECT



LT2BC series

High uniformity continuous LED backlights

COLLIMATED/DIFFUSED

NEW
MODELS

KEY ADVANTAGES

4 Pin M8 connector.

Excellent uniformity.

Test report with measured uniformity.

Suitable for frequent cleaning

Thanks to the optical grade and scratch resistant protective window.

Wide selection and modular design

Size options with an active area ranging from 48x36 to 288x216 mm.

Available in red, white, green, blue and IR.

Compact design with reduced thickness (26 mm).

Optional integrated collimation film.



The **LT2BC series** offers high intensity LED backlights designed to provide exceptional illumination performances and excellent uniformity. Their special design provides both even lighting that perfectly fits in confined spaces thanks to a special beam shaping diffuser, new high efficiency LEDs and reduced thickness.

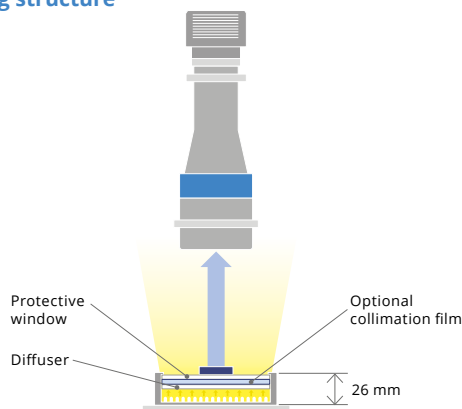
The LT2BC series innovative optical layout has been designed to emit a directional light beam and achieve accurate results even when used in combination with telecentric lenses for measurement applications.

When positioned behind the objects being inspected, the LT2BC series highlights the silhouette of the objects providing excellent image contrast.

These backlights work in continuous mode but they can also be overdriven.

Their robust and modular design featuring M8 connector and scratch resistant protective cover is conceived for demanding industrial automation environments and to provide you with a great choice of sizes, colors and aspect ratios for many diverse applications (from 4:3 to 16:9 and bar lights). Furthermore, LT2BC 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 constraints.

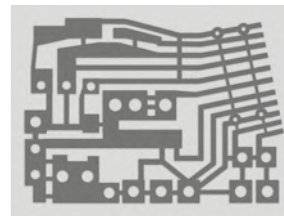
Lighting structure



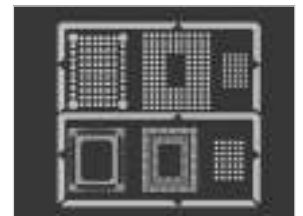
NEW

Optional collimation film available. The collimation film reduces light diffusion and increases parallelism: it is ideal for measurement applications or for the inspection of subtle scratches/dents on transparent surfaces.

Application examples



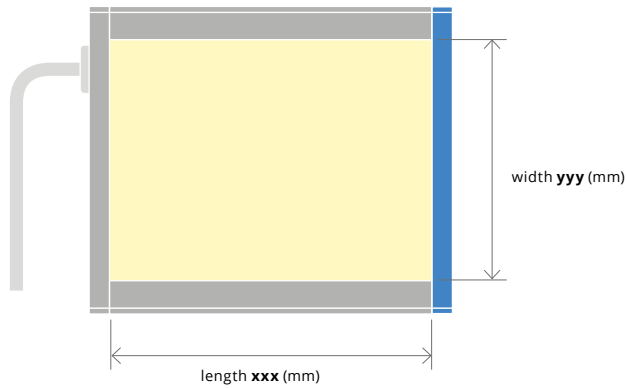
Shape inspection.



Detection of patterns/holes.



Inspection of subtle scratches/dents on transparent surfaces.



COMPATIBLE LIGHT INTENSITY CONTROLLER		
	Light intensity controller	p. 256
FULL RANGE OF COMPATIBLE STROBE CONTROLLERS		
	LTDV series	p. 252
FULL RANGE OF COMPATIBLE TELECENTRIC LENSES		
	Telecentric lenses	p. 18-71
FULL RANGE OF FIXED FOCAL LENGTH LENSES		
	EN2MP series, EN5MP series, EN-2RT series, EN-5RT series	p. 74-77

Light color		-R (red)	-G (green)	-B (blue)	-W (white)	-IR860 (infrared)
Wavelength	(nm)	620	525	470	cool white > 4500 K	860
Spectral FWHM	(nm)	20	33	25	cool white > 4500 K	30

Part number 1	Modules	Number of LEDs	Lighting area dim.		Light color Z	Diffuser	Optional optical sheet a 6	Optical specifications					Electrical specifications				Mechanical specs		
			Width xxx (mm)	Height yyy (mm)				Illuminance					Continuous mode			Pulsed mode	Dimensions		
								-R (red)	-G (green)	-B (blue)	-W (white)	-IR860 (infrared)	Supply voltage (V)	Current (mA) 4	Power cons (W) 5	Max pulse current (mA) 3	Width (mm)	Height (mm)	Thickness (mm)
LT2BC 048 036-z-a	1x1	48	48	36		Yes		28	50	12	46	439	24	220	5.3	500	60	56	26
LT2BC 096 036-z-a	2x1	96	96	36		Yes		21	39	8	31	304	24	310	7.4	700	108	56	26
LT2BC 144 036-z-a	3x1	144	144	36		Yes		17	30	7	25	260	24	380	9.1	850	156	56	26
LT2BC 192 036-z-a	4x1	192	192	36		Yes		15	29	6	24	245	24	460	11.0	1000	204	56	26
LT2BC 240 036-z-a	5x1	240	240	36		Yes		14	26	6	22	229	24	540	13.0	1200	252	56	26
LT2BC 288 036-z-a	6x1	288	288	36		Yes		14	26	6	22	224	24	640	15.4	1400	300	56	26
LT2BC 048 072-z-a	1x2	96	48	72		Yes		21	39	8	31	304	24	310	7.4	700	60	92	26
LT2BC 096 072-z-a	2x2	192	96	72		Yes		15	29	6	24	245	24	460	11.0	1000	108	92	26
LT2BC 144 072-z-a	3x2	288	144	72		Yes		14	26	6	22	224	24	640	15.4	1400	156	92	26
LT2BC 192 072-z-a	4x2	384	192	72		Yes		13	24	5	20	193	24	780	18.7	1700	204	92	26
LT2BC 240 072-z-a	5x2	480	240	72		Yes		12	22	5	18	184	24	910	21.8	1900	252	92	26
LT2BC 288 072-z-a	6x2	576	288	72		Yes		12	21	5	18	177	24	1080	25.9	2250	300	92	26
LT2BC 048 108-z-a	1x3	144	48	108	R = red,	Yes	CO = collimation film,	17	30	7	25	260	24	380	9.1	850	60	128	26
LT2BC 096 108-z-a	2x3	288	96	108	G = green,	Yes	Leave empty if no optional optical sheet is required	14	26	6	22	224	24	640	15.4	1400	108	128	26
LT2BC 144 108-z-a	3x3	432	144	108	B = blue,	Yes		13	22	5	18	193	24	880	21.1	1800	156	128	26
LT2BC 192 108-z-a	4x3	576	192	108	W = white,	Yes		12	21	5	18	177	24	1080	25.9	2250	204	128	26
LT2BC 240 108-z-a	5x3	720	240	108	IR860 = Infrared 860 nm	Yes		11	19	4	16	155	24	1200	28.8	2500	252	128	26
LT2BC 288 108-z-a	6x3	864	288	108		Yes		9	17	4	15	150	24	1280	30.7	2650	300	128	26
LT2BC 048 144-z-a	1x4	192	48	144		Yes		15	29	6	24	245	24	460	11.0	1000	60	164	26
LT2BC 096 144-z-a	2x4	384	96	144		Yes		13	23	5	20	193	24	780	18.7	1700	108	164	26
LT2BC 144 144-z-a	3x4	576	144	144		Yes		12	21	5	18	177	24	1080	25.9	2250	156	164	26
LT2BC 192 144-z-a	4x4	768	192	144		Yes		10	19	4	16	155	24	1240	29.8	2550	204	164	26
LT2BC 240 144-z-a	5x4	960	240	144		Yes		9	17	4	15	153	24	1440	34.6	2900	252	164	26
LT2BC 288 144-z-a	6x4	1152	288	144		Yes		11	19	4	16	170	24	1920	46.1	4000	300	164	26
LT2BC 048 180-z-a	1x5	240	48	180		Yes		14	26	6	22	229	24	540	13.0	1200	60	200	26
LT2BC 096 180-z-a	2x5	480	96	180		Yes		12	24	5	18	184	24	950	22.8	1900	108	200	26
LT2BC 144 180-z-a	3x5	720	144	180		Yes		11	19	4	16	155	24	1200	28.8	2500	156	200	26
LT2BC 192 180-z-a	4x5	960	192	180		Yes		9	17	4	15	148	24	1420	34.1	2900	204	200	26
LT2BC 240 180-z-a	5x5	1200	240	180		Yes		11	19	4	16	155	24	2000	48.0	4100	252	200	26
LT2BC 288 180-z-a	6x5	1440	288	180		Yes		9	16	3	13	146	24	2060	49.4	4100	300	200	26
LT2BC 048 216-z-a	1x6	288	48	216		Yes		14	26	6	22	224	24	640	15.4	1400	60	236	26
LT2BC 096 216-z-a	2x6	576	96	216		Yes		12	21	5	18	177	24	1080	25.9	2250	108	236	26
LT2BC 144 216-z-a	3x6	864	144	216		Yes		9	17	4	15	150	24	1280	30.7	2650	156	236	26
LT2BC 192 216-z-a	4x6	1152	192	216		Yes		11	19	4	16	170	24	1920	46.1	4000	204	236	26
LT2BC 240 216-z-a	5x6	1440	240	216		Yes		9	16	3	13	146	24	2060	49.4	4100	252	236	26
LT2BC 288 216-z-a	6x6	1728	288	216		Yes		8	14	3	12	121	24	2230	53.5	4500	300	236	26

- At emitting surface.
- At 25°C. At max pulse width (1 ms), max pulse frequency = 15 Hz.
- 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).
- Maximum current +/- 10%.
- Maximum power +/- 10%.
- LT2BCxxx-IR860 are not available as a standard product with integrated optional collimation film. Contact us for customized options.

Ordering information

Our part numbers are coded as **LT2BC xxx yyy - z - a**, where:

- **xxx** defines the illumination area length (in mm),

- **yyy** defines the illumination area width (in mm),

- **z** defines the color. R = red, G = green, B = blue, W = white, IR860 = Infrared 860 nm,

- **a** defines the presence of an optional optical sheet. CO = with collimation films in both horizontal and vertical directions. Leave empty if no optional optical sheet is required.

For additional options such as horizontal/vertical linear or circular polarizers, contact us.

LTBP series

High power strobed LED backlights

H COLLIMATED/DIFFUSED

NEW
MODELS

KEY ADVANTAGES

4 Pin M8 connector.

Excellent uniformity.

Test report with measured uniformity.

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, blue and Infrared.

Compact design with reduced thickness (26 mm).

Special continuous alignment mode.

Optional integrated collimation film.



The **LTBP series** offers high power LED backlights designed to provide exceptional illumination performance and excellent uniformity. Their special design provides both powerful and uniform lighting that perfectly fits in confined spaces thanks to a special beam shaping diffuser, new high efficiency LEDs and reduced thickness. The LTBP series innovative optical layout has been designed to emit a directional light beam and achieve accurate results even when used in combination with telecentric lenses for measurement applications.

When positioned behind the objects being 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 μ s).

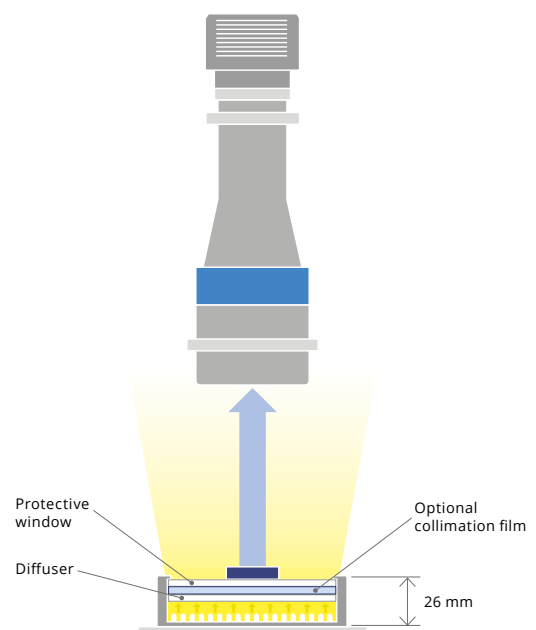
These backlights work in strobe mode only but they also feature a special continuous mode to be used for alignment/setting purposes. Their robust and modular design featuring M8/M12 connectors and scratch resistant protective cover is conceived for heavy duty industrial automation environments and to provide you with a great choice of sizes, colors and aspect ratios for many diverse applications (from 4:3 to 16:9 and bar lights).

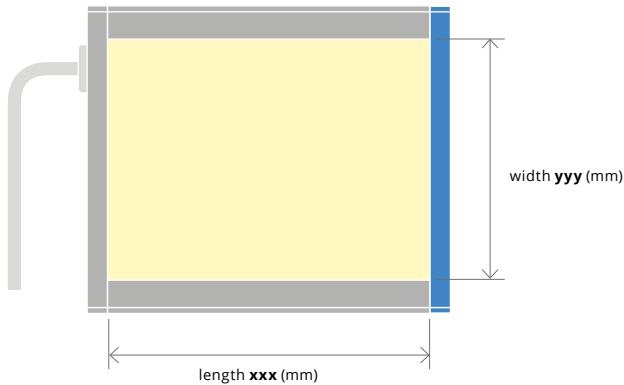
NEW

Optional collimation film available. The collimation film reduces light diffusion and increases parallelism: it is ideal for measurement applications or for the inspection of subtle scratches/dents on transparent surfaces.

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 constraints.

Lighting structure





Optical specifications

Available light colors	red, green, blue, white, infrared 850 nm
------------------------	--

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

Part number 1	Modules	Optical specifications					Electrical specifications					Mechanical specs				
		Number of LEDs	Lighting area dim.		Light color Z	Diffuser	Optional optical sheet a 3	Driving Current / Peak power consumption					Connection type	Dimensions		
			Width xxx (mm)	Height yyy (mm)				-R (red)	-G (green)	-B (blue)	-W (white)	-IR860 (infrared)		Width (mm)	Height (mm)	Thickness (mm)
LTBP 048 036-z-a	1x1	48	48	36	Yes	CO = collimation film,	1.8 / 43	1.8 / 60	1.8 / 55	1.8 / 48	1.8 / 37	M8	60	56	26	
LTBP 096 036-z-a	2x1	96	96	36			3.6 / 86	3.6 / 121	3.6 / 109	3.6 / 95	3.6 / 75	M8	108	56	26	
LTBP 144 036-z-a	3x1	144	144	36			5.4 / 130	5.4 / 181	5.4 / 164	5.4 / 143	5.4 / 112	M8	156	56	26	
LTBP 192 036-z-a	4x1	192	192	36			7.2 / 173	7.2 / 242	7.2 / 219	7.2 / 190	7.2 / 150	M8	204	56	26	
LTBP 240 036-z-a	5x1	240	240	36			9 / 216	9 / 302	9 / 274	9 / 238	9 / 187	M8	252	56	26	
LTBP 288 036-z-a	6x1	288	288	36			10.8 / 259	10.8 / 363	10.8 / 328	10.8 / 285	10.8 / 225	M8	300	56	26	
LTBP 048 072-z-a	1x2	96	48	72	Yes	Leave empty if no optional optical sheet is required	3.6 / 86	3.6 / 121	3.6 / 109	3.6 / 95	3.6 / 75	M8	60	92	26	
LTBP 096 072-z-a	2x2	192	96	72			7.2 / 173	7.2 / 242	7.2 / 219	7.2 / 190	7.2 / 150	M8	108	92	26	
LTBP 144 072-z-a	3x2	288	144	72			10.8 / 259	10.8 / 363	10.8 / 328	10.8 / 285	10.8 / 225	M8	156	92	26	
LTBP 192 072-z-a	4x2	384	192	72			14.4 / 346	14.4 / 484	14.4 / 438	14.4 / 380	14.4 / 300	M8	204	92	26	
LTBP 240 072-z-a	5x2	480	240	72			8.4 / 168	8.4 / 242	4.9 / 125	4.8 / 123	8.4 / 151	M8	252	92	26	
LTBP 288 072-z-a	6x2	576	288	72			10.1 / 202	10.1 / 291	5.8 / 148	5.8 / 148	10.1 / 182	M8	300	92	26	
LTBP 048 108-z-a	1x3	144	48	108	Yes	CO = collimation film,	5.4 / 130	5.4 / 181	5.4 / 164	5.4 / 143	5.4 / 112	M8	60	128	26	
LTBP 096 108-z-a	2x3	288	96	108			10.8 / 259	10.8 / 363	10.8 / 328	10.8 / 285	10.8 / 225	M8	108	128	26	
LTBP 144 108-z-a	3x3	432	144	108			16.2 / 389	16.2 / 544	16.2 / 492	16.2 / 428	16.2 / 337	M8	156	128	26	
LTBP 192 108-z-a	4x3	576	192	108			10.1 / 202	10.1 / 291	5.8 / 148	5.8 / 148	10.1 / 182	M8	204	128	26	
LTBP 24 0108-z-a	5x3	720	240	108			12.6 / 252	12.6 / 363	7.3 / 187	7.2 / 184	12.6 / 227	M8	252	128	26	
LTBP 288 108-z-a	6x3	864	288	108			15.1 / 302	15.1 / 435	8.7 / 223	8.6 / 220	15.1 / 272	M8	300	128	26	
LTBP 048 144-z-a	1x4	192	48	144	Yes	Leave empty if no optional optical sheet is required	7.2 / 173	7.2 / 242	7.2 / 219	7.2 / 190	7.2 / 150	M8	60	164	26	
LTBP 096 144-z-a	2x4	384	96	144			14.4 / 346	14.4 / 484	14.4 / 438	14.4 / 380	14.4 / 300	M8	108	164	26	
LTBP 144 144-z-a	3x4	576	144	144			10.1 / 202	10.1 / 291	5.8 / 148	5.8 / 148	10.1 / 182	M8	156	164	26	
LTBP 192 144-z-a	4x4	768	192	144			13.4 / 268	13.4 / 386	7.8 / 200	7.7 / 197	13.4 / 241	M8	204	164	26	
LTBP 240 144-z-a	5x4	960	240	144			16.8 / 336	16.8 / 484	9.7 / 248	9.6 / 246	16.8 / 302	M8	252	164	26	
LTBP 288 144-z-a	6x4	1152	288	144			20.2 / 404	20.2 / 582	11.7 / 300	11.5 / 294	20.2 / 364	M8	300	164	26	
LTBP 048 180-z-a	1x5	240	48	180	Yes	Leave empty if no optional optical sheet is required	9 / 216	9 / 302	9 / 274	9 / 238	9 / 187	M8	60	200	26	
LTBP 096 180-z-a	2x5	480	96	180			8.4 / 168	8.4 / 242	4.9 / 125	4.8 / 123	8.4 / 151	M8	108	200	26	
LTBP 144 180-z-a	3x5	720	144	180			12.6 / 252	12.6 / 363	7.3 / 187	7.2 / 184	12.6 / 227	M8	156	200	26	
LTBP 192 180-z-a	4x5	960	192	180			16.8 / 336	16.8 / 484	9.7 / 248	9.6 / 246	16.8 / 302	M8	204	200	26	
LTBP 240 180-z-a 2	5x5	1200	240	180			10.5 + 10.5 / 420	10.5 + 10.5 / 605	12.2 / 312	12 / 307	10.5 + 10.5 / 378	M12	252	200	26	
LTBP 288 180-z-a 2	6x5	1440	288	180			12.6 + 12.6 / 504	12.6 + 12.6 / 504	14.6 / 374	14.4 / 369	12.6 + 12.6 / 454	M12	300	200	26	
LTBP 048 216-z-a	1x6	288	48	216	Yes	Leave empty if no optional optical sheet is required	10.8 / 259	10.8 / 363	10.8 / 328	10.8 / 285	10.8 / 225	M8	60	236	26	
LTBP 096 216-z-a	2x6	576	96	216			10.1 / 202	10.1 / 291	5.8 / 148	5.8 / 148	10.1 / 182	M8	108	236	26	
LTBP 144 216-z-a	3x6	864	144	216			15.1 / 302	15.1 / 435	8.7 / 223	8.6 / 220	15.1 / 272	M8	156	236	26	
LTBP 192 216-z-a	4x6	1152	192	216			20.2 / 404	20.2 / 582	11.7 / 300	11.5 / 294	20.2 / 364	M8	204	236	26	
LTBP 240 216-z-a 2	5x6	1440	240	216			12.6 + 12.6 / 504	12.6 + 12.6 / 726	14.6 / 374	14.4 / 369	12.6 + 12.6 / 454	M12	252	236	26	
LTBP 288 216-z-a 2	6x6	1728	288	216			15.1 + 15.1 / 604	15.1 + 15.1 / 870	17.5 / 448	17.3 / 443	15.1 + 15.1 / 544	M12	300	236	26	

- 1** 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).
2 Red and Green versions of these models feature 2 separate channels.

- 3** LTBPxxxxxy-IR850 are not available as a standard product with integrated optional collimation film. Contact us for customized options.

Ordering information

Our part numbers are coded as **LTBP xxx yyy - z - a**, where:

- **xxx** defines the illumination area length (in mm),
- **yyy** defines the illumination area width (in mm),
- **z** defines the color. R = red, G = green, B = blue, W = white, IR850 = Infrared 850 nm,
- **a** defines the presence of an optional optical sheet. CO = with collimation films in both horizontal and vertical directions. Leave empty if no optional optical sheet is required. For additional options such as horizontal/vertical linear or circular polarizers, contact us.

LTBP series




High power strobed LED backlights



LTBP096072-W



LTBP048036-G

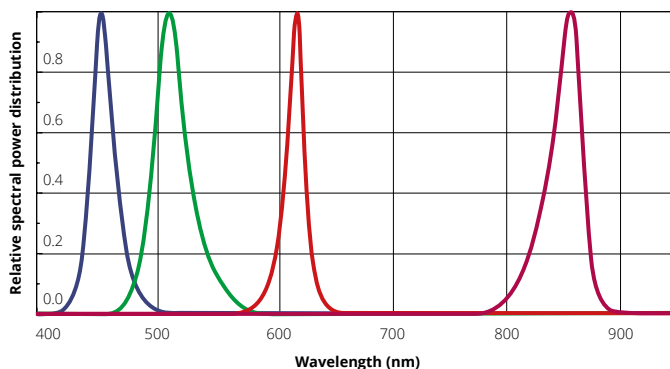
FULL RANGE OF COMPATIBLE STROBE CONTROLLERS		
	LTDV series	p. 252
FULL RANGE OF COMPATIBLE TELECENTRIC LENSES		
	Telecentric lenses	p. 18-71
FULL RANGE OF FIXED FOCAL LENGTH LENSES		
	EN2MP series, EN5MP series, EN-2RT series, EN-5RT series	p. 74-77

Light color			-R (red)	-G (green)	-B (blue)	-W (white)	-IR850 (infrared)
Wavelength	(nm)	LED Type A	620	522	465	cool white > 4500 K	850
		B	625	525	470	cool white > 4500 K	850
Spectral FWHM	(nm)	A	20	30	20	cool white > 4500 K	30
		B	20	30	25	cool white > 4500 K	30
Min estimated illumination	(klux)	A ¹	70	150	30	200	-
		B ²	n.a.	n.a.	n.a.	n.a.	-

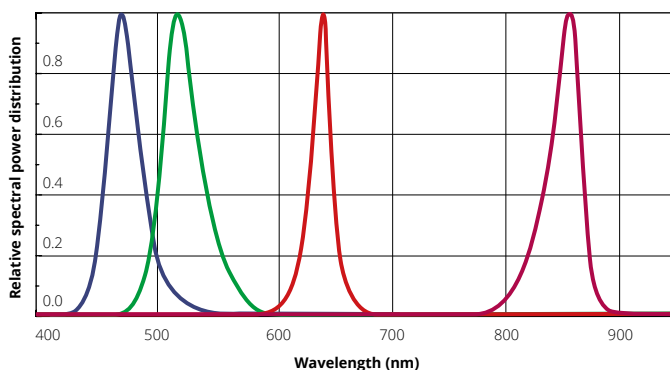
- 1 At max driving current, on emitting surface.
- 2 Available on request.

Part number	Module	LED type
LTBP 048 036-z-a	1 x 1	A
LTBP 096 036-z-a	2 x 1	A
LTBP 144 036-z-a	3 x 1	A
LTBP 192 036-z-a	4 x 1	A
LTBP 240 036-z-a	5 x 1	A
LTBP 288 036-z-a	6 x 1	A
LTBP 048 072-z-a	1 x 2	A
LTBP 096 072-z-a	2 x 2	A
LTBP 144 072-z-a	3 x 2	A
LTBP 192 072-z-a	4 x 2	A
LTBP 240 072-z-a	5 x 2	B
LTBP 288 072-z-a	6 x 2	B
LTBP 048 108-z-a	1 x 3	A
LTBP 096 108-z-a	2 x 3	A
LTBP 144 108-z-a	3 x 3	A
LTBP 192 108-z-a	4 x 3	B
LTBP 240 108-z-a	5 x 3	B
LTBP 288 108-z-a	6 x 3	B
LTBP 048 144-z-a	1 x 4	A
LTBP 096 144-z-a	2 x 4	A
LTBP 144 144-z-a	3 x 4	B
LTBP 192 144-z-a	4 x 4	B
LTBP 240 144-z-a	5 x 4	B
LTBP 288 144-z-a	6 x 4	B
LTBP 048 180-z-a	1 x 5	A
LTBP 096 180-z-a	2 x 5	B
LTBP 144 180-z-a	3 x 5	B
LTBP 192 180-z-a	4 x 5	B
LTBP 240 180-z-a	5 x 5	B
LTBP 288 180-z-a	6 x 5	B
LTBP 048 216-z-a	1 x 6	A
LTBP 096 216-z-a	2 x 6	B
LTBP 144 216-z-a	3 x 6	B
LTBP 192 216-z-a	4 x 6	B
LTBP 240 216-z-a	5 x 6	B
LTBP 288 216-z-a	6 x 6	B

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

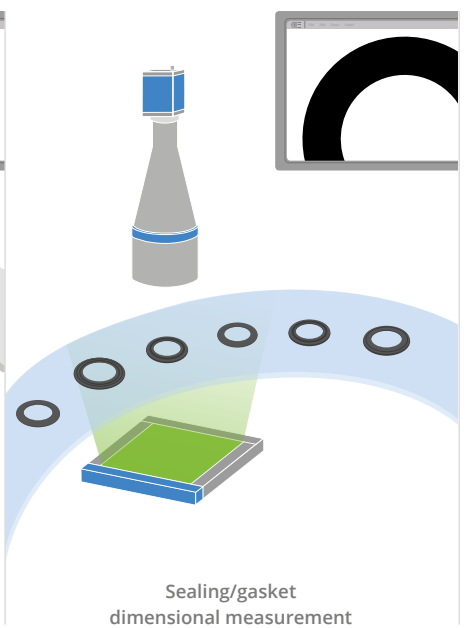
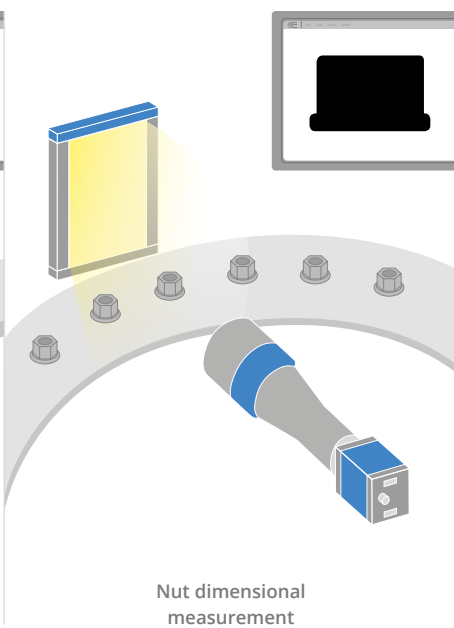
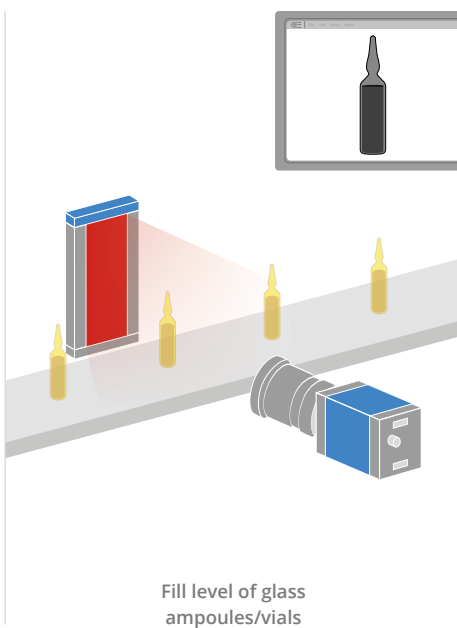


Typical emission spectrum of type B LEDs (R, G, B, IR)





Application examples



LTBC series

Continuous LED backlights

DIFFUSED



KEY ADVANTAGES

Cost-effective homogeneous illumination

Densely packed LED arrays with matte diffuser eliminating hot spots and glare.

Robust industrial Design

M8 connector for easy connection to power supplies.

Easy integration

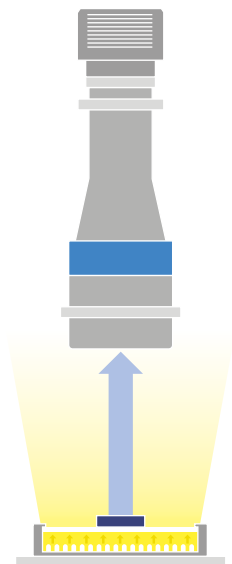
M6 nut channels for easy mounting.



The **LTBC series** offers 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 compromising on quality: they feature a robust design and provide diffuse, even illumination without hotspots.

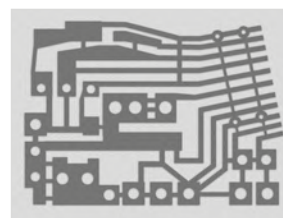
LTBC series backlights effectively emphasize the silhouette of a workpiece, providing excellent optical contrast in combination with many different lenses.

Lighting structure

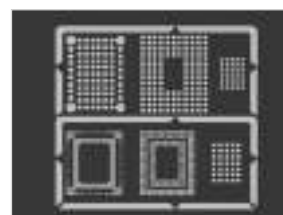


COMPATIBLE STROBE CONTROLLER	
	LTDV1CH-17V strobe controller p. 252
COMPATIBLE LIGHT INTENSITY CONTROLLER	
	LTICGR1000-D1-PS-xx light intensity controller p. 256

Application examples



Shape inspection.



Detection of patterns/holes.



LTBC114114-G



LTBC054054 with M6 threaded hole for easy mounting.

Part number	Optical specifications				Electrical specifications						Dimensions			Compatibility
	Color, peak wavelength	Illuminance (lux) 3	Lighting area		Continuous mode			Pulsed mode		Length (mm)	Width (mm)	Height (mm)	Optics	
			Length (mm)	Width (mm)	Supply Voltage (V)	Current (mA)	Power cons. (W)	Supply Voltage (V) 1	Max pulse Current (mA) 2					
LTBC 054 054-W	white, 6300 K	11100	54.5	54.5	24	54	1.3	36	162	99	99	35.6	TC2300y, TC23012, TCxx016, TCxx024, TCxx036, TCLWD series, TCxMHR016-x, TCxMHR024-x, TCxMHR036-x, TC4M00y-x, TC12M016-F, TC12M024-F, TC12M036-F, TC16M009-x, TC16M012-x, TC16M018-x, TC16M036-x, TCZR036S, TCEL series (except TCEL23036) 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, 525 nm	8500	54.5	54.5	24	54	1.3	36	162	99	99	35.6	TCxx048 - TCxx085, TCCRxx048, TCCRxx056, TCCRxx064, TCCRxx080, TCxMHR048-x, TCxMHR056-x, TCxMHR064-x, TCxMHR080-x, TCCR2Mxx048-x, TCCR2Mxx056-x, TCCR2Mxx064-x, TCCR2Mxx080-x, TCCR4Mxx048-x, TCCR4Mxx056-x, TCCR4Mxx064-x, TCCR4Mxx080-x, TC12M048-F, TC12M056-F, TC12M064-F, TC12M080-F, TC16M048-x, TC16M056-x, TC16M064-x, TC16M080-x, TCZR072S, MC4K025X-x, MC12K067X-x, MC12K050X-x	
LTBC 114 114-W	white, 6300 K	18700	114.5	114.5	24	216	5.2	36	648	159	159	35.6	TCxx096 - TCxx130, TCCRxx096, TCCRxx120, TCxMHR096-x, TCxMHR120-x, TCCR2M096-x, TCCR2M120-x, TCCR4M096-x, TCCR4M120-x, TC12M096-F, TC12M0120-F, TC16M096-x, TC16M0120-x, TCDPx096, TCDPx120, MCZR033-008, MC12K025X-x	
LTBC 114 114-G	green, 525 nm	15500	114.5	114.5	24	216	5.2	36	648	159	159	35.6	TCxx144, TC23172, TCCPxx144, TCCPxx192, TCxMHR144-x, TC12M144-F, TCCP3MHR144, TCCP3MHR192, TCCP5MHR144, TCCP5MHR192, TC12M192-F, TC16M144-x, TC16M192-x, TCDPx144, MCZR025-006, MCZR018-004	
LTBC 174 174-W	white, 6300 K	18500	174.5	174.5	24	486	11.7	36	1458	219	219	35.6	TCxx144, TC23172, TCCPxx144, TCCPxx192, TCxMHR144-x, TC12M144-F, TCCP3MHR144, TCCP3MHR192, TCCP5MHR144, TCCP5MHR192, TC12M192-F, TC16M144-x, TC16M192-x, TCDPx144, MCZR025-006, MCZR018-004	
LTBC 174 174-G	green, 525 nm	16800	174.5	174.5	24	486	11.7	36	1458	219	219	35.6	TCxx144, TC23172, TCCPxx144, TCCPxx192, TCxMHR144-x, TC12M144-F, TCCP3MHR144, TCCP3MHR192, TCCP5MHR144, TCCP5MHR192, TC12M192-F, TC16M144-x, TC16M192-x, TCDPx144, MCZR025-006, MCZR018-004	
LTBC 234 234-W	white, 6300 K	19200	234.5	234.5	24	864	20.8	36	2592	279	279	35.6	TCxx144, TC23172, TCCPxx144, TCCPxx192, TCxMHR144-x, TC12M144-F, TCCP3MHR144, TCCP3MHR192, TCCP5MHR144, TCCP5MHR192, TC12M192-F, TC16M144-x, TC16M192-x, TCDPx144, MCZR025-006, MCZR018-004	
LTBC 234 234-G	green, 525 nm	15200	234.5	234.5	24	864	20.8	36	2592	279	279	35.6	TCxx144, TC23172, TCCPxx144, TCCPxx192, TCxMHR144-x, TC12M144-F, TCCP3MHR144, TCCP3MHR192, TCCP5MHR144, TCCP5MHR192, TC12M192-F, TC16M144-x, TC16M192-x, TCDPx144, MCZR025-006, MCZR018-004	

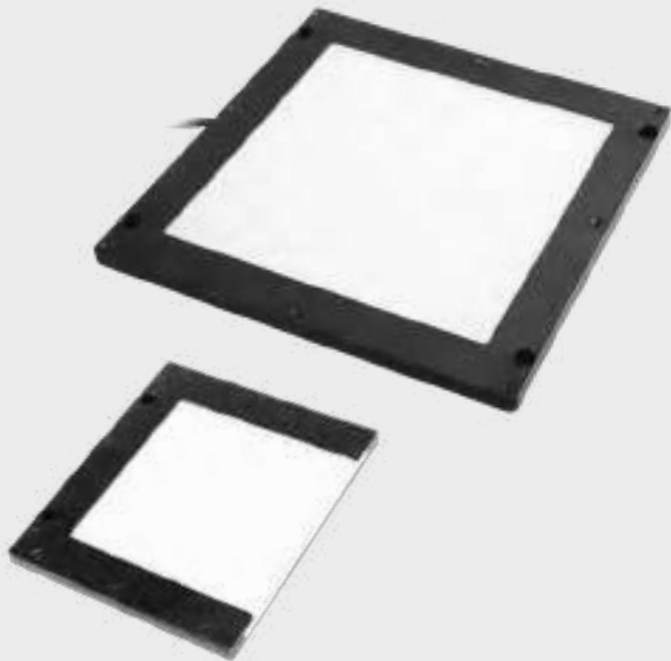
1 With constant driving voltage (36V recommended, 48V max). Duty cycle = 0-10%. Max pulse width = 10 ms.

2 With constant driving current. Duty cycle = 0-10%. Max pulse width = 10 ms.
3 ± 15% at 20 mm working distance.

LTBFC series

Continuous flat side-emitting LED backlights

DIFFUSED



KEY ADVANTAGES

24V DC supply voltage.

Easy integration & compact size.

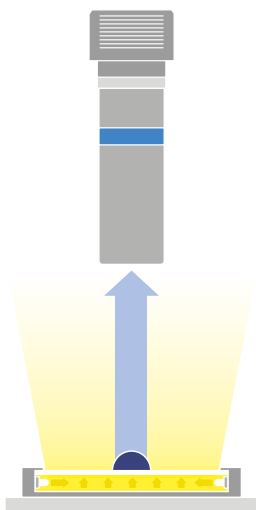
JST connector (optional M8, M12).

Red, Green, Blue and White.

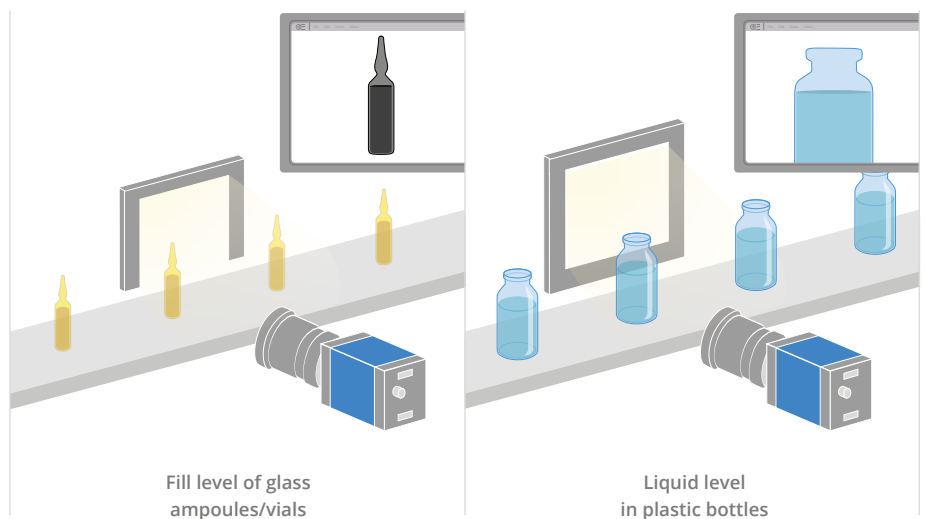
Custom sizes available on request.

The **LTBFC series** consists of flat side-emitting LED backlights: two types are available either with four borders or with three borders and one side flush. Suggested use is continuous mode.

Lighting structure





Application examples



Fill level of glass ampoules/vials

Liquid level in plastic bottles



COMPATIBLE STROBE CONTROLLER		
	LTDV1CH-17V strobe controller	p. 252
COMPATIBLE LIGHT INTENSITY CONTROLLER		
	LTICGR1000-D1-PS-xx light intensity controller	p. 256

Part number	Optical specifications				Electrical specifications					Dimensions		
	Light color, wavelength peak	Lighting area		Sides type	Continuous mode			Pulsed mode		Length (mm)	Width (mm)	Height (mm)
		Width (mm)	Length (mm)		Supply voltage (V)	Current (mA)	Power cons. (W)	Supply voltage (V)	Max pulse current (mA)			
LTPVR070-00-1-W-24V	white, 6300 K	70	70	4 borders	24	120	2.9	36	360	98.5	98.5	5.30
LTPVR070-00-1-R-24V	red, 630 nm	70	70	4 borders	24	120	2.9	36	360	98.5	98.5	5.30
LTPVR070-00-1-G-24V	green, 525 nm	70	70	4 borders	24	120	2.9	36	360	98.5	98.5	5.30
LTPVR070-00-1-B-24V	blue, 470 nm	70	70	4 borders	24	120	2.9	36	360	98.5	98.5	5.30
LTPVR100-00-1-W-24V	white, 6300 K	100	100	4 borders	24	160	3.9	36	480	128.5	128.5	5.30
LTPVR100-00-1-R-24V	red, 630 nm	100	100	4 borders	24	180	4.4	36	540	128.5	128.5	5.30
LTPVR100-00-1-G-24V	green, 525 nm	100	100	4 borders	24	160	3.9	36	480	128.5	128.5	5.30
LTPVR100-00-1-B-24V	blue, 470 nm	100	100	4 borders	24	160	3.9	36	480	128.5	128.5	5.30
LTPVRG25X36-00-1-W-24V	white, 6300 K	25	36	3 borders and 1 edge to edge	24	20	0.5	36	60	38.5	43.5	5.30
LTPVRG25X36-00-1-R-24V	red, 630 nm	25	36	3 borders and 1 edge to edge	24	15	0.4	36	45	38.5	43.5	5.30
LTPVRG25X36-00-1-G-24V	green, 525 nm	25	36	3 borders and 1 edge to edge	24	20	0.5	36	60	38.5	43.5	5.30
LTPVRG25X36-00-1-B-24V	blue, 470 nm	25	36	3 borders and 1 edge to edge	24	20	0.5	36	60	38.5	43.5	5.30
LTPVRG31X58-00-1-W-24V	white, 6300 K	31	58	3 borders and 1 edge to edge	24	30	0.8	36	90	60	43.5	5.30
LTPVRG31X58-00-1-R-24V	red, 630 nm	31	58	3 borders and 1 edge to edge	24	30	0.8	36	90	60	43.5	5.30
LTPVRG31X58-00-1-G-24V	green, 525 nm	31	58	3 borders and 1 edge to edge	24	30	0.8	36	90	60	43.5	5.30
LTPVRG31X58-00-1-B-24V	blue, 470 nm	31	58	3 borders and 1 edge to edge	24	30	0.8	36	90	60	43.5	5.30
LTPVRG070-00-1-W-24V	white, 6300 K	70	70	3 borders and 1 edge to edge	24	90	2.2	36	270	98.5	84.5	4.30
LTPVRG070-00-1-R-24V	red, 630 nm	70	70	3 borders and 1 edge to edge	24	90	2.2	36	270	98.5	84.5	4.30
LTPVRG070-00-1-G-24V	green, 525 nm	70	70	3 borders and 1 edge to edge	24	90	2.2	36	270	98.5	84.5	4.30
LTPVRG070-00-1-B-24V	blue, 470 nm	70	70	3 borders and 1 edge to edge	24	90	2.2	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.

Ordering information

Our part numbers are coded as LTPVR(G)xxxx-yy-z-a-bbV where:

- xxxx defines the lighting area length and width. If the lighting length and width are equal, only one size is indicated.
- yy defines the light angle (for this series the angle is 00 = 0°)
- z defines the number of LED rows
- a defines the color: R = red, G = green, B = blue, W = white. Contact us for additional wavelengths.
- bb defines the supply voltage. Optional 12V version is available.

Lighting extension cables (CB series) are not included and must be ordered separately.

Optional connectors: LTBF series is available with JST connector per standard. For M8 or M12 connectors (available as optional) add -M8 or -M12 at the end of the part number.

Examples: LTPVR100-00-1-W-24V-M8, LTPVR100-00-1-W-24V-M12

LTCLHP series

High-performance telecentric illuminators

COLLIMATED



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.

No border effects

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

Improved field depth and telecentricity




Collimated illumination geometry increases the telecentric lens' natural field depth and telecentricity far beyond its nominal specs.

Homogeneity test report with measured values.

The **LTCLHP series** offers high-performance telecentric illuminators specifically designed to back-illuminate objects imaged by telecentric lenses. This high performance series provides:

- 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 at the back.
- **Easy LED source replacement** and alignment for all the LED colors offered by Opto Engineering®.

SEE ALSO

	TCBENCH series	p. 62
FULL RANGE OF COMPATIBLE ACCESSORIES		
	CMHO series	p. 248
	LTDV1CH-17V strobe controller	p. 252

DID YOU KNOW?

The LTCLHP series is now also available with new LTSCHP1W-GZ **green** light source, suitable for any kind of sample and specifically tailored for measuring reflective objects and objects with sharp edges.

KEY FEATURES

- **Reduction of edge diffraction effects**
- Enhanced **illumination uniformity**, especially on large FOVs
- Less sensitive to **alignment**



Ordering information

To order the version with the new green LED module use p/n **LTCLHPxxx-GZ** (i.e. LTCLHP064-GZ).

Part number (*)	Beam diameter (mm)	Available colors				Optical specs	Mechanical specs		Compatibility
		R	G	B	W	Working distance range (mm)	Length (mm)	Outer diameter (mm)	
		1				2			
LTCLHP 023-x	16	x	x	x	x	45 – 90	96.8	28	TC2300y, TC23012, TC4M00y-x, LTSCHP1W-x
LTCLHP 016-x	20	x	x	x	x	35 – 70	99.9	38	TCxx016, TC12M016-F, TCxMHR016-x, TCLWD series, TCEL series (except TCEL23036)
LTCLHP 024-x	30	x	x	x	x	45 – 90	124.7	44	TCxx024, TCxMHR024-x, TC12M024-F, TC16M009-x, TC16M012-x, TC16M018-x
LTCLHP 036-x	45	x	x	x	x	70 – 140	152.1	61	TCxx036, TC12M036-F, TCxMHR036-x, TC16M036-x, TCEL23036
LTCLHP 048-x	60	x	x	x	x	90 – 180	187.2	75	TCxx048, TC12M048-F, TCCRxx048, TCxMHR048-x, TC16M048-x
LTCLHP 056-x	70	x	x	x	x	100 – 200	210.5	80	TCxx056, TC12M056-F, TCCRxx056, TCxMHR056-x, TC16M056-x
LTCLHP 064-x	80	x	x	x	x	120 – 240	231.6	100	TCxx064, TCCRxx064, TCxMHR064-x, TC16M064-x, TC12M064-F, TC12K064
LTCLHP 080-x	100	x	x	x	x	150 – 300	277.2	116	TCxx080, TCCRxx080, TCxMHR080-x, TC16M080-x, TC12M080-F, TC12K080
LTCLHP 096-x	120	x	x	x	x	200 – 350	322.2	143	TC23085, TCxx096, TCCRxx096, TCxMHR096-x, TC12M096-F, TC16M096-x
LTCLHP 120-x	150	x	x		x	220 – 440	408.2	180	TC23110, TCxx120, TCxMHR120-x, TC16M120-x, TC12M120-F, TC12K121
LTCLHP 144-x	180	x	x			270 – 540	467.2	200	TC23130, TCxx144, TCCP12144, TCCPxMHR144, TCxMHR144-x, TC16M144-x, TC12M120-F, TC12K144
LTCLHP 192-x	250	x	x		x	350 – 700	608.2	260	TC23172, TCxx192, TCCP12192, TCCPxMHR192, TCxMHR192-x, TC12K192
LTCLHP 240-x	300	x	x			350 – 700	769.2	322	TC23200, TC23240, TCxMHR240-x, TC12M240-F

(*) The last digit of the part number “-x” defines the source color.

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

2 Nominal value, with no spacers in place.

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

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

Precise light intensity tuning

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



Direct LED control

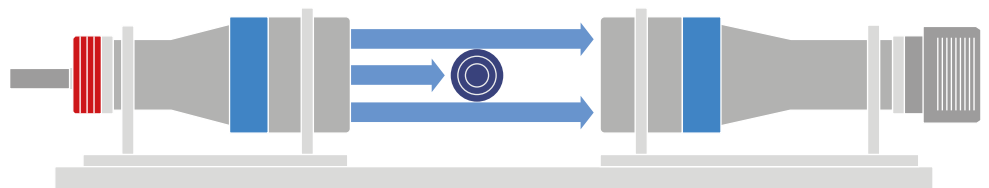
The built-in electronics can be bypassed in order to drive the LED directly for use in continuous or pulsed mode.

When bypassed, the built-in electronics behave as an open circuit allowing for 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.



Wide selection of different colors

Part number	Light color, wavelength peak	Device power ratings				LED power ratings		
		DC voltage		Power consumption (W)	Max LED fwd current (mA)	Forward voltage		Max pulse current (mA)
		min (V)	max (V)			typical (V)	max (V)	
		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

Compact telecentric illuminators

COLLIMATED

KEY ADVANTAGES

Deliver excellent performance

LTCLHP CORE telecentric illuminators deliver exactly the same excellent optical performance 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.

Easy retrofitting into existing systems

LTCLHP CORE illuminators can be mounted in different directions in your machine.

Improve your system performance

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

Cut costs and sell more

A smaller system means less expenses and less space and is preferred by the industry.

Homogeneity test report with measured values.



The **LTCLHP CORE Series** offers ultra compact telecentric illuminators. They are up to 60% more compact than other collimated illuminators on the market.

The ultra compact size allows you 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 the CORE family such as the TC CORE, TC2MHR CORE and TC4MHR CORE series.

DID YOU KNOW?

The LTCLHP CORE series is now also available with new LTSCHP1W-GZ **green** light source, suitable for any kind of sample and specifically tailored for measuring reflective objects and objects with sharp edges.

KEY FEATURES

- **Reduction of edge diffraction effects**
- **Enhanced illumination uniformity**, especially on large FOVs
- **Less sensitive to alignment**



Ordering information

To order the version with the new green LED module use p/n **LTCLCRxxx-GZ** (i.e. LTCLCR064-GZ).







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

Precise light intensity tuning

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



SEE ALSO		
	TC series	p. 20
FULL RANGE OF COMPATIBLE ACCESSORIES		
	Mounting mechanics CMHOCR	p. 248
	CMPTCR series	p. 250
	LTDV1CH-17V strobe controller	p. 252

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, the built-in electronics behaves as an open circuit allowing for direct control of the LED source.



Part number	Light	Device power ratings			LED power ratings			
		DC voltage		Power consumption (W)	Max LED fwd current (mA)	Forward voltage		Max pulse current (mA)
		min (V)	max (V)			typical (V)	max (V)	
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

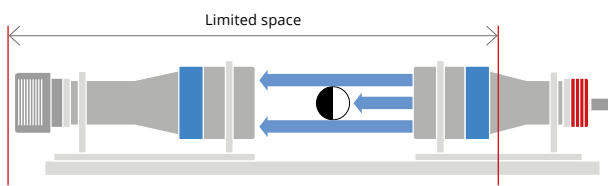
- 1 Tolerance ± 10%.
- 2 Used in continuous (not pulsed) mode.
- 3 At max forward current. Tolerance is ±0.06V on forward voltage measurements.

- 4 At pulse width ≤ 10 ms, duty cycle ≤ 10% condition. Built-in electronics board must be bypassed (see tech info online).

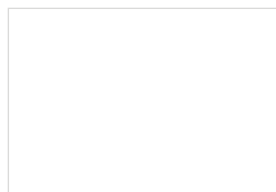
LTCLHP CORE series

Compact telecentric illuminators

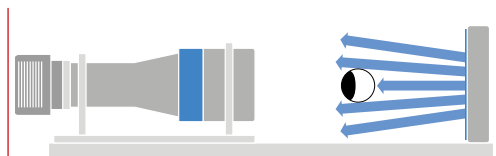
LTCLHP CORE - True collimated illumination in a reduced space



Telecentric lens and collimated illuminator.



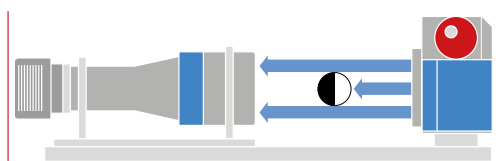
A standard collimated illuminator is impossible to use due to lack of space.



"Classic" telecentric lens and flat backlight.



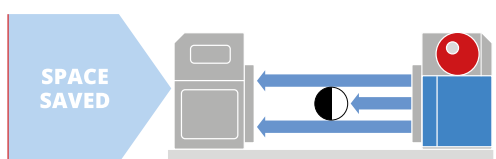
Classic solution with diffuse backlight: less precise measurements due to surface reflections and uncertain edge position.



"Classic" telecentric lens and LTCLHP CORE collimated illuminator.



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



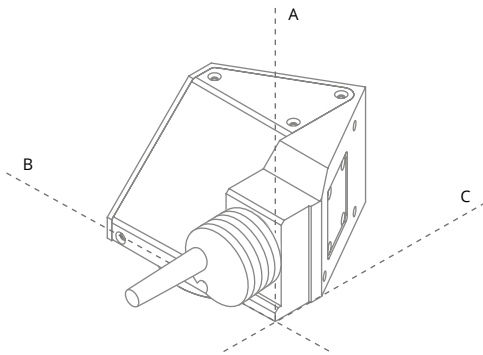
TC CORE telecentric lens and LTCLHP CORE collimated illuminator.



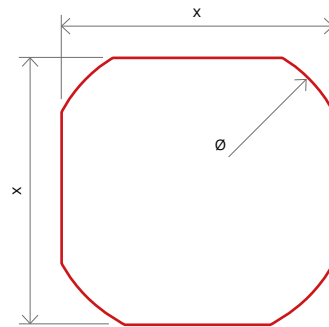
The smartest solution with TC CORE telecentric lens and LTCLHP CORE telecentric illuminator: excellent measurement results in a super compact space.



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



Minimum beam shape dimensions:



Part number	Optical specifications			Dimensions			Compatibility
	Light color, wavelength peak	Minimum beam shape dimensions (mm)	Working distance range (mm)	(mm)			
	1			A	B	C 2	
LTCLCR 048-R	red, 630 nm	Ø = 56; x = 50	90 - 180	77	106	162	TCCRxx048, CMHOCR048, CMPTCR048, TCCRxM048-x, TCxx048, TCxMHR048-x, TC12M048-F, 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, TCCRxM056-x, TCxx056, TCxMHR056-x, TC12M056-F, 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, TCCRxM064-x, TCxx064, TCxMHR0564-x, TC12M064-F, 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, TCCRxM080-x, TCxx080, TCxMHR080x, TC12M080-F, TC16M080, TC16M080-Q, TC12K080, TCZR0725
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-R	red, 630 nm	Ø = 120; x = 99	200 - 350	139	172	223	TCCRxx096, CMHOCR096, CMPTCR096, TCCRxM096-x, TCxx096, TCxMHR096x, TC12M096-F, TC16M096, TC16M096-Q, TC12K096
LTCLCR 096-G	green, 520 nm	Ø = 120; x = 99	200 - 350	139	172	223	
LTCLCR 096-W	white	Ø = 120; x = 99	200 - 350	139	172	223	
LTCLCR 120-R	red, 630 nm	Ø = 156; x = 130	220 - 440	182	220	231	TCCRxx0120, TCCRxM0120-x, TCxx0120, TCxMHR0120x, TC12M120-F, TC16M0120, TC16M0120-Q, TC12K0120
LTCLCR 120-G	green, 520 nm	Ø = 156; x = 130	220 - 440	182	220	231	
LTCLCR 120-W	white	Ø = 156; x = 130	220 - 440	182	220	231	

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

2 Nominal value, with no spacers in place.

LTCLHP CORE PLUS series

Compact telecentric illuminators for large FOV systems

COLLIMATED

NEW
MODELS



KEY ADVANTAGES

Large illumination area in a super compact form factor

LTCLHP CORE PLUS are up to 40% shorter than other telecentric lights on the market.

Reduce the size of your vision system

The working distance of LTCLHP CORE PLUS telecentric illuminators has been optimised to reduce the system's overall footprint.

Boost your measurement system's performance

LTCLHP CORE PLUS illuminators may be used in place of flat backlights to improve your system's performance.

Smart integration

LTCLHP CORE PLUS illuminators integrate a mounting flange for easy integration without additional clamps.

System compactness is a competitive advantage

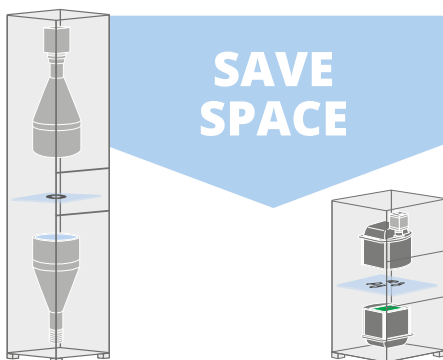
A smaller vision system or measurement machine is preferred by the industry.

LTCLHP CORE PLUS telecentric illuminators are designed to illuminate large areas in a reduced space. They are up to 40% shorter than other telecentric lights on the market.

The length and working distance of a telecentric lens strongly impact the size of a vision system. Their working distance range has been optimised to make a measurement system as compact as possible, allowing to reduce the system's overall dimensions by up to half. The super compact form factor allows you to easily integrate CORE PLUS collimated illumination where classic telecentric lights do not fit instead of common diffuse backlights, thus improving your system's performance.

LTCLHP CORE PLUS lights have been designed for smart integration. They feature a built-in mounting flange so no additional clamps are required.

System compactness is a competitive advantage



Comparison of precision measurement systems with "classic" telecentric lens and light vs. CORE PLUS telecentric lens and light.

SEE ALSO

	TC CORE PLUS series telecentric lenses	p. 28
FULL RANGE OF COMPATIBLE BACKLIGHTS		
	Flat backlights LT2BC, LTBC, LTBP series	p. 118-125
COMPATIBLE ACCESSORIES		
	LTDV1CH-17V strobe controller	p. 252

ADVANTAGES

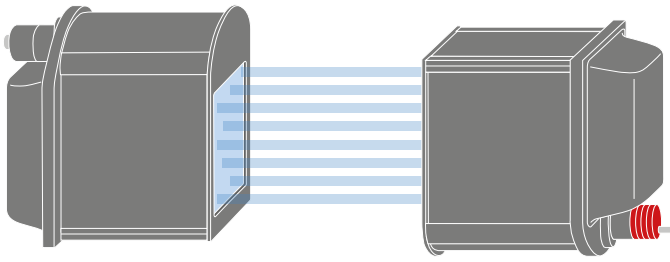


Save more

- Lower manufacturing cost due to less material employed
- Cost of mounting is reduced as no additional clamps are needed
- Less space required for storage and use
- Lower shipment expenses due to smaller size
- Lower transportation risks

Sell more

- Compactness offers a competitive advantage

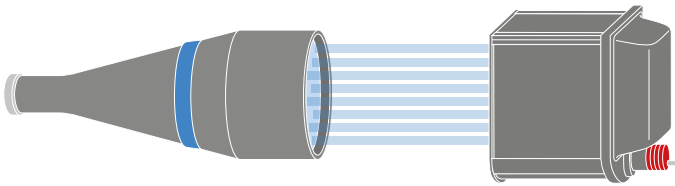


TC CORE PLUS telecentric lens.

LTCLHP CORE PLUS telecentric illuminator.

Setup instructions 1:

To build a telecentric measurement setup it is necessary to position a LTCLHP CORE telecentric illuminator upside down with respect to the TC CORE PLUS telecentric lens.

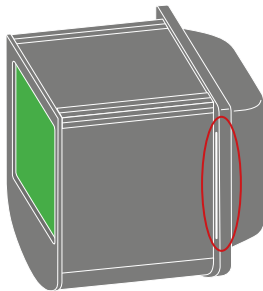


TC telecentric lens.

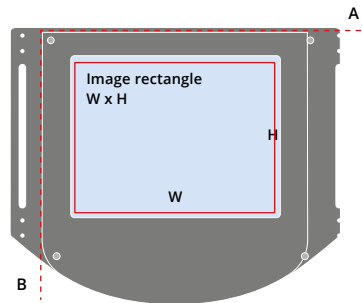
LTCLHP CORE PLUS telecentric illuminator.

Setup instructions 2:

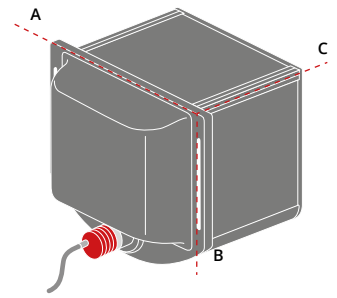
LTCLHP CORE PLUS telecentric illuminator is also a perfect solution when coupled with classic telecentric lenses (e.g. TC series).



Built-in mounting flange: no additional clamps required.



The width of the beam rectangle is aligned along the A axis. The height of the beam rectangle is aligned along the B axis.



A, B and C indicate the mechanical dimensions of the illuminator.

Part number	Optical specifications			Electrical specifications							Mechanical specifications		
	Light color, wavelength peak	Minimum beam shape dimensions (mm x mm)	Working distance range (mm)	Device power rating			Max LED fwd current (mA)	LED power ratings		Dimensions			
				DC voltage		Power cons. (W)		Forward voltage (V)	Max pulse current (mA)				
	min (V)	max (V)	typical (V)	max (V)	A		B (mm)			C			
1	2	3	4	5	6	7	8	9	10				
LTCLCP 144-G	green, 520 nm	165 x 120	170 - 350	12	24	< 2.5	350	3.3	4	2000	332.0	302.5	310.5
LTCLCP 192-G	green, 520 nm	220 x 160	230 - 450	12	24	< 2.5	350	3.3	4	2000	410.4	344.1	359.3
LTCLCP 260-G	green, 520 nm	265 x 200	270 - 500	12	24	< 2.5	350	3.3	4	2000	425.3	396.7	421.0

- 1 Opto Engineering® recommends green light for high precision measurement applications.
- 2 Beam shape is not circular.
- 3 Working distance: distance between the front end of the mechanics and the object. Set this distance within +/- 5% of the nominal value for maximum resolution and minimum distortion.
- 4 Tolerance ± 10%.
- 5 Used in continuous (not pulsed) mode.

- 6 At max forward current.
- 7 Tolerance is ±0.06V on forward voltage measurements.
- 8 At pulse width ≤ 10 ms, duty cycle ≤ 10% condition. Built-in electronics board must be bypassed (see tech info).
- 9 Maximum dimension of the clamping flange.
- 10 Nominal value, with no spacers in place.

LTCL4K series

Flat telecentric illuminators for line scan cameras

COLLIMATED



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.

Homogeneity test report with measured values.

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 line scan measurement applications involving, for instance, steering components, gear and cam shafts, grinding and turning parts.

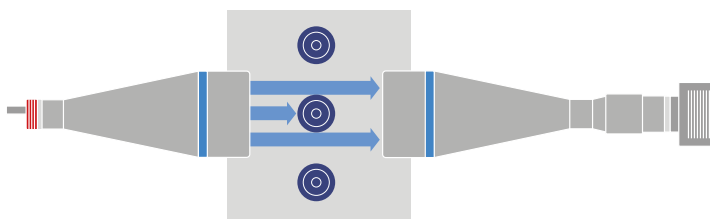
These illuminators are equipped with state-of-the-art LED driving electronics, providing exceptional illumination stability, precise light

intensity tuning and easy replacement of the LED source. The unique "slim" form factor allows these units to be used in tight spaces, often a critical factor in many industrial environments.

Also, CMMR4K right angle mirror attachments can be integrated to quickly assemble different illumination geometries, compatible with most types of inspection configurations.

Application examples

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



DID YOU KNOW?

The LTCL4K series is now also available with the new LTSCHP1W-GZ **green** light source, suitable for any kind of sample and specifically tailored for measuring reflective objects and objects with sharp edges.

KEY FEATURES




- Reduction of edge diffraction effects
- Enhanced illumination uniformity, especially on large FOVs
- Less sensitive to alignment



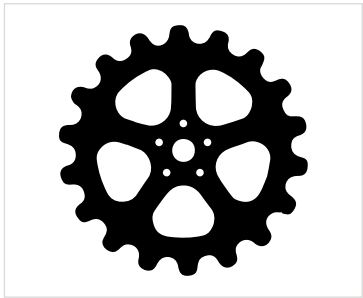
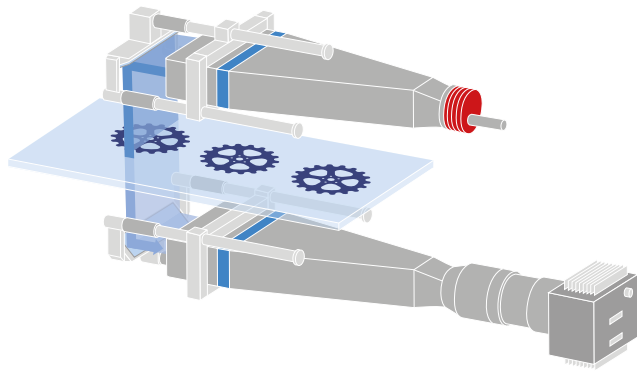
Ordering information

To order the version with the new green LED module use p/n **LTCL4Kxxx-GZ** (i.e. LTCL4K060-GZ).



SEE ALSO		
	TC4K series	p. 52
FULL RANGE OF COMPATIBLE ACCESSORIES		
	CMMR4K series	p. 235
	LTDV1CH-17V strobe controller	p. 252

A LTCL4K illuminator coupled with a TC4K lens using 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 on 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, the built-in electronics behaves as an open circuit allowing for direct control of the LED source.



Electrical specifications

Part number	Light	Device power ratings			LED power ratings			
	Light color, wavelength peak	DC voltage		Power consumption	Max LED fwd current	Forward voltage		Max pulse current
		min (V)	max (V)			typical (V)	max (V)	
		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).

Part number	Optical specifications				Mechanical specifications			Compatibility
	Light color, wavelength peak	Beam width (mm)	Beam height (mm)	Working distance range (mm)	Length (mm)	Width (mm)	Height (mm)	Compatible TC4K
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

LTRNST series

LED ring illuminators - straight type

α 0°

DIFFUSED



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 compromising quality.

FULL RANGE OF COMPATIBLE TELECENTRIC LENSES



Telecentric lenses

p. 18-71

COMPATIBLE STROBE CONTROLLER



LTDV1CH-17V strobe controller

p. 252

COMPATIBLE LIGHT INTENSITY CONTROLLER



LTICGR1000-D1-PS-xx light intensity controller

p. 256

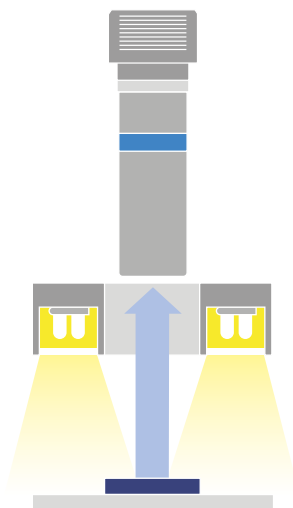
The **LTRNST series** offers LED ring illuminators specifically designed for a wide range of Opto Engineering® products. The straight type models especially fit Opto Engineering® telecentric lenses perfectly.

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 TC23064

Lighting structure



LTRNST - Ring lights / straight illumination

Product overview



LTRN 016 NW



LTRN 120 NW

Part number	Optical specifications				Electrical specifications					Dimensions			Compatibility
	Light color, peak wavelength	Optimal WD (mm)	Lighting area diam.		Continuous mode ¹			Pulsed mode		Outer diam. (mm)	Inner diam. (mm)	Height (mm)	Compatible OE products
			inner (mm)	outer (mm)	Supply voltage (V)	Current (mA)	Power cons. (W)	Supply voltage (V) ²	Max pulse current (mA) ³				
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
LTRN 023 GR	green, 525 nm	55-85	32	90	24	220	5.3	24 - 48	660	104	28	40	TC2300y, TC23012, TC4M00y-x
LTRN 023 BL	blue, 470 nm	55-85	32	90	24	220	5.3	24 - 48	660	104	28	40	TC2300y, TC23012, TC4M00y-x
LTRN 023 NW	white, 6300 K	55-85	32	90	24	480	11.6	24 - 48	1440	104	28	40	TC2300y, TC23012, TC4M00y-x
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, TCxSM016, TCLWD series, TCEL series (except TCEL23036)
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, TCxSM016, TCLWD series, TCEL series (except TCEL23036)
LTRN 016 BL	blue, 470 nm	85-150	48	107	24	315	7.6	24 - 48	945	120.6	37.7	40	TCxx016, TCxMHR016-x, TCxSM016, TCLWD series, TCEL series (except TCEL23036)
LTRN 016 NW	white, 6300 K	85-150	48	107	24	650	15.6	24 - 48	1950	120.6	37.7	40	TCxx016, TCxMHR016-x, TCxSM016, TCLWD series, TCEL series (except TCEL23036)
LTRN 024 RD	red, 630 nm	85-150	48	107	24	300	7.2	24 - 48	900	120.6	44	40	TCxx024, TCxMHR024-x, TCxSM024
LTRN 024 GR	green, 525 nm	85-150	48	107	24	275	6.6	24 - 48	825	120.6	44	40	TCxx024, TCxMHR024-x, TCxSM024
LTRN 024 BL	blue, 470 nm	85-150	48	107	24	315	7.6	24 - 48	945	120.6	44	40	TCxx024, TCxMHR024-x, TCxSM024
LTRN 024 NW	white, 6300 K	85-150	48	107	24	650	15.6	24 - 48	1950	120.6	44	40	TCxx024, TCxMHR024-x, TCxSM024
LTRN 032 RD	red, 630 nm	65-240	84	143	24	400	9.6	24 - 48	1200	157	56	40	TCZR0365
LTRN 032 GR	green, 525 nm	65-240	84	143	24	385	9.3	24 - 48	1155	157	56	40	TCZR0365
LTRN 032 BL	blue, 470 nm	65-240	84	143	24	434	10.5	24 - 48	1302	157	56	40	TCZR0365
LTRN 032 NW	white, 6300 K	65-240	84	143	24	840	20.2	24 - 48	2000	157	56	40	TCZR0365
LTRN 036 RD	red, 630 nm	65-240	84	143	24	400	9.6	24 - 48	1200	157	61	40	TCxx036, TCxMHR036-x, TC12M036-F, TC16M036-x, TCxSM036, MCZRxxx-yyy, TCEL23036
LTRN 036 GR	green, 525 nm	65-240	84	143	24	385	9.2	24 - 48	1155	157	61	40	TCxx036, TCxMHR036-x, TC12M036-F, TC16M036-x, TCxSM036, MCZRxxx-yyy, TCEL23036
LTRN 036 BL	blue, 470 nm	65-240	84	143	24	434	10.4	24 - 48	1302	157	61	40	TCxx036, TCxMHR036-x, TC12M036-F, TC16M036-x, TCxSM036, MCZRxxx-yyy, TCEL23036
LTRN 036 NW	white, 6300 K	65-240	84	143	24	840	20.2	24 - 48	2000	157	61	40	TCxx036, TCxMHR036-x, TC12M036-F, TC16M036-x, TCxSM036, MCZRxxx-yyy, TCEL23036
LTRN 048 RD	red, 630 nm	65-240	84	143	24	400	9.6	24 - 48	1200	157	75	40	TCxx048, TCxMHR048-x, TC12M048-F, TC16M048-x, TCxSM048
LTRN 048 GR	green, 525 nm	65-240	84	143	24	385	9.3	24 - 48	1155	157	75	40	TCxx048, TCxMHR048-x, TC12M048-F, TC16M048-x, TCxSM048
LTRN 048 BL	blue, 470 nm	65-240	84	143	24	434	10.5	24 - 48	1302	157	75	40	TCxx048, TCxMHR048-x, TC12M048-F, TC16M048-x, TCxSM048
LTRN 048 NW	white, 6300 K	65-240	84	143	24	840	20.2	24 - 48	2000	157	75	40	TCxx048, TCxMHR048-x, TC12M048-F, TC16M048-x, TCxSM048
LTRN 056 RD	red, 630 nm	65-240	84	143	24	400	9.6	24 - 48	1200	157	80	40	TCxx056, TCxMHR056-x, TC12M056-F, TC16M056-x, TCxSM056
LTRN 056 GR	green, 525 nm	65-240	84	143	24	385	9.3	24 - 48	1155	157	80	40	TCxx056, TCxMHR056-x, TC12M056-F, TC16M056-x, TCxSM056
LTRN 056 BL	blue, 470 nm	65-240	84	143	24	434	10.5	24 - 48	1302	157	80	40	TCxx056, TCxMHR056-x, TC12M056-F, TC16M056-x, TCxSM056
LTRN 056 NW	white, 6300 K	65-240	84	143	24	840	20.2	24 - 48	2000	157	80	40	TCxx056, TCxMHR056-x, TC12M056-F, TC16M056-x, TCxSM056
LTRN 064 RD	red, 630 nm	280-365	120	178	24	500	12	24 - 48	1500	192	100	40	TCxx064, TCxMHR064-x, TC12M064-F, TC16M064-x, TC12K064, TCxSM064, TCZR0725
LTRN 064 GR	green, 525 nm	280-365	120	178	24	522	12.6	24 - 48	1566	192	100	40	TCxx064, TCxMHR064-x, TC12M064-F, TC16M064-x, TC12K064, TCxSM064, TCZR0725
LTRN 064 BL	blue, 470 nm	280-365	120	178	24	567	13.7	24 - 48	1701	192	100	40	TCxx064, TCxMHR064-x, TC12M064-F, TC16M064-x, TC12K064, TCxSM064, TCZR0725
LTRN 064 NW	white, 6300 K	280-365	120	178	24	960	23.1	24 - 48	2000	192	100	40	TCxx064, TCxMHR064-x, TC12M064-F, TC16M064-x, TC12K064, TCxSM064, TCZR0725
LTRN 080 RD	red, 630 nm	280-365	120	178	24	500	12	24 - 48	1500	192	116	40	TCxx080, TC23072, TCxMHR080-x, TC12M080-F, TC16M080-x, TC12K080, TCxSM080
LTRN 080 GR	green, 525 nm	280-365	120	178	24	522	12.6	24 - 48	1566	192	116	40	TCxx080, TC23072, TCxMHR080-x, TC12M080-F, TC16M080-x, TC12K080, TCxSM080
LTRN 080 BL	blue, 470 nm	280-365	120	178	24	567	13.7	24 - 48	1701	192	116	40	TCxx080, TC23072, TCxMHR080-x, TC12M080-F, TC16M080-x, TC12K080, TCxSM080
LTRN 080 NW	white, 6300 K	280-365	120	178	24	1170	28.1	24 - 48	2000	192	116	40	TCxx080, TC23072, TCxMHR080-x, TC12M080-F, TC16M080-x, TC12K080, TCxSM080
LTRN 096 RD	red, 630 nm	350-450	148	207	24	600	14.4	24 - 48	1800	221	143	40	TCxx096, TC23085, TCxMHR096-x, TC12M096-F, TC16M096-x, TCxSM096
LTRN 096 GR	green, 525 nm	350-450	148	207	24	550	13.2	24 - 48	1650	221	143	40	TCxx096, TC23085, TCxMHR096-x, TC12M096-F, TC16M096-x, TCxSM096
LTRN 096 BL	blue, 470 nm	350-450	148	207	24	650	15.6	24 - 48	1950	221	143	40	TCxx096, TC23085, TCxMHR096-x, TC12M096-F, TC16M096-x, TCxSM096
LTRN 096 NW	white, 6300 K	350-450	148	207	24	1200	28.8	24 - 48	2000	221	143	40	TCxx096, TC23085, TCxMHR096-x, TC12M096-F, TC16M096-x, TCxSM096
LTRN 120 RD	red, 630 nm	450-580	204	276	24	875	21	24 - 48	2000	290	180	40	TCxx120, TC23110, TCxMHR120-x, TC12M120-F, TC16M120-x, TC12K120
LTRN 120 GR	green, 525 nm	450-580	204	276	24	1118	26.9	24 - 48	2000	290	180	40	TCxx120, TC23110, TCxMHR120-x, TC12M120-F, TC16M120-x, TC12K120
LTRN 120 BL	blue, 470 nm	450-580	204	276	24	1118	26.9	24 - 48	2000	290	180	40	TCxx120, TC23110, TCxMHR120-x, TC12M120-F, TC16M120-x, TC12K120
LTRN 120 NW	white, 6300 K	450-580	204	276	24	1690	40.6	24 - 48	2000	290	180	40	TCxx120, TC23110, TCxMHR120-x, TC12M120-F, 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, TC12M144-F, TC16M144-x, TC12K144
LTRN 144 GR	green, 525 nm	450-580	204	276	24	1118	26.9	24 - 48	2000	290	200	40	TCxx144, TC23130, TCxMHR144-x, TC12M144-F, TC16M144-x, TC12K144
LTRN 144 BL	blue, 470 nm	450-580	204	276	24	1118	26.9	24 - 48	2000	290	200	40	TCxx144, TC23130, TCxMHR144-x, TC12M144-F, TC16M144-x, TC12K144
LTRN 144 NW	white, 6300 K	450-580	204	276	24	1690	40.6	24 - 48	2000	290	200	40	TCxx144, TC23130, TCxMHR144-x, TC12M144-F, 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.

LTRNDC series

Continuous LED direct ring lights

α 0°, 15°, 30°, 45° **DIRECT**



KEY ADVANTAGES

24V DC supply voltage.

Easy integration & compact size.

JST connector (optional M8, M12).

Red, Green, Blue and White.

Custom sizes available on request.

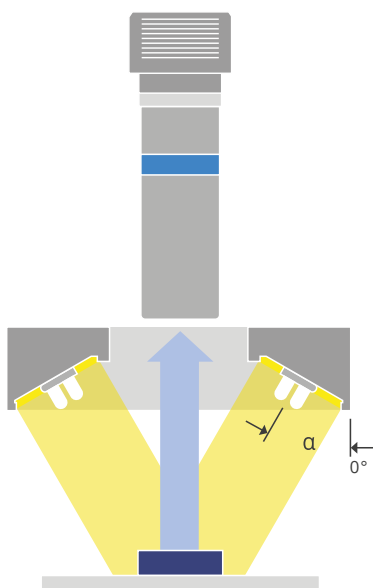
COMPATIBLE STROBE CONTROLLER		
	LTDV1CH-17V strobe controller	p. 252
COMPATIBLE LIGHT INTENSITY CONTROLLER		
	LTICGR1000-D1-PS-xx light intensity controller	p. 256
FULL RANGE OF FIXED FOCAL LENGTH LENSES		
	EN2MP series, EN5MP series, EN-2RT series, EN-5RT series	p. 74-77

LTRNDC series consists of LED direct ring lights that provide direct side illumination from different angles. These ring lights reduce shadows and can effectively illuminate non-reflective objects. Suggested use is continuous mode.

Optional diffusers

Diffusers can be added to LTRNDC series to increase light uniformity.

Lighting structure



Part number	Compatibility
DFLTZGK040-00-2	LTZGK040-00-2-a-24V
DFLTZGK050-00-2	LTZGK050-00-2-a-24V
DFLTZGK070-00-3	LTZGK070-00-3-a-24V
DFLTZGK090-00-4	LTZGK090-00-4-a-24V
DFLTZGK050-15-2	LTZGK050-15-2-a-24V
DFLTZGK070-15-3	LTZGK070-15-3-a-24V
DFLTZGK090-15-4	LTZGK090-15-4-a-24V
DFLTZGK100-15-5	LTZGK100-15-5-a-24V

Optional polarizers

Polarizers can be added to LTRNDC series to reduce unwanted reflections.



Part number	Compatibility
PLLTZGK040-00-2	LTZGK040-00-2-a-24V
PLLTZGK050-00-2	LTZGK050-00-2-a-24V
PLLTZGK070-00-3	LTZGK070-00-3-a-24V
PLLTZGK090-00-4	LTZGK090-00-4-a-24V
PLLTZGK050-15-2	LTZGK050-15-2-a-24V
PLLTZGK070-15-3	LTZGK070-15-3-a-24V
PLLTZGK090-15-4	LTZGK090-15-4-a-24V
PLLTZGK100-15-5	LTZGK100-15-5-a-24V

Part number	Optical specifications			Electrical specifications						Dimensions		
	Light color, peak wavelength	Illumination area diam.		Emission angle α	Continuous mode			Pulsed mode		Outer diam.	Inner diam.	Height
		inner diam. (mm)	outer diam. (mm)		Supply voltage (V)	Current (mA)	Power cons. (W)	Supply voltage (V) ¹	Max pulse current (mA) ²			
LTZGK040-00-2-R-24V	red, 630 nm	16	36	0	24	60	1.44	36	180	43	15	20
LTZGK040-00-2-G-24V	green, 525 nm	16	36	0	24	75	1.8	36	225	43	15	20
LTZGK040-00-2-B-24V	blue, 470 nm	16	36	0	24	75	1.8	36	225	43	15	20
LTZGK040-00-2-W-24V	white, 6300 K	16	36	0	24	75	1.8	36	225	43	15	20
LTZGK050-00-2-R-24V	red, 630 nm	25.2	47.7	0	24	90	2.16	36	270	54	23.5	20
LTZGK050-00-2-G-24V	green, 525 nm	25.2	47.7	0	24	120	2.88	36	360	54	23.5	20
LTZGK050-00-2-B-24V	blue, 470 nm	25.2	47.7	0	24	120	2.88	36	360	54	23.5	20
LTZGK050-00-2-W-24V	white, 6300 K	25.2	47.7	0	24	120	2.88	36	360	54	23.5	20
LTZGK070-00-3-R-24V	red, 630 nm	28.2	62	0	24	180	4.32	36	540	70	26	20
LTZGK070-00-3-G-24V	green, 525 nm	28.2	62	0	24	225	5.4	36	675	70	26	20
LTZGK070-00-3-B-24V	blue, 470 nm	28.2	62	0	24	225	5.4	36	675	70	26	20
LTZGK070-00-3-W-24V	white, 6300 K	28.2	62	0	24	225	5.4	36	675	70	26	20
LTZGK090-00-4-R-24V	red, 630 nm	42.2	84	0	24	270	6.48	36	810	92	40	20
LTZGK090-00-4-G-24V	green, 525 nm	42.2	84	0	24	345	8.28	36	1035	92	40	20
LTZGK090-00-4-B-24V	blue, 470 nm	42.2	84	0	24	345	8.28	36	1035	92	40	20
LTZGK090-00-4-W-24V	white, 6300 K	42.2	84	0	24	345	8.28	36	1035	92	40	20
LTZGK050-15-2-R-24V	red, 630 nm	30	49.6	15	24	90	2.2	36	270	50	28	16
LTZGK050-15-2-G-24V	green, 525 nm	30	49.6	15	24	105	2.6	36	315	50	28	16
LTZGK050-15-2-B-24V	blue, 470 nm	30	49.6	15	24	105	2.6	36	315	50	28	16
LTZGK050-15-2-W-24V	white, 6300 K	30	49.6	15	24	105	2.6	36	315	50	28	16
LTZGK070-15-3-R-24V	red, 630 nm	37	67	15	24	180	4.4	36	540	70	32	20.5
LTZGK070-15-3-G-24V	green, 525 nm	37	67	15	24	240	5.8	36	720	70	32	20.5
LTZGK070-15-3-B-24V	blue, 470 nm	37	67	15	24	240	5.8	36	720	70	32	20.5
LTZGK070-15-3-W-24V	white, 6300 K	37	67	15	24	240	5.8	36	720	70	32	20.5
LTZGK090-15-4-R-24V	red, 630 nm	49.4	85	15	24	330	7.9	36	990	92	47	20.5
LTZGK090-15-4-G-24V	green, 525 nm	49.4	85	15	24	420	10	36	1260	92	47	20.5
LTZGK090-15-4-B-24V	blue, 470 nm	49.4	85	15	24	420	10	36	1260	92	47	20.5
LTZGK090-15-4-W-24V	white, 6300 K	49.4	85	15	24	420	10	36	1260	92	47	20.5
LTZGK100-15-5-R-24V	red, 630 nm	53	99	15	24	450	10.8	36	1350	103	48	24
LTZGK100-15-5-G-24V	green, 525 nm	53	99	15	24	570	13.7	36	1710	103	48	24
LTZGK100-15-5-B-24V	blue, 470 nm	53	99	15	24	570	13.7	36	1710	103	48	24
LTZGK100-15-5-W-24V	white, 6300 K	53	99	15	24	570	13.7	36	1710	103	48	24
LTZGK040-30-2-R-24V	red, 630 nm	22.2	39	30	24	75	1.8	36	225	46	20	16.5
LTZGK040-30-2-G-24V	green, 525 nm	22.2	39	30	24	105	2.52	36	315	46	20	16.5
LTZGK040-30-2-B-24V	blue, 470 nm	22.2	39	30	24	105	2.52	36	315	46	20	16.5
LTZGK040-30-2-W-24V	white, 6300 K	22.2	39	30	24	105	2.52	36	315	46	20	16.5
LTZGK050-30-2-R-24V	red, 630 nm	26.3	46	30	24	90	2.16	36	270	54	23.5	18.3
LTZGK050-30-2-G-24V	green, 525 nm	26.3	46	30	24	120	2.88	36	360	54	23.5	18.3
LTZGK050-30-2-B-24V	blue, 470 nm	26.3	46	30	24	120	2.88	36	360	54	23.5	18.3
LTZGK050-30-2-W-24V	white, 6300 K	26.3	46	30	24	120	2.88	36	360	54	23.5	18.3
LTZGK070-30-3-R-24V	red, 630 nm	34.7	63	30	24	180	4.32	36	540	70	32	20
LTZGK070-30-3-G-24V	green, 525 nm	34.7	63	30	24	225	5.4	36	675	70	32	20
LTZGK070-30-3-B-24V	blue, 470 nm	34.7	63	30	24	225	5.4	36	675	70	32	20
LTZGK070-30-3-W-24V	white, 6300 K	34.7	63	30	24	225	5.4	36	675	70	32	20
LTZGK090-30-4-R-24V	red, 630 nm	51.2	84	30	24	345	8.28	36	1035	92	48	22
LTZGK090-30-4-G-24V	green, 525 nm	51.2	84	30	24	435	10.44	36	1305	92	48	22
LTZGK090-30-4-B-24V	blue, 470 nm	51.2	84	30	24	435	10.44	36	1305	92	48	22
LTZGK090-30-4-W-24V	white, 6300 K	51.2	84	30	24	435	10.44	36	1305	92	48	22
LTZGK070-45-3-R-24V	red, 630 nm	40.5	62.5	45	24	195	4.7	36	585	70	35	21
LTZGK070-45-3-G-24V	green, 525 nm	40.5	62.5	45	24	240	5.8	36	720	70	35	21
LTZGK070-45-3-B-24V	blue, 470 nm	40.5	62.5	45	24	240	5.8	36	720	70	35	21
LTZGK070-45-3-W-24V	white, 6300 K	40.5	62.5	45	24	240	5.8	36	720	70	35	21
LTZGK100-45-5-R-24V	red, 630 nm	58	95	45	24	465	11.2	36	1395	100	48	30
LTZGK100-45-5-G-24V	green, 525 nm	58	95	45	24	600	14.4	36	1800	100	48	30
LTZGK100-45-5-B-24V	blue, 470 nm	58	95	45	24	600	14.4	36	1800	100	48	30
LTZGK100-45-5-W-24V	white, 6300 K	58	95	45	24	600	14.4	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.

Ordering information

Our part numbers are coded as **LTZGKxxx-yy-z-a-bbV** where:

- **xxx** defines the lighting diameter
- **yy** defines the light angle (for this series the angle is 00 = 0°, 15 = 15°, 30 = 30°, 45 = 45°)
- **z** defines the number of LED rows
- **a** defines the color: R = red, G = green, B = blue, W = white. Contact us for additional wavelengths.
- **bb** defines the supply voltage. Optional 12V version is available.

All accessories including lighting extension cables (CB series), diffusers (DFLT series), polarizers (PLLT series) and mounting brackets (CMLT series) must be ordered separately. Optional connectors: LTRNDC series is available with JST connector per standard. For M8 or M12 connectors (available as optional) add -M8 or -M12 at the end of the part number. Examples: LTZGK040-00-2-W-24V-M8, LTZGK040-00-2-W-24V-M12

LTLA series

High power strobe LED low angle diffused ring lights

H α 60°

DIFFUSED



KEY ADVANTAGES

Ultra-high power light output and strobe mode only operation
For the inspection of fast moving objects 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 synchronisation of the illuminator.

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

The **LTLA series** offers high power diffuse LED strobe low-angle ring light illuminators designed to provide darkfield lighting and to effectively enhance minute surface features or textures.

The 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.

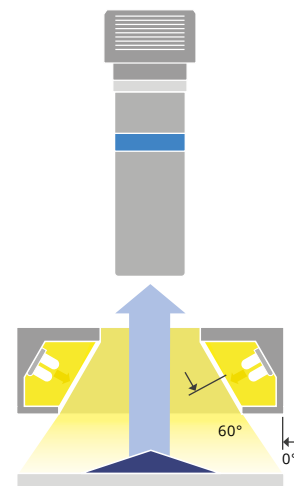
LTLA low angle ring illuminators can be exclusively operated in strobe mode, making them the perfect choice to illuminate very fast moving objects while ensuring extended LED lifetime since no heat is generated.




The LTLA series can be easily powered, controlled and synchronised 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.

The LTLA series features industry standard connection (M12 four poles connector) and can be easily integrated into any machine vision system with M6 screws.

Lighting structure



FULL RANGE OF COMPATIBLE STROBE CONTROLLERS	
	LTDV series p. 252
FULL RANGE OF FIXED FOCAL LENGTH LENSES	
	EN2MP series, EN5MP series, EN-2RT series, EN-5RT series p. 74-77
COMPATIBLE HOLE INSPECTION OPTICS	
	PCHI series p. 100

DESIGNED FOR OEM APPLICATIONS

Compatible LTDV strobe controllers available to easily power, control and synchronise 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 color		white, 6000 K	green, 525 nm	red, 625 nm	white, 6500 K	white, 6500 K	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	
	Max	(A)	17.0	17.0	17.0	7.5	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	
	Width	(mm)	133	133	133	206	206	206	
	Height	(mm)	38	38	38	76	76	76	
Materials		black anodised aluminium body			black anodised aluminium body				
Clamping system		4 holes for M6 screw			8 threaded holes for M6 screw				
Compatibility									
Strobe controllers		LTDV6CH, LTDV1CH-17V, LTDVExCH-20			LTDV6CH, LTDV1CH-17V, LTDVExCH-20	LTDV6CH, LTDV1CH-17V, LTDVExCH-20			
Lenses		TC2300y, TC23012, TC12016, TC23016, TC12024, TC23024, TCxx036, TCEL23036, TC1MHR016-C, TC1MHR024-C, TC1MHR036-C, TC2MHR016-x, TC2MHR024-x, TC2MHR036-x, TC3MHR016-C, TC3MHR024-C, TC3MHR036-C, TC4M004-x, TC4M007-x, TC4M009-x, TC4MHR016-x, TC4MHR024-x, TC4MHR036-x, TC12M016-F, TC12M024-F, TC12M036-F, TC16M009-x, TC16M012-x, TC16M018-x, TC16M036-x, TCLWD series, TCZR036S, MC150X, MC100X, MC075X, MC050X, MC033X, MC4K050X-x, MC4K075X-x, MC4K100X-x, MC4K125X-x, MC4K150X-x			TCxx036, TCEL23036, TCxx048, TC12056, TC23056, TC13064, TCxx064, TC1MHR036-C, TC1MHR048-C, TC1MHR056-C, TC1MHR064-C, TC2MHR036-x, TC2MHR048-x, TC2MHR056-x, TC2MHR064-x, TC3MHR036-C, TC3MHR048-C, TC3MHR056-C, TC3MHR064-C, TC2MHR036-x, TC4MHR036-x, TC4MHR048-x, TC4MHR056-x, TC4MHR064-x, TC12M036-F, TC12M048-F, TC12M056-F, TC12M064-F, TC16M036-x, TC16M048-x, TC16M056-x, TC16M064-x, TC12K064, TCLWD series, TC4K060-x, TCZR072S, MC033X, MC12K200X-x, MC12K150X-x, MC12K100X-x, MC12K067X-x, MC4K050X-x, MC4K075X-x, MC4K100X-x, MC4K125X-x, MC4K150X-x				

- At max Working Distance WD.
- At 25°C. At max pulse width (1 ms), max pulse frequency = 15 Hz.
- 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).
- At 25°C.

Ordering information

It is 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 diffuse strobe low angle ring light illuminator - medium size high power red.

LTLAIC series

Continuous LED low angle diffused ring lights

α 60°

DIFFUSED



KEY ADVANTAGES

24V DC supply voltage.

Easy integration & compact size.

JST connector (optional M8, M12).

Red, Green, Blue and White.

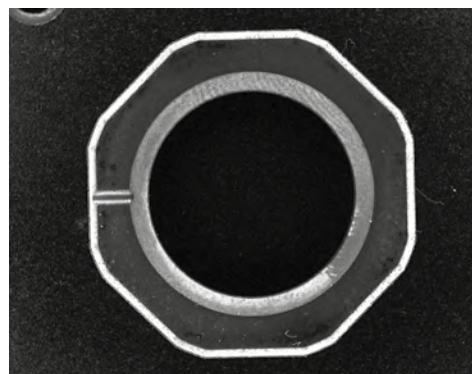
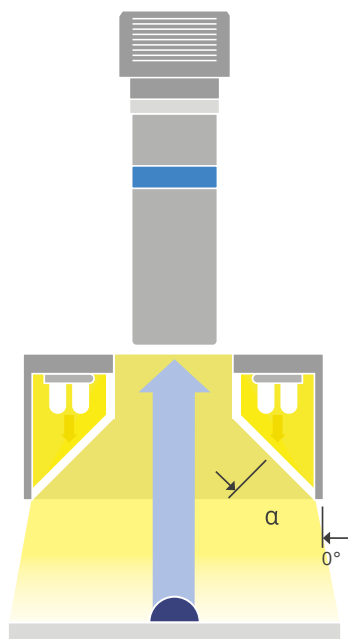
Custom sizes available on request.

COMPATIBLE STROBE CONTROLLER		
	LTDV1CH-17V strobe controller	p. 252
COMPATIBLE LIGHT INTENSITY CONTROLLER		
	LTCGR1000-D1-PS-xx light intensity controller	p. 256
FULL RANGE OF FIXED FOCAL LENGTH LENSES		
	EN2MP series, EN5MP series, EN-2RT series, EN-5RT series	p. 74-77

The **LTLAIC series** consists of LED low angle diffused ring lights that provide diffused even illumination, effectively preventing glare when inspecting shiny surfaces. Suggested use is continuous mode.

Application examples

Lighting structure



Locking ring cosmetic inspection and orientation check: the sloped surfaces are evenly illuminated with the LTLAIC ring light.



Part number	Optical specifications					Electrical specifications					Dimensions		
	Light color, wavelength peak	Optimal WD (mm)	Lighting area		Emission angle α (deg)	Continuous mode			Pulsed mode		Outer diam. (mm)	Inner diam. (mm)	Height (mm)
			inner diam. (mm)	outer diam. (mm)		Supply voltage (V)	Current (mA)	Power cons. (W)	Supply voltage (V)	Max pulse current (mA)			
LT3RZF050-60-1-W-24V	white	5	12	44	60	24	120	2.9	36	360	56.4	10	35
LT3RZF050-60-1-R-24V	red, 620 nm	5	12	44	60	24	120	2.9	36	360	56.4	10	35
LT3RZF050-60-1-G-24V	green, 525 nm	5	12	44	60	24	120	2.9	36	360	56.4	10	35
LT3RZF050-60-1-B-24V	blue, 450 nm	5	12	44	60	24	120	2.9	36	360	56.4	10	35
LT3RZF080-60-1-W-24V	white	5 - 15	38.2	69	60	24	180	4.3	36	540	81	36.2	35
LT3RZF080-60-1-R-24V	red, 620 nm	5 - 15	38.2	69	60	24	180	4.3	36	540	81	36.2	35
LT3RZF080-60-1-G-24V	green, 525 nm	5 - 15	38.2	69	60	24	180	4.3	36	540	81	36.2	35
LT3RZF080-60-1-B-24V	blue, 450 nm	5 - 15	38.2	69	60	24	180	4.3	36	540	81	36.2	35
LT3RZF100-60-1-W-24V	white	5 - 20	59	93.2	60	24	270	6.5	36	810	105.2	57	35
LT3RZF100-60-1-R-24V	red, 620 nm	5 - 20	59	93.2	60	24	270	6.5	36	810	105.2	57	35
LT3RZF100-60-1-G-24V	green, 525 nm	5 - 20	59	93.2	60	24	270	6.5	36	810	105.2	57	35
LT3RZF100-60-1-B-24V	blue, 450 nm	5 - 20	59	93.2	60	24	270	6.5	36	810	105.2	57	35
LT3RZF130-60-1-W-24V	white	7 - 26	86	119.5	60	24	360	8.6	36	1080	131.5	84	35
LT3RZF130-60-1-R-24V	red, 620 nm	7 - 26	86	119.5	60	24	360	8.6	36	1080	131.5	84	35
LT3RZF130-60-1-G-24V	green, 525 nm	7 - 26	86	119.5	60	24	360	8.6	36	1080	131.5	84	35
LT3RZF130-60-1-B-24V	blue, 450 nm	7 - 26	86	119.5	60	24	360	8.6	36	1080	131.5	84	35

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.

Ordering information

Our part numbers are coded as **LT3RZFxxx-yy-z-a-bbV** where:

- **xxx** defines the lighting diameter
- **yy** defines the light angle (for this series the angle is 60° = 60°)
- **z** defines the number of LED rows
- **a** defines the color: R = red, G = green, B = blue, W = white. Contact us for additional wavelengths.
- **bb** defines the supply voltage. Optional 12V version is available.

Lighting extension cables (CB series) are not included and must be ordered separately.

Optional connectors: The LTLAIC series is available with JST connector per standard. For M8 or M12 connectors (available as optional) add -M8 or -M12 at the end of the part number.

Examples: LT3RZF050-60-1-W-24V-M8, LT3RZF050-60-1-W-24V-M12

LTLADC series

Continuous LED low angle direct ring lights

α 75°

DIRECT



KEY ADVANTAGES

24V DC supply voltage.


Easy integration & compact size.

JST connector (optional M8, M12).


Red, Green, Blue and White.

Custom sizes available on request.

COMPATIBLE STROBE CONTROLLER

	LTDV1CH-17V strobe controller	p. 252
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COMPATIBLE LIGHT INTENSITY CONTROLLER

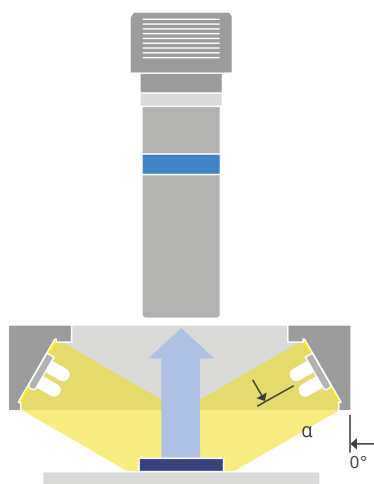
	LTICGR1000-D1-PS-xx light intensity controller	p. 256
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FULL RANGE OF FIXED FOCAL LENGTH LENSES

	EN2MP series, EN5MP series, EN-2RT series, EN-5RT series	p. 74-77
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The **LTLADC series** consists of low angle direct ring lights that provide direct side illumination to emphasize the surface features of the workpiece, such as scratches or texture. Suggested use is continuous mode.

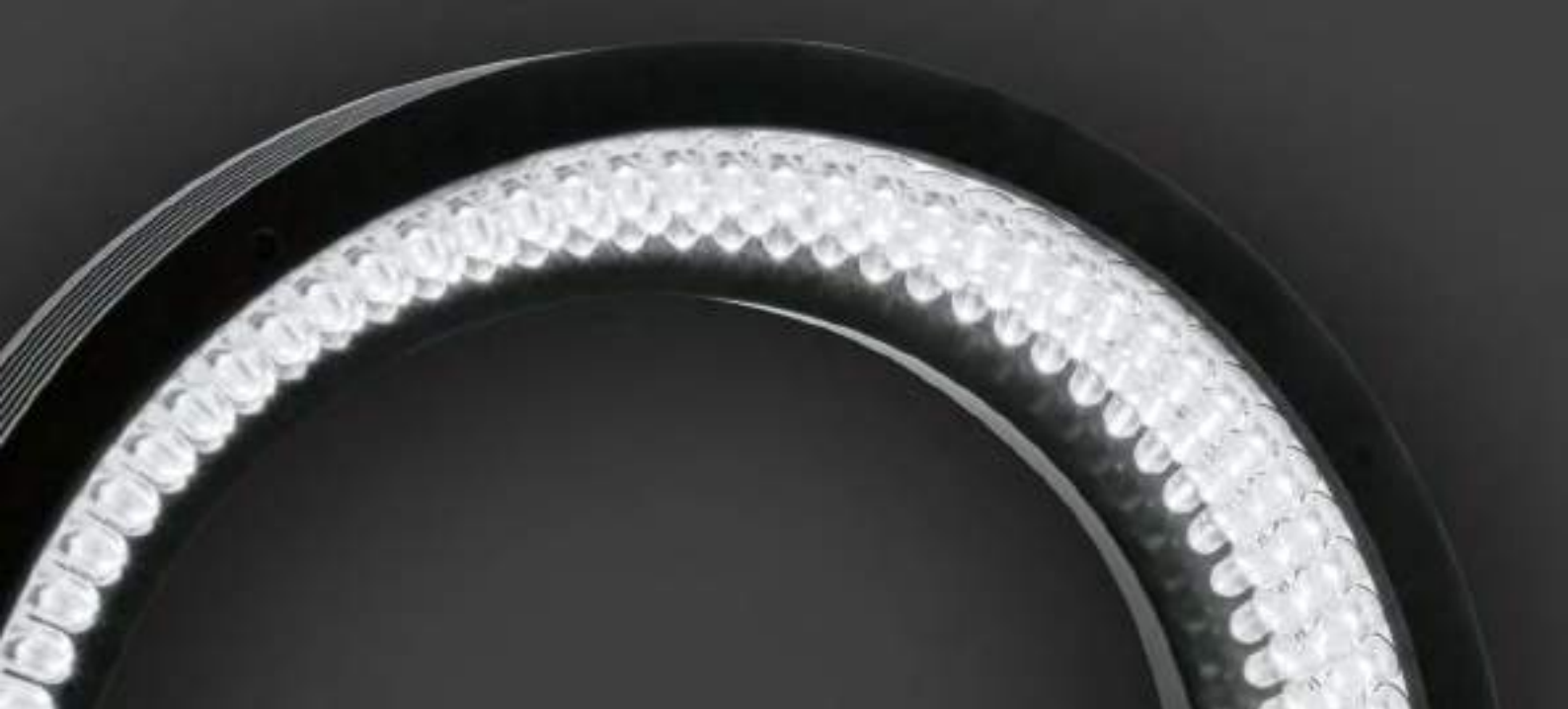
Lighting structure



Application examples



Gear dents counting and inspection with LTLADC low angle ring light (in darkfield configuration) imaged by a macro lens.



Optional diffusers

Diffusers can be added to the LTRNDC series to increase light uniformity.



Part number	Compatibility
DFLTZZO130-75-3	LTZZO130-75-3-a-24V
DFLTZZO170-75-3	LTZZO170-75-3-a-24V

Optional polarizers

Polarizers can be added to the LTRNDC series to reduce unwanted reflections.



Part number	Compatibility
PLLTZZO130-75-3	LTZZO130-75-3-a-24V
PLLTZZO170-75-3	LTZZO170-75-3-a-24V

Part number	Optical specifications					Electrical specifications					Dimensions		
	Light color, wavelength peak	Optimal WD (mm)	Lighting area		Emission angle α (deg)	Continuous mode			Pulsed mode		Outer diam. (mm)	Inner diam. (mm)	Height (mm)
			inner diam. (mm)	outer diam. (mm)		Supply voltage (V)	Current (mA)	Power cons. (W)	Supply voltage (V)	Max pulse current (mA)			
LTZZO130-75-3-W-24V	white, 6300 K	5 - 15	111	126	75	24	540	13	36	225	131	94	24.5
LTZZO130-75-3-R-24V	red, 630 nm	5 - 15	111	126	75	24	420	10.1	36	180	131	94	24.5
LTZZO130-75-3-G-24V	green, 525 nm	5 - 15	111	126	75	24	540	13	36	225	131	94	24.5
LTZZO130-75-3-B-24V	blue, 470 nm	5 - 15	111	126	75	24	540	13	36	225	131	94	24.5
LTZZO170-75-3-W24V	white, 6300 K	5 - 15	154	170	75	24	735	17.7	36	450	175	136	24.5
LTZZO170-75-3-R-24V	red, 630 nm	5 - 15	154	170	75	24	570	13.7	36	360	175	136	24.5
LTZZO170-75-3-G-24V	green, 525 nm	5 - 15	154	170	75	24	735	17.7	36	450	175	136	24.5
LTZZO170-75-3-B-24V	blue, 470 nm	5 - 15	154	170	75	24	735	17.7	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.

Ordering information

Our part numbers are coded as **LTZZOxxx-yy-z-a-bbV** where:

- **xxx** defines the lighting diameter
- **yy** defines the light angle (for this series the angle is 75 = 75°)
- **z** defines the number of LED rows
- **a** defines the color: R = red, G = green, B = blue, W = white. Contact us for additional wavelengths.
- **bb** defines the supply voltage. Optional 12V version is available.

All accessories including lighting extension cables (CB series), diffusers (DFLT series), polarizers (PLLT series) must be ordered separately.

Optional connectors: The LTLADC series is available with JST connector per standard. For M8 or M12 connectors (available as optional) add -M8 or -M12 at the end of the part number. Examples: LTZZO130-75-3-W-24V-M8, LTZZO130-75-3-W-24V-M12

LTRNOB series

LED ring illuminators - oblique type

DIFFUSED



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 compromising quality.

The **LTRNOB series** offers LED ring illuminators specifically designed for a wide range of Opto Engineering® products. The oblique type models especially fit Opto Engineering 360° view lenses perfectly.

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.

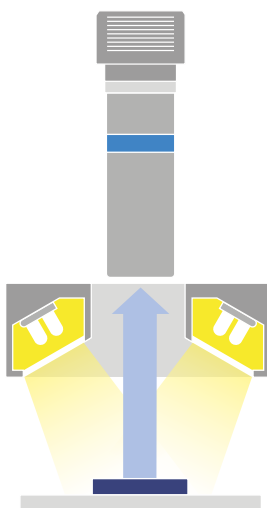


LTRN 245 W45



LTRN 050 W45

Lighting structure



LTRNOB - Ring lights / oblique illumination

Combination examples of LTRNOB and 360° view optics



PC23030XS + compatible LTRN210x20 ring light and CMHO080 clamping mechanics.



PCCD013 + compatible LTRN165x45 ring light.



PCHI023 + compatible LTRN075x45 ring light.



LTRN 050 W 45 mounted on PCPW series.

FULL RANGE OF COMPATIBLE 360° VIEW LENSES		
	360° view lenses	p. 93-109
COMPATIBLE STROBE CONTROLLER		
	LTDV1CH-17V strobe controller	p. 252
COMPATIBLE LIGHT INTENSITY CONTROLLER		
	LTICGR1000-D1-PS-xx light intensity controller	p. 256



Part number	Optical specifications				Electrical specifications					Dimensions			Compatibility
	Light color, peak wavelength	Optimal WD (mm)	Lighting area diam.		Continuous mode ¹			Pulsed mode		Outer diam. (mm)	Inner diam. (mm)	Height (mm)	Compatible OE products
			inner (mm)	outer (mm)	Supply voltage (V)	Current (mA)	Power cons. (W)	Supply voltage ² (V)	Max pulse current ³ (mA)				
Oblique illumination													
LTRN 050 R45	red, 630 nm	20-80	19	49	24	60	1.5	24-48	180	53.5	15.2	22	PCPW0xx, MCxxxX, TCCAGExx048, TCCAGE2MHR048, TCCAGE3MHR048
LTRN 050 G45	green, 525 nm	20-80	19	49	24	70	1.7	24-48	210	53.5	15.2	22	PCPW0xx, MCxxxX, TCCAGExx048, TCCAGE2MHR048, TCCAGE3MHR048
LTRN 050 B45	blue, 470 nm	20-80	19	49	24	105	2.6	24-48	315	53.5	15.2	22	PCPW0xx, MCxxxX, TCCAGExx048, TCCAGE2MHR048, TCCAGE3MHR048
LTRN 050 W45	white, 6300 K	20-80	19	49	24	105	2.6	24-48	700	53.5	15.2	22	PCPW0xx, MCxxxX, TCCAGExx048, TCCAGE2MHR048, TCCAGE3MHR048
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, TCCAGE2MHR096, TCCAGE3MHR096, TCCAGE4MHR096, PCHI023-MF, PCHI023-AF
LTRN 075 G45	green, 525 nm	20-50	43.8	65.4	24	60	1.5	24-48	180	75.4	28	32	TC2300y, TC23012, TC4M00y-x, PCHI0xx, TCCAGExx096, MC3-03X, TCCAGE2MHR096, TCCAGE3MHR096, TCCAGE4MHR096, PCHI023-MF, PCHI023-AF
LTRN 075 B45	blue, 470 nm	20-50	43.8	65.4	24	60	1.5	24-48	180	75.4	28	32	TC2300y, TC23012, TC4M00y-x, PCHI0xx, TCCAGExx096, MC3-03X, TCCAGE2MHR096, TCCAGE3MHR096, TCCAGE4MHR096, PCHI023-MF, PCHI023-AF
LTRN 075 W45	white, 6300 K	20-50	43.8	65.4	24	90	2.2	24-48	270	75.4	28	32	TC2300y, TC23012, TC4M00y-x, PCHI0xx, TCCAGExx096, MC3-03X, TCCAGE2MHR096, TCCAGE3MHR096, TCCAGE4MHR096, PCHI023-MF, PCHI023-AF
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	11.6	24-48	1440	175	132.5	36.5	PCCD0xx
LTRN 165 W45	white, 6300 K	30-50	134.5	164.5	24	800	19.2	24-48	2400	175	132.5	36.5	PCCD0xx
LTRN 210 R20	red, 630 nm	55-95	116.5	195.6	24	600	14.4	24-48	1800	210	116.5	40	PCxx030XS
LTRN 210 G20	green, 525 nm	55-95	116.5	195.6	24	560	13.5	24-48	1580	210	116.5	40	PCxx030XS
LTRN 210 B20	blue, 470 nm	55-95	116.5	195.6	24	630	15.2	24-48	1890	210	116.5	40	PCxx030XS
LTRN 210 W20	white, 6300 K	55-95	116.5	195.6	24	840	20.2	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, 6300 K	20-80	160	225	24	1120	26.9	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, 6300 K	20-80	160	225	24	1120	26.9	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, 6300 K	20-80	160	225	24	1120	26.9	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.

LTRNOBHP series

High power LED ring illuminators - oblique type

H DIFFUSED



KEY ADVANTAGES

High power working both in continuous and strobe mode.

Brighter than LTRNOB series also in continuous mode.

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.

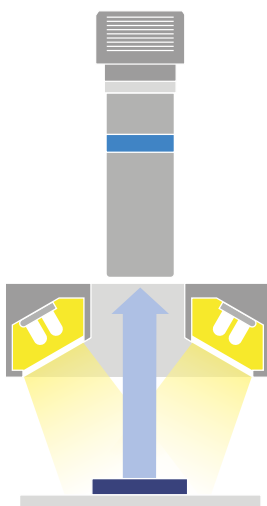
Integrated thermal sensor.

The **LTRNOBHP series** offers the high power version of the LTRNOB series LED ring illuminators and is specifically designed to match Opto Engineering® 360° view lenses.

Every illuminator is equipped with a clamping system which makes it very easy to mount it on Opto Engineering® 360° view lenses.

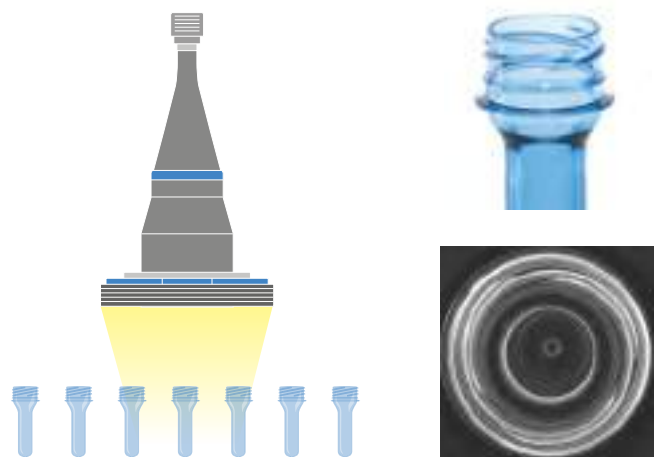
These LED ring lights are designed to work both in continuous and strobe mode for high speed inspection and provide the best illumination geometry for the most common applications of the matching lenses in the beverage, pharma and automotive industries.

Lighting structure



LTRNOBHP - Ring lights / oblique illumination

Application example



Check for defects in bottle preforms (Incomplete or defective thread - Oval Shape - Mouth defects) at high speed using a 360° view lens and a high power ring light from the LTRNOBHP series.

FULL RANGE OF COMPATIBLE 360° VIEW LENSES		
	360° view lenses	p. 93-109
COMPATIBLE STROBE CONTROLLER		
	LTDV1CH-17V strobe controller	p. 252
COMPATIBLE LIGHT INTENSITY CONTROLLER		
	light intensity controller	p. 256

Part number	Optical specifications				Electrical specifications					Dimensions			Compatibility		
	Light color, peak wavelength	Optimal WD (mm)	Lighting area diam. (mm)		Supply voltage (V)	Current (mA)	Max power cons. (W)	Max pulse current (mA)	Peak power (W)	Outer diam. (mm)	Inner diam. (mm)	Height (mm)	Lenses	Controllers	Cables
Oblique illumination															
LTRNHP 075 R45	red, 625 nm	20-50	43.5	65	24 ± 2%	420	10	2800	79	86	28	38	TC2300y, TC23012, TC4M00y-x, PCHI0xx, PCHI023-MF, PCHI023-AF	LTDV1CH-17V, LTDVExCH-20, LTDV6CH	CBLT010
LTRNHP 075 G45	green, 525 nm	20-50	43.5	65	24 ± 2%	420	10	6000	163	86	28	38			
LTRNHP 075 B45	blue, 475 nm	20-50	43.5	65	24 ± 2%	420	10	6000	163	86	28	38			
LTRNHP 075 W45	white, 6200 K	20-50	43.5	65	24 ± 2%	420	10	7200	178	86	28	38			
LTRNHP 165 R45	red, 625 nm	30-50	133.5	162	24 ± 2%	1670	40	7000	169	190	132.5	42	PCCD0xx		
LTRNHP 165 G45	green, 525 nm	30-50	133.5	162	24 ± 2%	1670	40	9000	239	190	132.5	42			
LTRNHP 165 B45	blue, 475 nm	30-50	133.5	162	24 ± 2%	1670	40	9000	221	190	132.5	42			
LTRNHP 165 W45	white, 6200 K	30-50	133.5	162	24 ± 2%	1670	40	13500	293	190	132.5	42			
LTRNHP 210 R20	red, 625 nm	50-100	117.5	182	24 ± 2%	2090	50	9000	217	210	116.5	42	PCxx030XS		
LTRNHP 210 G20	green, 525 nm	50-100	117.5	182	24 ± 2%	2090	50	12000	319	210	116.5	42			
LTRNHP 210 B20	blue, 475 nm	50-100	117.5	182	24 ± 2%	2090	50	12000	294	210	116.5	42			
LTRNHP 210 W20	white, 6200 K	50-100	117.5	182	24 ± 2%	2090	50	18000	391	210	116.5	42			
LTRNHP 245 R25	red, 625 nm	20-80	160	215	24 ± 2%	2710	65	10000	241	245	157	50	PCxx030HP		
LTRNHP 245 G25	green, 525 nm	20-80	160	215	24 ± 2%	2710	65	14000	372	245	157	50			
LTRNHP 245 B25	blue, 475 nm	20-80	160	215	24 ± 2%	2710	65	14000	343	245	157	50			
LTRNHP 245 W25	white, 6200 K	20-80	160	215	24 ± 2%	2710	65	20000	434	245	157	50			

1 With constant driving voltage.

2 With constant driving current. At max pulse width (1 ms), max pulse frequency = 15Hz. Contact us to check other allowable combinations of duty cycle-frequency.

LTDMC series

Continuous LED domes



INDIRECT

NEW MODELS



KEY ADVANTAGES

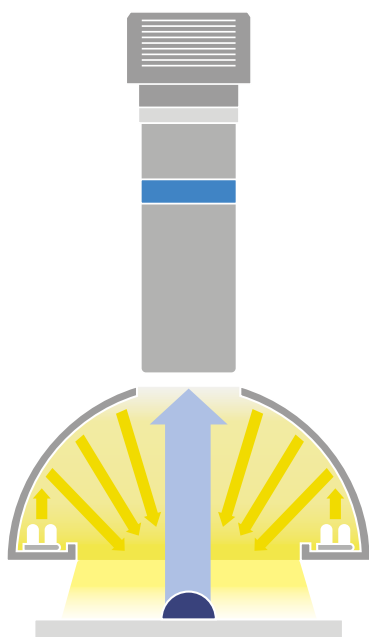
- 24V DC supply voltage.
- Easy integration & compact size.
- JST connector (optional M8, M12).
- Red, Green, Blue, White and Infrared.
- Custom sizes available on request.

COMPATIBLE STROBE CONTROLLER		
	LTDV1CH-17V strobe controller	p. 252
COMPATIBLE LIGHT INTENSITY CONTROLLER		
	LTCIGR1000-D1-PS-xx light intensity controller	p. 256

The **LTDMC series** consists of LED dome illuminators designed to provide uniform illumination of complex surfaces.

The light comes from all angles effectively eliminating glare and shadows. Suggested usage is continuous mode.

Lighting structure



Optional mounting bracket

Specifically designed to easily mount LTDMC.



Part number	Compatibility
CMLT5WRG050-00-X	LT5WRG050-00-1-a-24V
CMLT5WRG070-00-X	LT5WRG070-00-1-a-24V
CMLT5WRG100-00-X	LT5WRG100-00-1-a-24V
CMLT5WRG150-00-X	LT5WRG150-00-1-a-24V
CMLT5WRG200-00-X	LT5WRG200-00-1-a-24V
CMLT5WRG250-00-X	LT5WRG250-00-1-a-24V

Application example



A dome light is the best choice to uniformly illuminate surfaces to perform OCR.



Part number	Optical specifications		Electrical specifications					Mechanical specifications		
	Light color, wavelength peak	Illumination area diam. (mm)	Continuous mode			Pulsed mode		Dimensions		
			Supply voltage (V)	Current (mA)	Power cons. (W)	Supply voltage (V)	Max pulse current (mA)	Outer diam. (mm)	Aperture (mm)	Height (mm)
						1	2			
LT5WRG050-00-1-R-24V	red, 620nm	37.4	24	243	5.8	36	729	68	10	33.8
LT5WRG050-00-1-G-24V	green, 540nm	37.4	24	315	7.6	36	945	68	10	33.8
LT5WRG050-00-1-B-24V	blue, 450nm	37.4	24	315	7.6	36	945	68	10	33.8
LT5WRG050-00-1-W-24V	white	37.4	24	315	7.6	36	945	68	10	33.8
LT5WRG050-00-1-IR850-24V	IR, 850nm	25	24	64	1.5	36	192	68	10	33.8
LT5WRG070-00-1-R-24V	red, 620nm	61	24	378	9	36	1134	95	20	44.5
LT5WRG070-00-1-G-24V	green, 540nm	61	24	490	11.8	36	1470	95	20	44.5
LT5WRG070-00-1-B-24V	blue, 450nm	61	24	490	11.8	36	1470	95	20	44.5
LT5WRG070-00-1-W-24V	white	61	24	490	11.8	36	1470	95	20	44.5
LT5WRG070-00-1-IR850-24V	IR, 850nm	41	24	96	2.3	36	288	95	20	44.5
LT5WRG100-00-1-R-24V	red, 620nm	85.4	24	540	13	36	1620	118	25	56.8
LT5WRG100-00-1-G-24V	green, 540nm	85.4	24	700	16.8	36	2100	118	25	56.8
LT5WRG100-00-1-B-24V	blue, 450nm	85.4	24	700	16.8	36	2100	118	25	56.8
LT5WRG100-00-1-W-24V	white	85.4	24	700	16.8	36	2100	118	25	56.8
LT5WRG100-00-1-IR850-24V	IR, 850nm	68	24	160	3.8	36	480	118	25	56.8
LT5WRG150-00-1-R-24V	red, 620nm	138	24	900	21.6	36	2700	185	40	89.8
LT5WRG150-00-1-G-24V	green, 540nm	138	24	930	22.3	36	2790	185	40	89.8
LT5WRG150-00-1-B-24V	blue, 450nm	138	24	930	22.3	36	2790	185	40	89.8
LT5WRG150-00-1-W-24V	white	138	24	930	22.3	36	2790	185	40	89.8
LT5WRG150-00-1-IR850-24V	IR, 850nm	113	24	1000	24	36	3000	185	40	89.8
LT5WRG200-00-1-R-24V	red, 620nm	193	24	1130	32	36	3990	232	50	112.8
LT5WRG200-00-1-G-24V	green, 540nm	193	24	1380	33.1	36	4140	232	50	112.8
LT5WRG200-00-1-B-24V	blue, 450nm	193	24	1380	33.1	36	4140	232	50	112.8
LT5WRG200-00-1-W-24V	white	193	24	1380	33.1	36	4140	232	50	112.8
LT5WRG200-00-1-IR850-24V	IR, 850nm	160	24	1250	30	36	3750	232	50	112.8
LT5WRG250-00-1-R-24V	red, 620nm	240	24	1500	36	36	4500	284	50	139.4
LT5WRG250-00-1-G-24V	green, 540nm	240	24	1600	38.4	36	4800	284	50	139.4
LT5WRG250-00-1-B-24V	blue, 450nm	240	24	1600	38.4	36	4800	284	50	139.4
LT5WRG250-00-1-W-24V	white	240	24	1600	38.4	36	4800	284	50	139.4
LT5WRG250-00-1-IR850-24V	IR, 850nm	212	24	1500	36	36	4500	284	50	139.4
LT4WRG360-00-1-R-24V	red, 620nm	300	24	1550	37	36	4650	381	36.5	189
LT4WRG360-00-1-G-24V	green, 525nm	300	24	1550	37	36	4650	381	36.5	189
LT4WRG360-00-1-B-24V	blue, 470nm	300	24	1550	37	36	4650	381	36.5	189
LT4WRG360-00-1-W-24V	white	300	24	1550	37	36	4650	381	36.5	189

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.

Ordering information

Our part numbers are coded as **LT5(4)WRGxxx-yy-z-a-bbV** where:

- **xxx** defines the lighting diameter
- **yy** defines the light angle (for this series the angle is 00 = 0°)
- **z** defines the number of LED rows
- **a** defines the color: R = red, G = green, B = blue, W = white, IR850 = Infrared 850 nm. Contact us for additional wavelengths.
- **bb** defines the supply voltage. The optional 12V version is available.

All accessories including lighting extension cables (CB series) and mounting brackets (CMLT series) must be ordered separately.

Optional connectors: LTDMC series is available with JST connector per standard. For M8 or M12 connectors (available as optional) add -M8 or -M12 at the end of the part number.

Examples: LT5WRG050-00-1-W-24V-M8, LT5WRG050-00-1-W-24V-M12

LTDM series

High power strobe LED domes

H INDIRECT



KEY ADVANTAGES

Ultra-high power light output and strobe mode only operation
For the inspection of fast moving objects 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 synchronisation of the illuminator.

The **LTDM series** offers high power diffuse LED strobe dome illuminators designed to provide non-directional diffused light and to effectively eliminate glare and shadows.

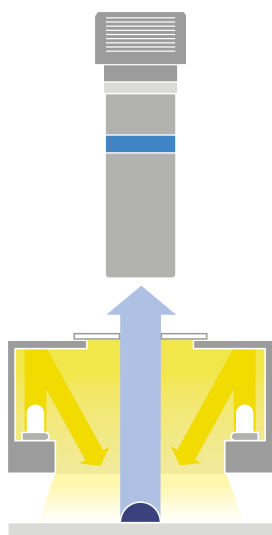
The LTDM series provides ultra-high power light output and can be used to illuminate complex shapes with curved and shiny surfaces. LTDM dome illuminators can be exclusively operated in strobe mode, making them the perfect choice to illuminate very fast moving objects while ensuring extended LED lifetime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

The LTDM series can be easily powered, controlled and synchronised 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.

The LTDM series features 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 M6 screws.

Lighting structure



Application example



Image with white dome light.



Image with red dome light.

High speed OCR on food cans with LTDM strobe LED dome light and a fixed focal length lens. The red wavelength works well on orange/yellow cans and increases the contrast of the expiration date with respect to the can background so that the image can be easily processed by machine vision algorithms.



DESIGNED FOR OEM APPLICATIONS

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


FULL RANGE OF COMPATIBLE STROBE CONTROLLERS

	LTDV series	p. 252
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FULL RANGE OF FIXED FOCAL LENGTH LENSES

	EN2MP series, EN5MP series, EN-2RT series, EN-5RT series	p. 74-77
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FULL RANGE OF INDUSTRIAL CAMERAS

	Area scan cameras	p. 188-203
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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 color		white, 6000 K	green, 525 nm	red, 625 nm	white, 6500 K	green, 528 nm	red, 625 nm	white	white, 6500 K	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	n.a.	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	
	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 anodised aluminium body			black anodised aluminium body			black anodised aluminium 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		LTDV6CH, LTDV1CH-17V, LTDVExCH-20			LTDV6CH, LTDV1CH-17V, LTDVExCH-20			LTDV6CH, LTDV1CH-17V, LTDVExCH-20	LTDV6CH, LTDV1CH-17V, LTDVExCH-20			
Lenses		TC23007, TC23009, TCLWD series, MC050X, MC033X, TCEL series (except TCEL23036)			TCLWD series, MC033X, TCEL series (except TCEL23036)			TCLWD series, MC4K050X-x, MC4K075X-x, TCEL series (except TCEL23036)				

- 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. The 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 is 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 diffuse strobe dome illuminator - medium size high power red.

LTDMLA series

High power strobe dome + low angle illumination systems

H **INDIRECT**



KEY ADVANTAGES

Two independent illumination units in one 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 objects and extended LED lifetime.

Rugged industrial design with built-in industrial connector

For easy integration into any machine vision system.

Multiple configurations

Available in two sizes and two power intensities.

Compatible LTDV strobe controllers available

For easy and appropriate power, control and synchronisation of the illuminator.

The **LTDMLA series** offers ultra-high power diffuse LED strobe illuminators combining a dome light and a low angle ring light.

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 glare 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.

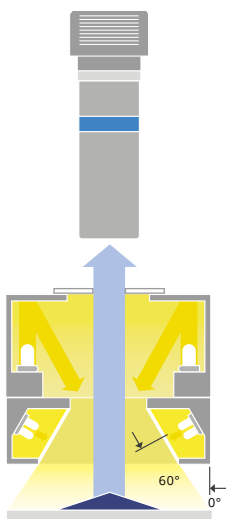
LTDMLA illuminators operate exclusively in strobe mode: the reduced heat generation guarantees extended LED lifetime and makes LTDMLA the perfect choice to illuminate very fast moving objects.

The two illumination units can be operated independently and easily powered, controlled and synchronised by compatible LTDV strobe controllers. The 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.

The 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 the formation of hot spots. Additionally the LTDMLA series can be easily mounted and integrated into any machine vision system with M6 screws.

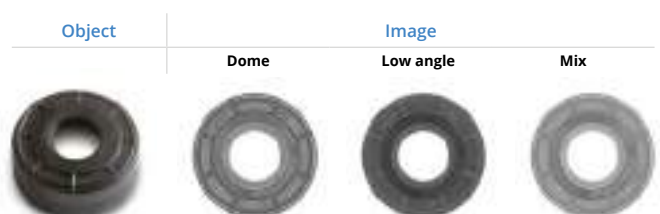
Lighting structure



DESIGNED FOR OEM APPLICATIONS



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

Application example



Surface inspection of rubber, plastic and metal sealings with LTDMLA series: the mixing of dome and low angle light achieves the best image contrast.



FULL RANGE OF COMPATIBLE STROBE CONTROLLERS		
	LTDV series	p. 252
FULL RANGE OF FIXED FOCAL LENGTH LENSES		
	EN2MP series, EN5MP series, EN-2RT series, EN-5RT series	p. 74-77

Part number			LTDMLAB2-WW	LTDMLAC1-WW	LTDMLAC2-WW
Optical specifications					
Dome unit					
Number of LEDs			40	40	80
Light color			white, 6500 K	white	white, 6500 K
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 ring light unit					
Number of LEDs			40	40	80
Light color			white, 6000 K	white, 6500 K	white, 6500 K
Spectral FWHM		(nm)	n.a.	n.a.	n.a.
Diffuse 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	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	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 anodised aluminium body	black anodised aluminium body / Painted steel reflector	black anodised aluminium body / Painted steel reflector
Clamping system			4 holes for M6 screw	8 threaded holes for M6 screw	8 threaded holes for M6 screw
Compatibility					
Strobe controllers			LTDV1CH-17V (2 units), LTDVExCH-20, LTDV6CH, TCEL series (except TCEL23036)	LTDV1CH-17V (2 units), LTDVExCH-20, LTDV6CH, TCEL series (except TCEL23036)	LTDV1CH-17V (2 units), LTDVExCH-20, LTDV6CH, TCEL series (except TCEL23036)
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 ring light 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 is 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 diffuse strobe dome + low angle illumination system - medium size, high power, dome white, ring light white.

LTBRZ3 series

LED bar lights with integrated driving electronics

DIRECT

NEW



KEY ADVANTAGES

Integrated constant current driving electronics.

Daisy-chain option

Easily connect up to 6 lights together.

Wide selection

- 295 x 25 mm active area
- Available in red, white, green blue and Infrared

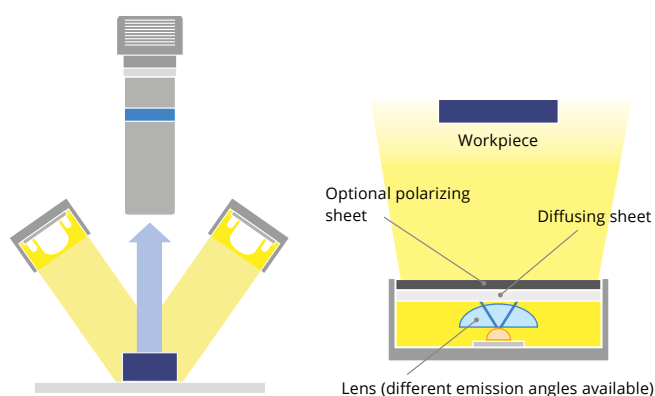
5-pin M12 connector.

Compact lightweight design with reduced thickness (33 mm).

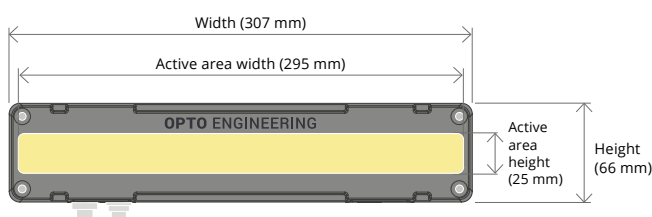
The **LTBRZ3 series** consists of high intensity LED bar lights with integrated constant current driving electronics that can be used in a wide variety of general purpose machine vision applications both as front lights or as back lights including front inspection such as parts identification, checking for presence/absence, visual inspection of large workpieces, robot picking. Each light features 12 high intensity LEDs and provides rectangular illumination on the workpiece. The installation angle can be set freely. Up to six units of these bar lights can be easily connected together via daisy-chain. These lights feature 5-pin M12 connectors, ideal for industrial automation environments.

LTBRZ3 slick and lightweight design is conceived for easy installation into any machine vision system. These bar lights feature 24V supply voltage and can be easily dimmed through a 0-10V analogue signal or a built-in manual potentiometer. They operate in continuous or overdrive/strobe mode: NPN or PNP strobe triggers can be used to control the on/off input of the light. Both continuous and strobe models integrate protection against over-heating. Strobe models integrate an additional protection that limits the maximum duty-cycle in a safe operating range. LTBRZ3 lights are available with different lenses featuring circular/elliptical emission angles or with a special diffusing sheet for backlight applications. Optional polarizing sheets are available (Horizontal or Vertical).

Lighting structure



Dimensions



Lens options (emission angles)

w=10: ~10° circular emission angle lenses that project a narrow beam of light. Ideal for long working distances and in applications that require pseudo collimated light.



Part number:
LTBRZ3-x-y-10-p-e

w=20: ~20° circular emission angle lenses that project a medium beam of light.



Part number:
LTBRZ3-x-y-20-p-e

w=30: ~30° circular emission angle lenses that project a wide beam of light.



Part number:
LTBRZ3-x-y-30-p-e

w=50: ~50° circular emission angle lenses that project an extra-wide beam of light. Ideal to cover large illumination areas in short distance applications.



Part number:
LTBRZ3-x-y-50-p-e

w=EL: ~35°/15° elliptical emission angle lenses that project a beam that is wide along the X axis and narrow along the Y axis. Ideal for applications that require an asymmetrical beam.



Part number:
LTBRZ3-x-y-EL-p-e

w=BL: a uniform and diffused light pattern is emitted at the active area. Ideal for backlight applications.

Part number:
LTBRZ3-x-y-BL-p-e

Illuminated areas at different working distances (WD)

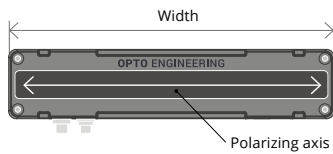
Illuminated area 1

WD	(mm)	300	500	1000	2000
LENS TYPE = 10°	Width	302	306	334	466
	Height	72	110	204	392
LENS TYPE = 20°	Width	304	316	424	754
	Height	112	178	352	700
LENS TYPE = 30°	Width	310	350	546	1006
	Height	166	262	506	988
LENS TYPE = 50°	Width	342	484	918	1680
	Height	260	428	848	1678
LENS TYPE = EL	Width	310	358	592	1126
	Height	78	120	230	454

1 Approximate data: refer to the product manual to select the appropriate lens. The illuminated areas (Width x Height) represent the rectangles which inscribe the regions with light distribution from 50% to 100%.

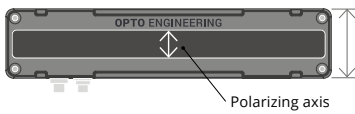
Optional polarizing sheets

PH: with horizontal linear polarizer. Polarizing axis parallel to the active area width.

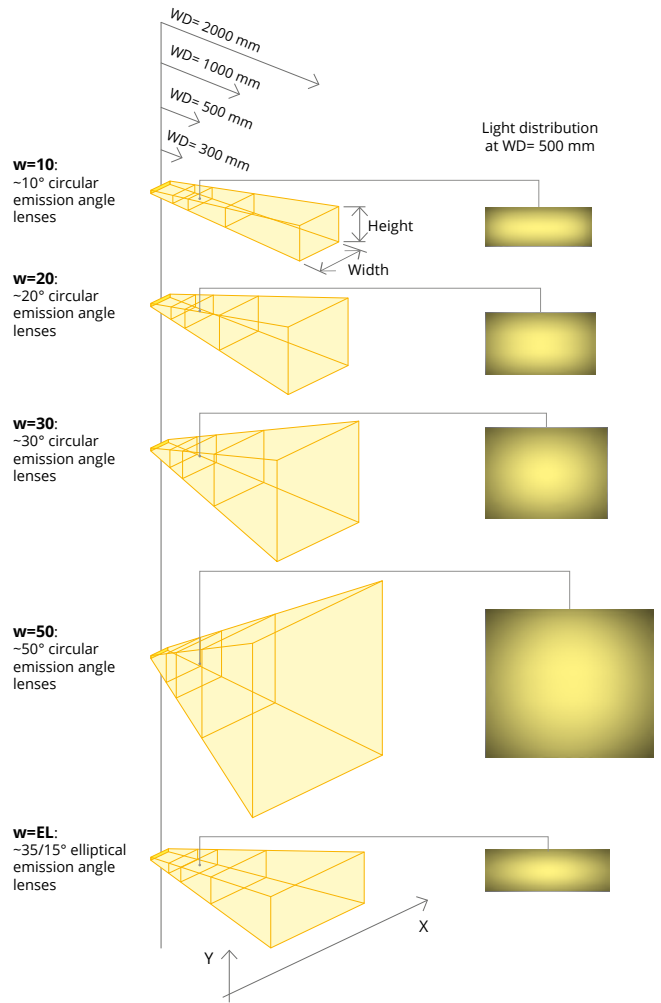


Part Number: LTBRZ3-x-y-w-PH-e

PV: with vertical linear polarizer. Polarizing axis parallel to the active area height.



Part Number: LTBRZ3-x-y-w-PV-e



Optical specifications

Part number	Number of LEDs	Lighting area dim.		Light color	Lens type	Polarizer
		Width H (mm)	Height V (mm)			
LTBRZ3-x-y-w-p-e	12	295	25	R = Red 630 nm, G = Green 530 nm, B = Blue 470 nm, W = White 6500 K, IR = Infrared 850 nm	10 = 10° beam, 20 = 20° beam, 30 = 30° beam, 50 = 50° beam, EL = 35° H x 15° V beam, BL = backlight	PH = linear polarizer with axis parallel to width, PV = linear polarizer with axis parallel to height. Leave empty if the polarizer is not required

Electrical specifications

Part number	Operation mode	Daisy chain	Power consumption				Pulse parameters				Connection 1	Dimension			Clamping		
			Supply voltage	Continuous version	Strobe version	Continuous version	Strobe version	Max duty-cycle	Min Ton	Max Ton		Max duty-cycle	Width	Height		Thickness	
																	(V)
LTBRZ3-x-y-w-p-e	C = continuous, P = pulsed	DC = daisy-chain connection ready. Leave empty if daisy-chain is not required	24 ±5%	20	0.85	120	5	10	100	5	50	10	M12 5 pins	307	66	33	4x M5 holes

1 Versions without daisy-chain are equipped with a single M12 5 pins connector. Versions with daisy-chain are equipped with two M12 5 pins connectors. Cables are not included and must be ordered separately.

Ordering information

Our part numbers are coded as **LTBRZ3-x-y-w-p-e**, where:

x Defines the operation mode of the barlight
 - C means continuous mode only
 - P means pulsed mode only

y Defines the color
 - R is Red, 630 nm
 - G is Green, 530 nm
 - B is Blue, 470 nm
 - W is white, 6500K color temperature
 - IR is Infrared, 850nm

w defines the beam angle:
 - 10 means that each LED emits a circular beam with an aperture of ~10°
 - 20 means that each LED emits a circular beam with an aperture of ~20°
 - 30 means that each LED emits a circular beam with an aperture of ~30°
 - 50 means that each LED emits a circular beam with an aperture of ~50°
 - EL means that each LED emits an elliptical beam with a horizontal aperture of ~35° and a vertical aperture of ~15°
 - BL means that LEDs emit a uniform pattern suitable for backlight applications

p defines the presence of a polarizing film
 - PH means that the polarizing axis of the film is parallel to the width of the illuminator
 - PV means that the polarizing axis of the film is parallel to the height of the illuminator
 Leave this field empty if the polarizer is not required
e defines the presence of a daisy chain connector
 Leave this field empty if the daisy-chain is not required

For additional options, such as wavelengths, optical, electrical or mechanical customization, contact us.

LTBRDC series

Continuous LED bar lights

DIRECT



KEY ADVANTAGES

24V DC supply voltage.

Easy integration & compact size.

JST connector (optional M8, M12).

Red, Green, Blue and White.

Custom sizes available on request.

COMPATIBLE STROBE CONTROLLER



LTDV1CH-17V strobe controller

p. 252

COMPATIBLE LIGHT INTENSITY CONTROLLER



LTICGR1000-D1-PS-xx light intensity controller

p. 256

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 can be set freely. Suggested use is continuous mode.

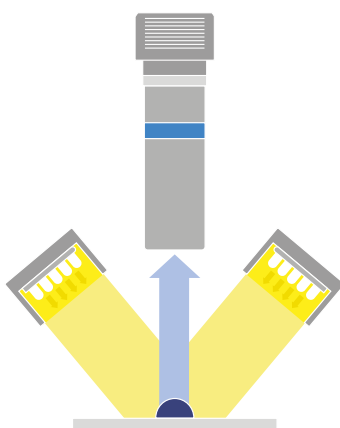
Optional diffusers

Diffusers can be added to LTRNDC series to increase light uniformity.



Part number	Compatibility
DFLTZPFL040-00-6	LTZPFL040-00-6-a-24V
DFLTZPFL080-00-6	LTZPFL080-00-6-a-24V
DFLTZPFL120-00-6	LTZPFL120-00-6-a-24V
DFLTZPFL160-00-6	LTZPFL160-00-6-a-24V
DFLTZPFL200-00-6	LTZPFL200-00-6-a-24V

Lighting structure



Optional polarizers

Polarizers can be added to the LTRNDC series to reduce unwanted reflections.



Part number	Compatibility
PLLTPFL040-00-6-H	LTZPFL040-00-6-a-24V
PLLTPFL040-00-6-V	LTZPFL040-00-6-a-24V
PLLTPFL080-00-6-H	LTZPFL080-00-6-a-24V
PLLTPFL080-00-6-V	LTZPFL080-00-6-a-24V
PLLTPFL120-00-6-H	LTZPFL120-00-6-a-24V
PLLTPFL120-00-6-V	LTZPFL120-00-6-a-24V
PLLTPFL160-00-6-H	LTZPFL160-00-6-a-24V
PLLTPFL160-00-6-V	LTZPFL160-00-6-a-24V
PLLTPFL200-00-6-H	LTZPFL200-00-6-a-24V
PLLTPFL200-00-6-V	LTZPFL200-00-6-a-24V



Optional mounting bracket

Specifically designed to easily mount LTBRDC.



*Includes 2 brackets

Part number	Compatibility
DFLTZPFL040-00-6*	LTZPFL040-00-6-a-24V

Part number	Optical specifications			Electrical specifications					Dimensions		
	Light color, wavelength peak	Lighting area		Continuous mode			Pulsed mode		Length (mm)	Width (mm)	Height (mm)
		Width (mm)	Length (mm)	Supply voltage (V)	Current (mA)	Power cons. (W)	Supply voltage (V)	Max pulse current (mA)			
LTZPFL040-00-6-W-24V	white, 6300 K	26.3	40	24	72	1.8	36	216	52	31.5	22
LTZPFL040-00-6-R-24V	red, 630 nm	26.3	40	24	78	1.9	36	234	52	31.5	22
LTZPFL040-00-6-G-24V	green, 525 nm	26.3	40	24	72	1.8	36	216	52	31.5	22
LTZPFL040-00-6-B-24V	blue, 470 nm	26.3	40	24	72	1.8	36	216	52	31.5	22
LTZPFL080-00-6-W-24V	white, 6300 K	26.3	80	24	144	3.5	36	432	92	31.5	22
LTZPFL080-00-6-R-24V	red, 630 nm	26.3	80	24	156	3.8	36	468	92	31.5	22
LTZPFL080-00-6-G-24V	green, 525 nm	26.3	80	24	144	3.5	36	432	92	31.5	22
LTZPFL080-00-6-B-24V	blue, 470 nm	26.3	80	24	144	3.5	36	432	92	31.5	22
LTZPFL120-00-6-W-24V	white, 6300 K	26.3	120	24	216	5.2	36	648	132	31.5	22
LTZPFL120-00-6-R-24V	red, 630 nm	26.3	120	24	234	5.7	36	702	132	31.5	22
LTZPFL120-00-6-G-24V	green, 525 nm	26.3	120	24	216	5.2	36	648	132	31.5	22
LTZPFL120-00-6-B-24V	blue, 470 nm	26.3	120	24	216	5.2	36	648	132	31.5	22
LTZPFL160-00-6-W-24V	white, 6300 K	26.3	160	24	288	7	36	864	172	31.5	22
LTZPFL160-00-6-R-24V	red, 630 nm	26.3	160	24	312	7.5	36	936	172	31.5	22
LTZPFL160-00-6-G-24V	green, 525 nm	26.3	160	24	288	7	36	864	172	31.5	22
LTZPFL160-00-6-B-24V	blue, 470 nm	26.3	160	24	288	7	36	864	172	31.5	22
LTZPFL200-00-6-W-24V	white, 6300 K	26.3	200	24	360	8.7	36	1080	212	31.5	22
LTZPFL200-00-6-R-24V	red, 630 nm	26.3	200	24	390	9.4	36	1170	212	31.5	22
LTZPFL200-00-6-G-24V	green, 525 nm	26.3	200	24	360	8.7	36	1080	212	31.5	22
LTZPFL200-00-6-B-24V	blue, 470 nm	26.3	200	24	360	8.7	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.

Ordering information

Our part numbers are coded as **LTZPFLxxx-yy-z-a-bbV** where:

- **xxx** defines the lighting area length
- **yy** defines the light angle (for this series the angle is 00 = 0°)
- **z** defines the number of LED rows
- **a** defines the color: R = red, G = green, B = blue, W = white. Contact us for additional wavelengths.
- **bb** defines the supply voltage. Optional 12V version is available.

All accessories including lighting extension cables (CB series), diffusers (DFLT series), polarizers (PLLT series) and mounting brackets (CMLT series) must be ordered separately. Optional connectors: LTBRDC series is available with JST connector per standard. For M8 or M12 connectors (available as optional) add -M8 or -M12 at the end of the part number. Examples: LTZPFL040-00-6-W-24V-M8, LTZPFL040-00-6-W-24V-M12

LTCXC series

Continuous LED coaxial lights

DIFFUSED



KEY ADVANTAGES

24V DC supply voltage.

Easy integration & compact size.

JST connector (optional M8, M12).

Red, Green, Blue and White.

Custom sizes available on request.

COMPATIBLE STROBE CONTROLLER



LTDV1CH-17V strobe controller

p. 252

COMPATIBLE LIGHT INTENSITY CONTROLLER



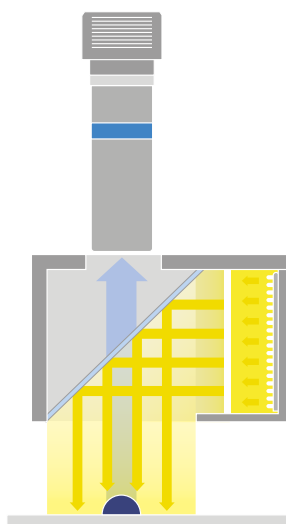
LTCIGR1000-D1-PS-xx light intensity controller

p. 256

The **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 onto the same axis as the camera. Suggested use is continuous mode.

Lighting structure



Application example



Measurement and burr inspection of mechanical valves using the LTCXC series with telecentric lenses.



Optional mounting bracket

Specifically designed to easily mount LTQOG040 model.



Part number	Compatibility
CMLTQOG040	LT2QOG040-00-X-a-24V

Part number	Optical specifications			Electrical specifications					Dimensions		
	Light color, wavelength peak	Lighting area		Supply voltage (V)	Current (mA)	Power cons. (W)	Pulsed mode		Length (mm)	Width (mm)	Height (mm)
		Width (mm)	Length (mm)				Supply voltage (V)	Max pulse current (mA)			
LT2QOG025-00-X-W-24V	white, 6300 K	27	27	24	160	3.9	36	480	54	33	33
LT2QOG025-00-X-R-24V	red, 630 nm	27	27	24	150	3.6	36	450	54	33	33
LT2QOG025-00-X-G-24V	green, 525 nm	27	27	24	160	3.9	36	480	54	33	33
LT2QOG025-00-X-B-24V	blue, 470 nm	27	27	24	160	3.9	36	480	54	33	33
LT2QOG040-00-X-W-24V	white, 6300 K	48	48	24	350	8.4	36	1050	107.5	60	66
LT2QOG040-00-X-R-24V	red, 630 nm	48	48	24	146	3.5	36	438	107.5	60	66
LT2QOG040-00-X-G-24V	green, 525 nm	48	48	24	350	8.4	36	1050	107.5	60	66
LT2QOG040-00-X-B-24V	blue, 470 nm	48	48	24	350	8.4	36	1050	107.5	60	66
LT2QOG070-00-X-W-24V	white, 6300 K	70	70	24	560	13.5	36	1680	139.6	89	95
LT2QOG070-00-X-R-24V	red, 630 nm	70	70	24	525	12.6	36	1575	139.6	89	95
LT2QOG070-00-X-G-24V	green, 525 nm	70	70	24	560	13.5	36	1680	139.6	89	95
LT2QOG070-00-X-B-24V	blue, 470 nm	70	70	24	560	13.5	36	1680	139.6	89	95
LT2QOG100-00-X-W-24V	white, 6300 K	100	100	24	781	18.8	36	2000	166.5	120	123.8
LT2QOG100-00-X-R-24V	red, 630 nm	100	100	24	450	10.8	36	1350	166.5	120	123.8
LT2QOG100-00-X-G-24V	green, 525 nm	100	100	24	781	18.8	36	2000	166.5	120	123.8
LT2QOG100-00-X-B-24V	blue, 470 nm	100	100	24	781	18.8	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.

Ordering information

Our part numbers are coded as **LT2QOGxxx-yy-X-a-bbV** where:
 - **xxx** defines the lighting area width and length
 - **yy** defines the light angle (for this series the angle is 00 = 0°)
 - **a** defines the color: R = red, G = green, B = blue, W = white. Contact us for additional wavelengths.
 - **bb** defines the supply voltage. Optional 12V version is available.

All accessories including lighting extension cables (CB series) and mounting brackets (CMLT series) must be ordered separately.
 Optional connectors: LTCXC series is available with JST connector per standard. For M8 or M12 connectors (available as optional) add -M8 or -M12 at the end of the part number.
 Examples: LT2QOG040-00-X-W-24V-M8, LT2QOG040-00-X-W-24V-M12

LTTNC series

Continuous LED tunnel lights

INDIRECT



KEY ADVANTAGES

24V DC supply voltage.

Easy integration & compact size.

JST connector (optional M8, M12).

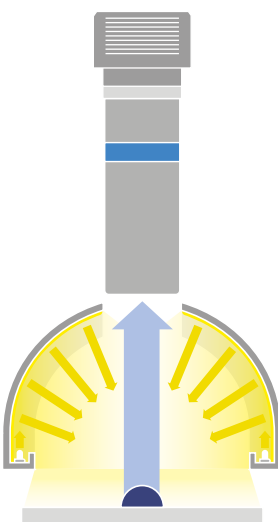
Red, Green, Blue and White.

Custom sizes available on request.

COMPATIBLE STROBE CONTROLLER		
	LTDV1CH-17V strobe controller	p. 252
COMPATIBLE LIGHT INTENSITY CONTROLLER		
	LTICGR1000-D1-PS-xx light intensity controller	p. 256
FULL RANGE OF FIXED FOCAL LENGTH LENSES		
	EN2MP series, EN5MP series, EN-2RT series, EN-5RT series	p. 74-77

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

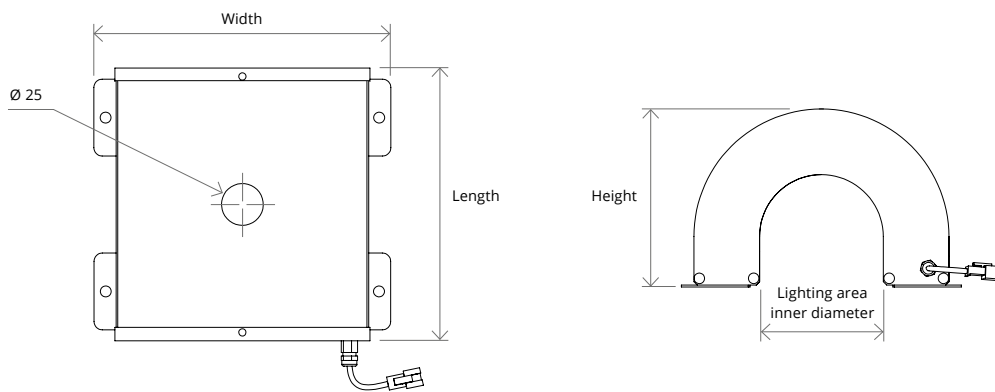
Lighting structure



Application example



Detection of scratches and dark spots on cylindrical metal parts using LTTNC tunnel lights and fixed focal length lenses.



Part number	Optical specifications				Electrical specifications					Dimensions		
	Light color, wavelength peak	Optimal WD (mm)	Lighting area		Continuous mode			Pulsed mode		Width x length (mm)	Aperture (mm)	Height (mm)
			inner diam. (mm)	Width (mm)	Supply voltage (V)	Current (mA)	Power cons. (W)	Supply voltage (V)	Max pulse current (mA)			
LT3WRH150-00-1-W-24V	white, 6300 K	40 - 60	74	147	24	400	9.6	36	1200	177.6 x 163	25	106.5
LT3WRH150-00-1-R-24V	red, 630 nm	40 - 60	74	147	24	450	10.8	36	1350	177.6 x 163	25	106.5
LT3WRH150-00-1-G-24V	green, 525 nm	40 - 60	74	147	24	400	9.6	36	1200	177.6 x 163	25	106.5
LT3WRH150-00-1-B-24V	blue, 470 nm	40 - 60	74	147	24	400	9.6	36	1200	177.6 x 163	25	106.5
LT3WRH200-00-1-W-24V	white, 6300 K	40 - 60	124	147	24	400	9.6	36	1200	227 x 163	25	131.5
LT3WRH200-00-1-R-24V	red, 630 nm	40 - 60	124	147	24	450	10.8	36	1350	227 x 163	25	131.5
LT3WRH200-00-1-G-24V	green, 525 nm	40 - 60	124	147	24	400	9.6	36	1200	227 x 163	25	131.5
LT3WRH200-00-1-B-24V	blue, 470 nm	40 - 60	124	147	24	400	9.6	36	1200	227 x 163	25	131.5

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.

Ordering information

Our part numbers are coded as **LT3WRHxxx-yy-z-a-bbV** where:

- **xxx** defines the lighting width
- **yy** defines the light angle (for this series the angle is 00 = 0°)
- **z** defines the number of LED rows
- **a** defines the color: R = red, G = green, B = blue, W = white. Contact us for additional wavelengths.
- **bb** defines the supply voltage. Optional 12V version is available.

Lighting extension cables (CB series) are not included and must be ordered separately.

Optional connectors: LTTNC series is available with JST connector per standard. For M8 or M12 connectors (available as optional) add -M8 or -M12 at the end of the part number.

Examples: LT3WRH150-00-1-W-24V-M8, LT3WRH150-00-1-W-24V-M12

LTLNC series

Continuous LED line lights

FOCUSED

NEW
MODELS



KEY ADVANTAGES

Ultra high power.

Color matched white models.

Condenser lens for a perfectly focused beam of light.

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




Forced air cooling option.

The **LTLNC series** offers ultra-high power LED line illuminators designed for line scan applications. Their special design provides both a powerful and homogeneous beam of light that is sharply focused onto the object being inspected, by means of a condenser lens.

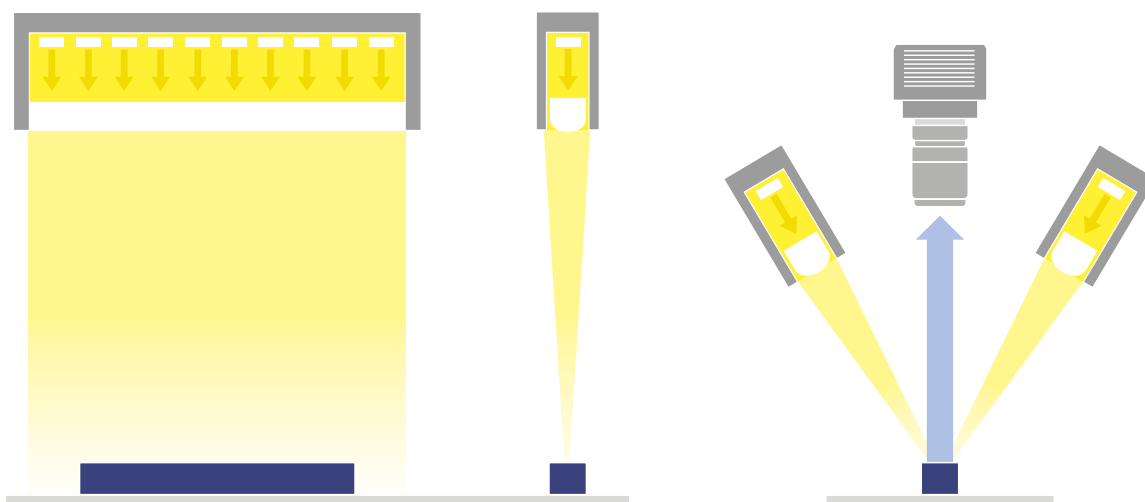
The LTLNC series can efficiently dissipate the generated heat thanks to the fins machined in the aluminium housing and the air cooling ports designed to inject compressed air into the illuminator.

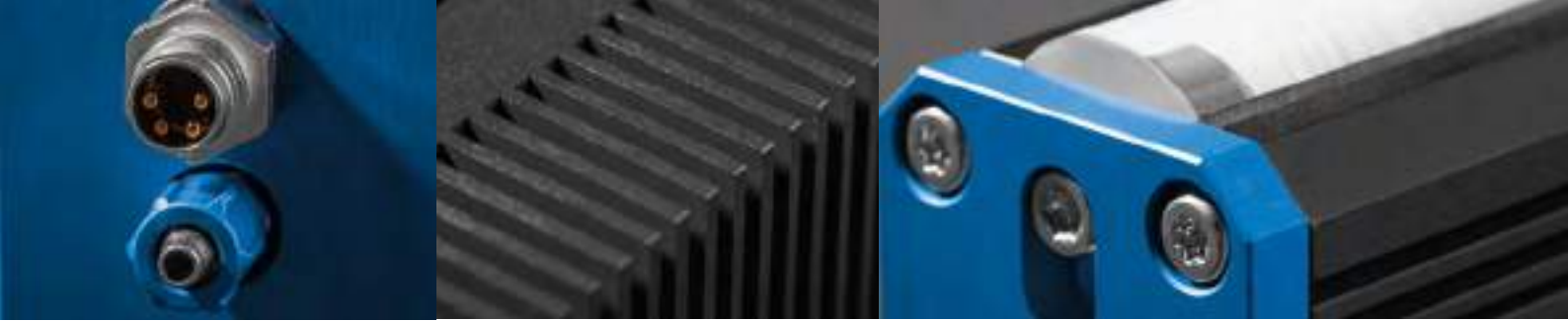
Furthermore the LTLNC series features industrial M8 connectors and can be easily installed into any machine vision system thanks to the four M3 threads in the rear part of the aluminium housing.

SEE ALSO FULL RANGE OF LINE SCAN LENSES

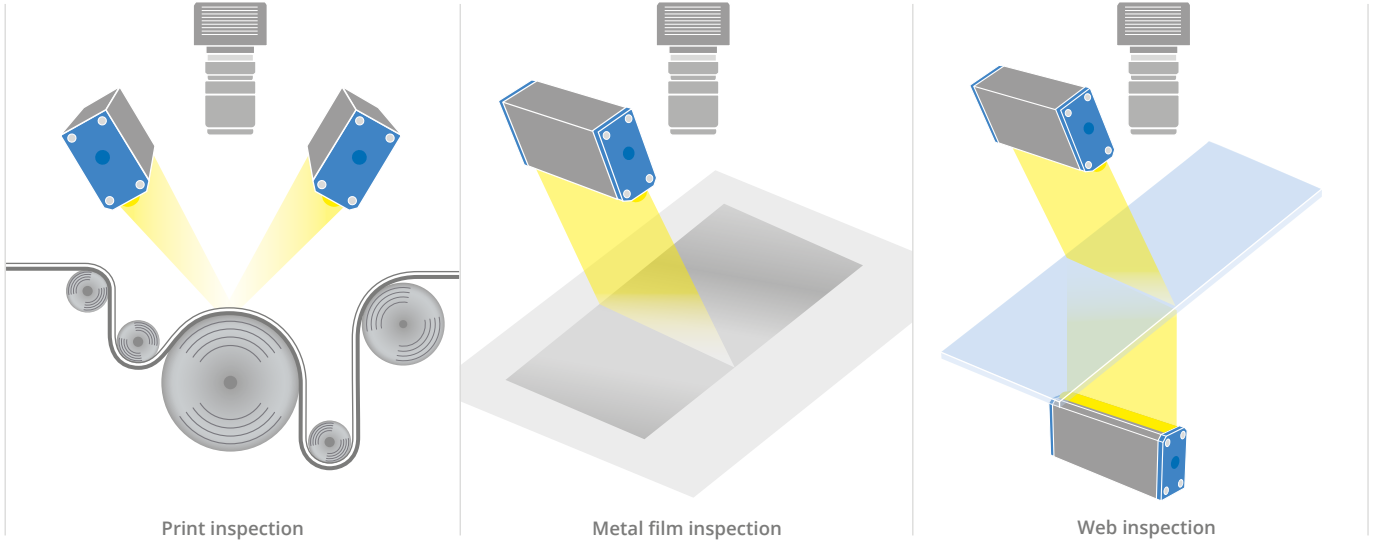
	TC12K series	p. 50
	TC4K series	p. 52
	MC4K series	p. 82
	MC12K series	p. 85

Lighting structure





Application examples



Part number	Optical specifications				Electrical specifications							Mechanical specifications			Compatibility		
	Number of LEDs	Light color	Illumination area (mm x mm)	Suggested working distance WD (mm)	Continuous mode			Pulsed mode ¹				Length (mm)	Width (mm)	Height (mm)	LED controllers	Cables	Lenses
					Supply voltage (V)	Continuous driving current max (mA)	Power consumption (W)	Max pulse current (mA)	Voltage (V)	Peak power (W)	Connection type ²						
LTLNC050-W	12	white, 6500 K	50 x 15	20 - 100	24 ± 2%	600	15	2900	55	160	M8 4 PIN industrial male connector	80	32	60	LTC1CH-A1-4, LTC1CH-D1-4, LTDVE2CH-20F, LTDVE4CH-20, LTDVE8CH-20	CBLT003, CBLT004	TC4K060-x TC4K090-x TC4K120-x TC4K180-x TC12K064, TC12K080, TC12K120, TC12K144, TC12K192, TC12K240, MC4K series, MC12K200X-x, MC12K150X-x, MC12K100X-x, MC12K067X-x, MC12K050X-x, MC12K025X-x
LTLNC050-R	9	red, 625 nm				600	15	1000	28	28		80	32	60			
LTLNC050-G	12	green, 525 nm				600	15	2000	39	78		80	32	60			
LTLNC050-B	12	blue, 475 nm				600	15	2000	41	82		80	32	60			
LTLNC050-IR850	11	IR, 850 nm				300	7,2	1500	59	89		80	32	60			
LTLNC100-W	21	white, 6500 K	100 x 15	20 - 100	24 ± 2%	1050	26	4350	42	183	M8 4 PIN industrial male connector	150	32	60	LTC1CH-A1-4, LTC1CH-D1-4, LTDVE2CH-20F, LTDVE4CH-20, LTDVE8CH-20	CBLT003, CBLT004	TC4K060-x TC4K090-x TC4K120-x TC4K180-x TC12K064, TC12K080, TC12K120, TC12K144, TC12K192, TC12K240, MC4K series, MC12K200X-x, MC12K150X-x, MC12K100X-x, MC12K067X-x, MC12K050X-x, MC12K025X-x
LTLNC100-R	18	red, 625 nm				1000	24	2000	31	62		150	32	60			
LTLNC100-G	21	green, 525 nm				1050	26	3000	31	93		150	32	60			
LTLNC100-B	21	blue, 475 nm				1050	26	3000	31	93		150	32	60			
LTLNC100-IR850	22	IR, 850 nm				600	15	3000	60	180		150	32	60			
LTLNC150-W	28	white, 6500 K	150 x 15	20 - 100	24 ± 2%	1400	34	5800	42	244	M8 4 PIN industrial male connector	200	32	60	LTC1CH-A1-4, LTC1CH-D1-4, LTDVE2CH-20F, LTDVE4CH-20, LTDVE8CH-20	CBLT003, CBLT004	TC4K060-x TC4K090-x TC4K120-x TC4K180-x TC12K064, TC12K080, TC12K120, TC12K144, TC12K192, TC12K240, MC4K series, MC12K200X-x, MC12K150X-x, MC12K100X-x, MC12K067X-x, MC12K050X-x, MC12K025X-x
LTLNC150-R	27	red, 625 nm				1500	36	3000	31	93		200	32	60			
LTLNC150-G	28	green, 525 nm				1400	34	4000	31	124		200	32	60			
LTLNC150-B	28	blue, 475 nm				1400	34	4000	31	124		200	32	60			
LTLNC150-IR850	33	IR, 850 nm				900	22	4500	60	270		150	32	60			
LTLNC200-W	28	white, 6500 K	200 x 15	20 - 100	24 ± 2%	1600	39	6000	41	246	M8 4 PIN industrial male connector	250	32	60	LTC1CH-A1-4, LTC1CH-D1-4, LTDVE2CH-20F, LTDVE4CH-20, LTDVE8CH-20	CBLT003, CBLT004	TC4K060-x TC4K090-x TC4K120-x TC4K180-x TC12K064, TC12K080, TC12K120, TC12K144, TC12K192, TC12K240, MC4K series, MC12K200X-x, MC12K150X-x, MC12K100X-x, MC12K067X-x, MC12K050X-x, MC12K025X-x
LTLNC200-R	27	red, 625 nm				1650	40	3000	31	93		250	32	60			
LTLNC200-G	28	green, 525 nm				1600	39	4000	32	128		250	32	60			
LTLNC200-B	28	blue, 475 nm				1600	39	4000	32	128		250	32	60			
LTLNC200-IR850	33	IR, 850 nm				1050	26	4500	55	248		150	32	60			
LTLNC300-W	42	white, 6500 K	300 x 15	20 - 100	24 ± 2%	2100	51	9000	44	396	M8 4 PIN industrial male connector	350	32	60	LTC1CH-A1-4, LTC1CH-D1-4, LTDVE2CH-20F, LTDVE4CH-20, LTDVE8CH-20	CBLT003, CBLT004	TC4K060-x TC4K090-x TC4K120-x TC4K180-x TC12K064, TC12K080, TC12K120, TC12K144, TC12K192, TC12K240, MC4K series, MC12K200X-x, MC12K150X-x, MC12K100X-x, MC12K067X-x, MC12K050X-x, MC12K025X-x
LTLNC300-R	36	red, 625 nm				2000	48	4000	31	124		350	32	60			
LTLNC300-G	42	green, 525 nm				2100	51	6000	33	198		350	32	60			
LTLNC300-B	42	blue, 475 nm				2100	51	6000	33	198		350	32	60			
LTLNC300-IR850	44	IR, 850 nm				1200	29	6000	60	360		150	32	60			

- ¹ T_{on} max = 100 ms, Duty cycle ≤ 5%.
- 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).

LTLNM series

Flicker free high power focused modular LED line lights

H FOCUSED/COLLIMATED



KEY ADVANTAGES

Emitting surface up 2 meters in 200 mm increments.

Flicker free for line scan applications.

3 types of projection lenses

Near field focusing (N), far field focusing (F), collimated (C).

Homogeneous beam for uniform illumination.

Built-in controller / 24VDC power supply.
Dimmable (external 0-10V analogue signal).
Enable signal.

Fault output (for overtemperature detection).
Auto shutdown in case of overheating.

Optional diffusive sheet (D) for superior illumination uniformity.

White color (other colors on request)
3 Amps / 72 W per module.

The LTLNM series offers high power LED line illuminators designed for line scan applications. These lights are flicker-free and meet the needs of demanding applications with reduced exposure times (tens of μs) ensuring very constant illumination and repeatable acquisition. Their modular design provides size flexibility without any compromise in terms of light uniformity.

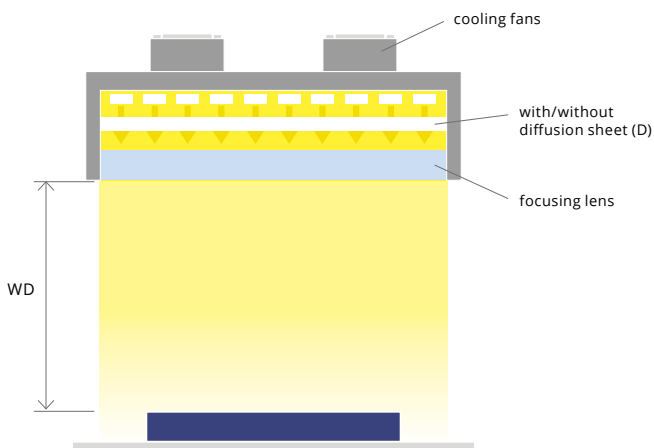
LTLNM are available with an emitting surface of up to 2 meters in 200 mm increments (custom sizes and colors can be requested). The LTLNM series can be supplied with three different light angles/ focusing distances: near field focused (N) with converging rays (10 - 100 mm), far field focused (F) with converging rays (100 - 200 mm) and collimated (C) working at a distance between 10 and 200 mm.

An optional diffusive sheet (D) can be integrated in any model to obtain the best illumination uniformity.

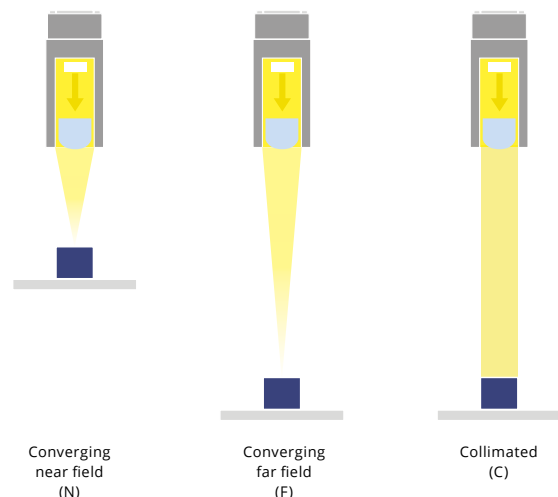
These lights feature 24V supply voltage and can be easily dimmed through an analogue signal.

The LTLNM series can efficiently dissipate the generated heat thanks an efficient forced-air cooling system (fans). The on-board electronics constantly monitor the LED temperature and drives the fans only if needed, in order to minimise noise and increase fan life. These line lights are perfect for applications that require high speed image processing such as fabrics and web inspection.

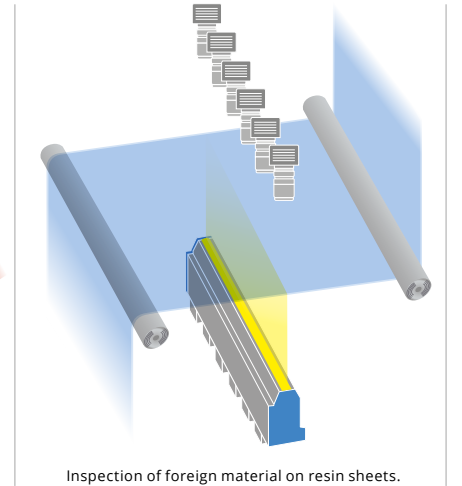
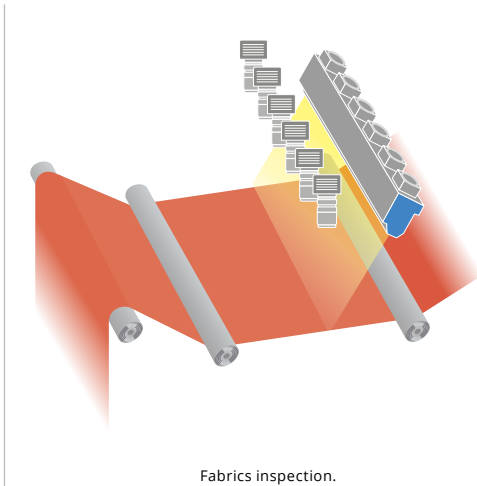
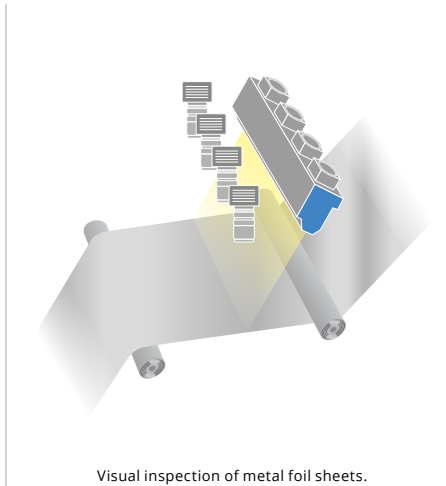
Lighting structure



Projection lenses and focusing distances



Application examples



Part number	Modules	Optical specifications				Electrical specifications				Mechanical specifications				Compatibility		
		Emitting length aaaa (mm)	Projection lens and suggested WD b (mm)	Diffuser c	Light color d	Supply voltage (V)	Current consumption (A)	Power consumption (W)	Connection type 1	Length (mm)	Width (mm)	Height (mm)	Cooling method	Clamping system	Light intensity controllers	Lenses
LTLNM-0200-b-c-FC-W	1	200			White	24V ± 2%	3	72	2 pigtaills terminated with industrial connectors 1	250	80	130	fan (FC)			
LTLNM-0400-b-c-FC-W	2	400			White	24V ± 2%	6	144	2 pigtaills terminated with industrial connectors 1	450	80	130	fan (FC)			
LTLNM-0600-b-c-FC-W	3	600			White	24V ± 2%	9	216	2 pigtaills terminated with industrial connectors 1	650	80	130	fan (FC)			
LTLNM-800-b-c-FC-W	4	800			White	24V ± 2%	12	288	2 pigtaills terminated with industrial connectors 1	850	80	130	fan (FC)			
LTLNM-1000-b-c-FC-W	5	1000	N = near field focusing (10- 100 mm), F = far field focusing (100- 200 mm), C = collimated (10 - 200 mm)	c = D, with diffuser, c = empty, no diffuser	White	24V ± 2%	15	360	2 pigtaills terminated with industrial connectors 1	1050	80	130	fan (FC)	4 threaded holes for M10 screw	embedded	TC4K060-x, TC4K090-x, TC4K120-x, TC4K180-x, TC12K064, TC12K080, TC12K120, TC12K144, TC12K144, TC12K192, TC12K240, MC4K series, MC12K200X-x, MC12K150X-x, MC12K100X-x, MC12K067X-x, MC12K050X-x, MC12K025X-x
LTLNM-1200-b-c-FC-W	6	1200			White	24V ± 2%	18	432	2 pigtaills terminated with industrial connectors 1	1250	80	130	fan (FC)			
LTLNM-1400-b-c-FC-W	7	1400			White	24V ± 2%	21	504	3 pigtaills terminated with industrial connectors 2	1450	80	130	fan (FC)			
LTLNM-1600-b-c-FC-W	8	1600			White	24V ± 2%	24	576	3 pigtaills terminated with industrial connectors 2	1650	80	130	fan (FC)			
LTLNM-1800-b-c-FC-W	9	1800			White	24V ± 2%	27	648	3 pigtaills terminated with industrial connectors 2	1850	80	130	fan (FC)			
LTLNM-2000-b-c-FC-W	10	2000			White	24V ± 2%	30	720	3 pigtaills terminated with industrial connectors 2	2050	80	130	fan (FC)			

1 1 pigtail terminated with industrial circular male connector for power supply,
1 pigtail terminated with industrial circular male connector for i/o signals.

2 2 pigtaills terminated with industrial circular male connector for power supply,
1 pigtail terminated with industrial circular male connector for i/o signals.

Ordering information

Our part numbers are coded as **LTLNM-aaaa-b-c-FC-d** where:

- **aaaa** defines the illumination active area length (in mm)

- **b** defines the focusing distance, N = near field focusing, F = far field focusing, C = collimated

- **c** defines the presence of a diffusing sheet. Leave empty if no diffuser is required or D = with diffuser mounted in front of the LEDs

- **d** defines the color -W = White.

LTLNE series

High power enhanced LED line lights

H FOCUSED/COLLIMATED



KEY ADVANTAGES

High density LEDs.

3 types of projection lenses

Near field focusing (N), far field focusing (F), collimated (C).

3 opto-mechanical configurations

Lens only, coaxial illumination (CX) or with 45° mirror (MR).

2 cooling methods and power intensities

Passive or active with fans.

Optional diffusive sheet (D) for illumination uniformity

Hot spots reduction when inspecting highly reflective surfaces.

The **LTLNE series** offers high power LED line illuminators designed for line scan applications. The LTLNE series is available in three opto-mechanical versions: basic configuration with condensing lens, as coaxial line lights (CX) or integrating a 45° mirror (MR).

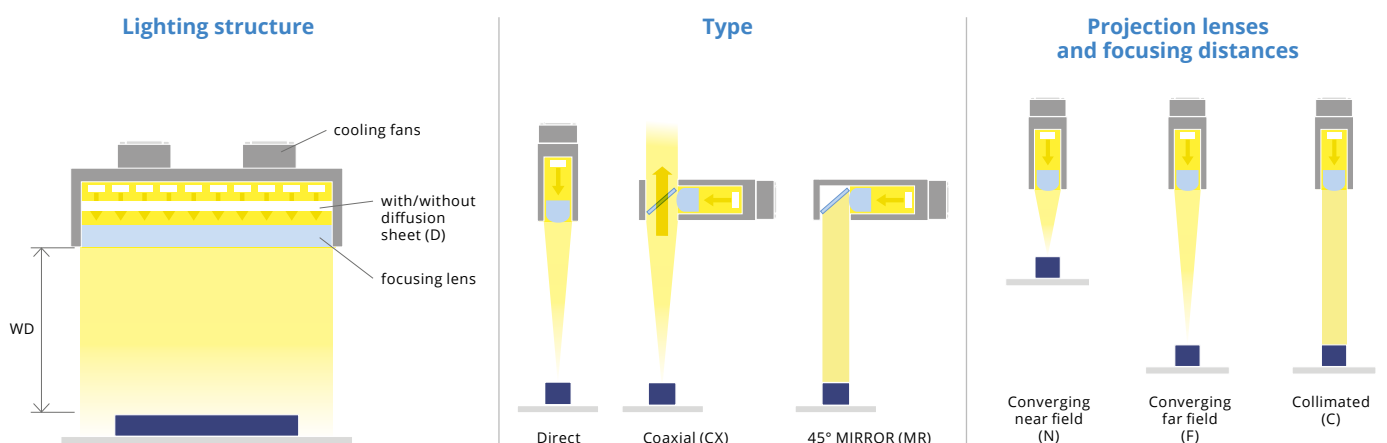
The LTLNE series can be supplied with three different light angles/ focusing distances: near field focused (N) with converging rays (10 – 100 mm), far field focused (F) with converging rays (100 - 200 mm) and collimated (C) focusing at a distance between 10 and 200 mm. An optional diffusive sheet (D) can be integrated in any model to obtain the best illumination uniformity.

These LED line lights are available with an emitting surface of 300 mm (custom sizes and colors can be requested) and feature 24V supply voltage.

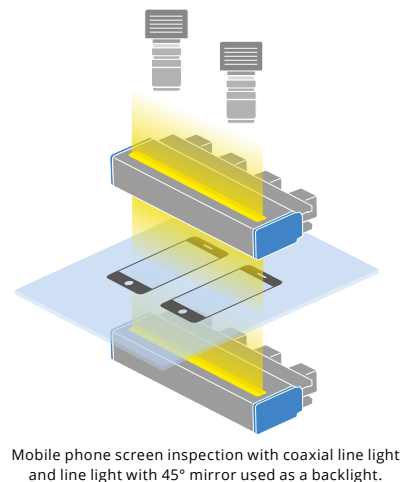
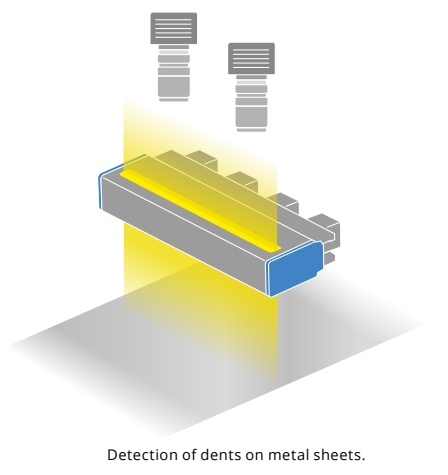
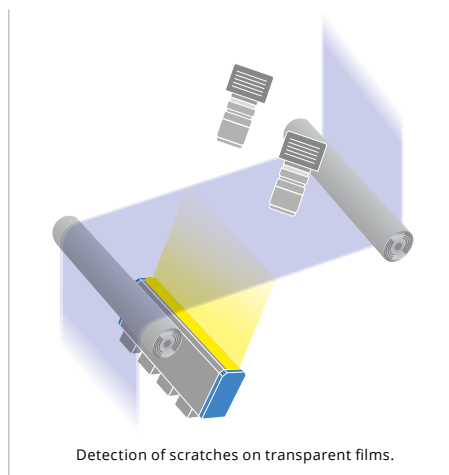
The whole family can efficiently dissipate the generated heat featuring two cooling options: passive cooling (PC) and fan cooling (FC).

Furthermore the LTLNE series features industrial threaded connectors and can be easily installed into any machine vision system thanks to the threaded holes conveniently located on the aluminium housing.

These line lights are perfect for applications that require high speed image processing such as transparent films or glass inspection and detection of dents on metal sheets.



Application examples



	Optical specifications					Electrical specifications				Mechanical specifications					Compatibility	
	Type	Emitting length	Light color	Projection lens and suggested WD	Diffuser	Supply voltage	Nominal driving current	Power consumption at nominal driving current ¹	Connection type	Length	Width	Height	Cooling method	Clamping system	Light intensity controllers	Lenses
	bb	aaa (mm)	f	c (mm)	d	(V)	(mA)	(W)		(mm)	(mm)	(mm)	ee			
LTLNE-300-N-PC-W					no		2000	50			110		passive			
LTLNE-300-N-FC-W					no		4000	100			150	40	fan		LTIC1CH-A1-4	
LTLNE-300-N-D-PC-W	direct	300	White	10 - 100 near field focusing		24V ± 2%	2000	50		340	110		passive			
LTLNE-300-N-D-FC-W					yes		4000	100			150		fan			
LTLNE-300-F-PC-W					no		2000	50			110		passive			
LTLNE-300-F-FC-W					no		4000	100			150	40	fan			
LTLNE-300-F-D-PC-W	direct	300	White	100 - 200 far field focusing		24V ± 2%	2000	50	20 cm pigtail terminated with industrial circular male connector	340	110		passive	8 threaded holes for M4 screw	LTIC1CH-A1-4	
LTLNE-300-F-D-FC-W					yes		4000	100			150		fan			
LTLNE-300-C-PC-W					no		2000	50			110		passive			
LTLNE-300-C-FC-W					no		4000	100			150	40	fan			
LTLNE-300-C-D-PC-W	direct	300	White	10 - 200 collimated		24V ± 2%	2000	50		340	110		passive		LTIC1CH-A1-4	
LTLNE-300-C-D-FC-W					yes		4000	100			150		fan			
LTLNE-300-CX-N-PC-W					no		2000	50			150		passive			
LTLNE-300-CX-N-FC-W					no		4000	100			190	54	fan		LTIC1CH-A1-4	TC4K060-x TC4K090-x TC4K120-x TC4K180-x TC12K054- TC12K080- TC12K120- TC12K144- TC12K144- TC12K192- TC12K240- MC4K series, MC12K200X-x, MC12K150X-x, MC12K100X-x, MC12K067X-x, MC12K050X-x, MC12K025X-x
LTLNE-300-CX-N-D-PC-W	coaxial	300	White	10 - 100 near field focusing		24V ± 2%	2000	50		340	150		passive			
LTLNE-300-CX-N-D-FC-W					yes		4000	100			190		fan			
LTLNE-300-CX-F-PC-W					no		2000	50			150		passive			
LTLNE-300-CX-F-FC-W					no		4000	100			190	54	fan			
LTLNE-300-CX-F-D-PC-W	coaxial	300	White	100 - 200 far field focusing		24V ± 2%	2000	50	20 cm pigtail terminated with industrial circular male connector	340	150		passive	8 threaded holes for M4 screw	LTIC1CH-A1-4	
LTLNE-300-CX-F-D-FC-W					yes		4000	100			190		fan			
LTLNE-300-CX-C-PC-W					no		2000	50			150		passive			
LTLNE-300-CX-C-FC-W					no		4000	100			190	54	fan			
LTLNE-300-CX-C-D-PC-W	coaxial	300	White	10 - 200 collimated		24V ± 2%	2000	50		340	150		passive		LTIC1CH-A1-4	
LTLNE-300-CX-C-D-FC-W					yes		4000	100			190		fan			
LTLNE-300-MR-N-PC-W					no		2000	50			150		passive			
LTLNE-300-MR-N-FC-W					no		4000	100			190	54	fan		LTIC1CH-A1-4	
LTLNE-300-MR-N-D-PC-W	with 45° mirror	300	White	10 - 100 near field focusing		24V ± 2%	2000	50		340	150		passive			
LTLNE-300-MR-N-D-FC-W					yes		4000	100			190		fan			
LTLNE-300-MR-F-PC-W					no		2000	50			150		passive			
LTLNE-300-MR-F-FC-W					no		4000	100			190	54	fan			
LTLNE-300-MR-F-D-PC-W	with 45° mirror	300	White	100 - 200 far field focusing		24V ± 2%	2000	50	20 cm pigtail terminated with industrial circular male connector	340	150		passive	8 threaded holes for M4 screw	LTIC1CH-A1-4	
LTLNE-300-MR-F-D-FC-W					yes		4000	100			190		fan			
LTLNE-300-MR-C-PC-W					no		2000	50			150		passive			
LTLNE-300-MR-C-FC-W					no		4000	100			190	54	fan			
LTLNE-300-MR-C-D-PC-W	with 45° mirror	300	White	10 - 200 collimated		24V ± 2%	2000	50		340	150		passive		LTIC1CH-A1-4	
LTLNE-300-MR-C-D-FC-W					yes		4000	100			190		fan			

1 Models with fan cooling are capable of more power. Ask technical support for details. Other colors are available on request.

Ordering information

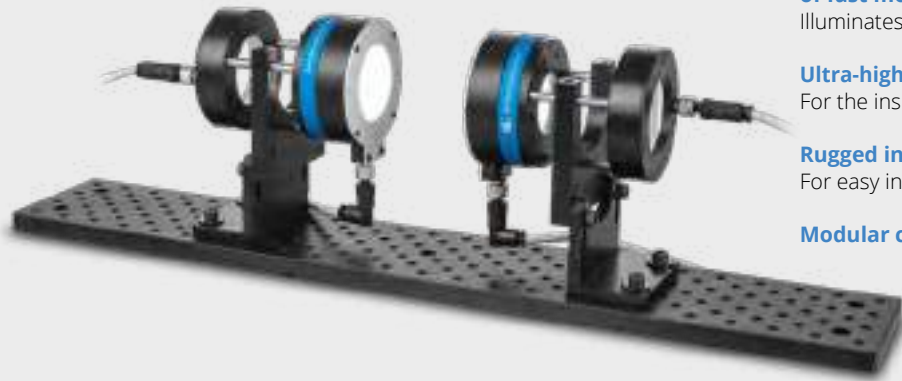
Our part numbers are coded as **LTLNE-aaa-bb-c-d-ee-f** where:

- **aaa** defines the illumination active area length (in mm)
- **bb** defines the presence of a beam splitter or a mirror. Leave empty for direct illumination (lens only) - CX = coaxial illumination (50T-50R Beam splitter), -MR = 90° mirror
- **c** defines the focusing distance, N = near field focusing, F = far field focusing, C = collimated
- **d** defines the presence of a diffusing sheet. Leave empty if no diffuser is required or D = with diffuser mounted in front of the LEDs
- **ee** defines the cooling options PC = passive cooling, FC = fan cooling
- **f** defines the color -W = White.

View-through system

Space-saving illumination system for double-side object inspection

DIFFUSED/INDIRECT



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.



The **View-through system** is a unique space-saving illumination solution designed to illuminate two sides of an object. It consists of two symmetrical modules, each one made of two illumination units:

- A diffuse strobe dome illuminator (white color)
- A special active “view-through” backlight unit (white color)

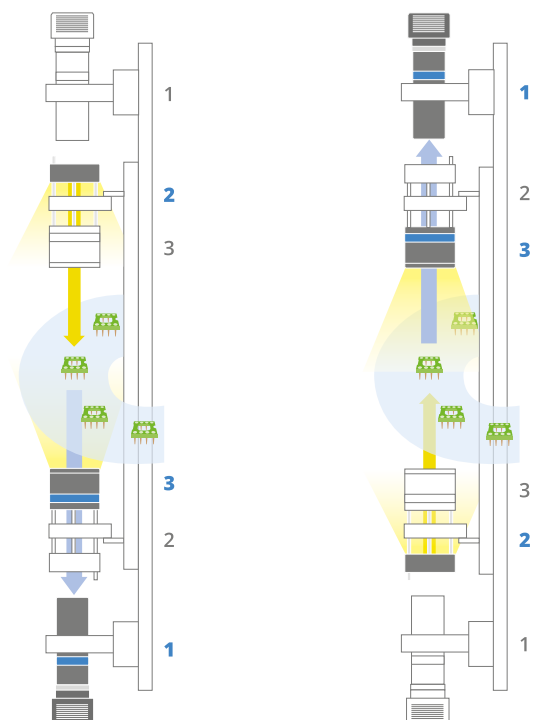
View-through system is designed to create very compact inline inspection solutions that illuminate and image both sides of fast-moving objects. While one camera acquires the image of one side of an object, the corresponding dome and special backlight units emit light simultaneously so that one side of 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 an innovative approach is achieved thanks to the special backlight units which act either as transparent windows (when turned off) or as backlights (when turned on), enabling to quickly and accurately inspect fast-moving objects almost simultaneously, in a very compact solution.

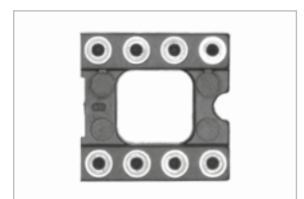
The View-through system can be used for many different inspections, especially for the identification of surface defects/features in applications spanning from automotive to pharmaceutical.

The 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 LTVTENCH, 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



DIL socket, bottom side.



DIL socket, top side.

DESIGNED FOR OEM APPLICATIONS

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



FULL RANGE OF COMPATIBLE TELECENTRIC LENSES

	TCLWD series	p. 22
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FULL RANGE OF FIXED FOCAL LENGTH LENSES

	EN2MP series, EN5MP series, EN-2RT series, EN-5RT series	p. 74-77
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COMPATIBLE STROBE CONTROLLER AVAILABLE

	LTDV6CH	p. 252
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Part number			LTVTA1-W	LTVTBENCH
Optical specifications				
Dome unit				
Number of LEDs				15
Light color				white, 6000 K
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 color				white, 6000 K
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 anodised aluminium body	
Clamping system			4 threaded holes for M6 screw	
Compatibility				
Lenses			TCLWD series, TCEL series (except TCEL23036)	

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 ring light unit.

⁴ At 25 °C.

⁵ Cables included.

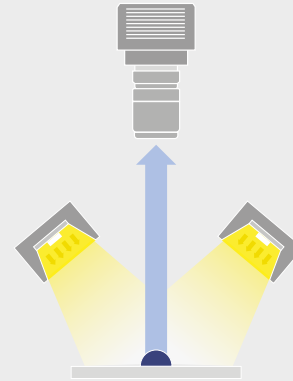
UV series

UV illuminators with different geometry

NEW

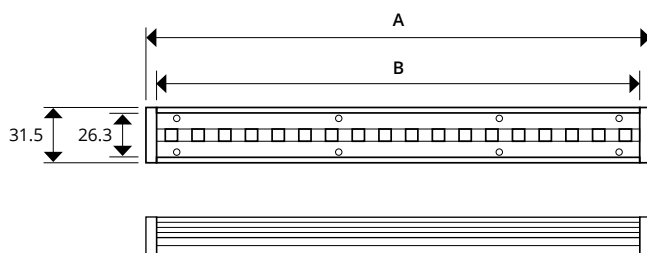


Lighting structure



UV illumination has shorter wavelengths compared to the visible illumination. Ultraviolet illumination with wavelengths shorter than the visible light has electromagnetic radiation in the range between

300 nm and 450 nm, which allows chemicals with UV lighting interaction to be visible under this light.



TECHNICAL SPECIFICATION

- UV365 - 24V Input Power
- continuous and strobe applications
- compact size
- lighting cable 500mn

CUSTOMIZE LIGHTING

- customize sizes, mounting requirements
- contact our sales for more information

Part number	Description	Dimensions (mm)		Color	Voltage/Watt	Current (mA)	Weight (g)
		A	B				
LTZPFL080-00-1-UV365-24V	LED bar light, 1 LED row, 80X17.3 illumination area, UV 365, 24V	92	80	UV365	24V/ 2.4W	100	95
LTZPFL160-00-1-UV365-24V	LED bar light, 1 LED row, 160X17.3 illumination area, UV 365, 24V	175	160	UV365	24V/ 4.8W	200	155
LTZPFL240-00-1-UV365-24V	LED bar light, 1 LED row, 240X17.3 illumination area, UV 365, 24V	252	240	UV365	24V/ 7.2W	300	230

Other lighting geometries



Part number	Description	Color	Voltage/Watt	Current (mA)	Weight (g)
LTZGK070-15-2-UV375-24V	LED ring light, 2 LED rows, outer diameter 70 mm, 15°, UV 375, 24V	UV375	24V/ 4.32W	180	103
LTZGK090-15-3-UV375-24V	LED ring light, 3 LED rows, outer diameter 92 mm, 15°, UV 375, 24V	UV375	24V/ 7.20W	300	160
LTZGK040-30-1-UV375-24V	LED ring light, 1 LED row, outer diameter 54 mm, 30°, UV 375, 24V	UV375	24V/ 1.08W	45	45
LTZZO090-60-2-UV375-24V	LED low angle ring light, 2 LED rows, outer diameter 90 mm, 60°, UV 375, 24V	UV375	24V/ 7.98W	320	109
LTZZO150-60-2-UV375-24V	LED low angle ring light, 2 LED rows, outer diameter 151 mm, 60°, UV 375, 24V	UV375	24V/ 11.52W	480	272
LTZZO170-75-2-UV375-24V	LED low angle ring light, 2 LED rows, outer diameter 175 mm, 75°, white, 24V	UV375	24V/ 8.40W	350	342
LT2QOG025-00-X-UV365-24V	LED coaxial light, 25x25.6 mm light emitting area, UV 365, 24V	UV365	24V/ 0.72W	30	83
LT2QOG040-00-X-UV365-24V	LED coaxial light, 48x48 mm light emitting area, UV 365, 24V	UV365	24V/ 1.44W	60	324

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 highprecision 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 different 2/3" C-mount lenses. To achieve the best results we suggest to use bi-telecentric lenses or zero distortion macro lenses.



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

LTPR series

LED pattern projectors



KEY ADVANTAGES

LED technology for perfectly sharp edge

The 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 emitter lines are thicker and show blurred edges; diffraction and speckle effects are also present.

3W, 10W or 90W strobe options.

Wide selection of projection patterns available (custom made on request).

Compatible with any C-mount optics.

The LTPR series consists of different LED pattern projectors available with three power intensities and four wavelengths designed for the most demanding structured light applications including 3D profilometry, stereovision and alignment. The LTPR series consists of LTPRHP3W models featuring = 3W power intensity, LTPRXP models featuring = 10W power intensity designed for continuous mode operation and LTPRUP models designed for strobe-only operation with peak power intensity of = 90W.

Unlike laser sources, our LED pattern projectors ensure sharp edges and homogeneous light without scattering and diffraction effects. Several projections patterns can be easily interchanged to project any kind of shape. Additionally LTPR fetatures built in phase-adjustment for easy alignment of the pattern. Any C-mount optics can be interfaced with LTPR series to project areas with different sizes.

Part number	Optical specifications			Electrical specifications							
	Light color	Spectral FWHM (nm)	Illuminance ¹ (klux)	Operation mode	Supply voltage (V)	LED driving current, max (mA)		Power consumption	Pulse width	Estimated MTBF ⁴	Connection Type
LTPRHP3W											
LTPRHP3W-W	White	n.a.	30	continuous and pulsed mode ²	12 - 24 ³	720 ⁴	2000 ⁵ ⁶	<4.5	≤10 ⁷	> 100.000 ⁹	M8 industrial male connector ¹²
LTPRHP3W-R	Red, 630 nm	15	9								
LTPRHP3W-G	Green, 520 nm	40	14								
LTPRHP3W-B	Blue, 460 nm	20	3								
LTPRXP											
LTPRXP-W	White	n.a.	85	continuous mode only	24 ³	700 ⁴	n.a.	<13	n.a.	> 65.000 ¹⁰	M8 industrial male connector ¹³
LTPRXP-R	Red, 630 nm	20	40								
LTPRXP-G	Green, 520 nm	40	68								
LTPRXP-B	Blue, 460 nm	25	9								
LTPRUP											
LTPRUP-W	White	n.a.	170	strobe only, constant current driving	n.a.	n.a.	17000 ⁶	≈90 (strobe peak LED source power)	≤1 ⁸	> 50000 ¹¹	M12 industrial male connector ¹⁴
LTPRUP-R	Red, 618 nm	20	65								
LTPRUP-G	Green, 525 nm	40	220								
LTPRUP-B	Blue, 460 nm	30	20								

1 With a 35 mm lens, F/N 1.4 at 100 mm working distance without projection pattern at maximum driving current. Estimated value.
 2 To pulse LTRHP3W, models built-in electronics must be bypassed in order to drive the LED directly.
 3 Tolerance ± 10%.
 4 Max continuous LED driving current is supplied through the built-in electronics. No external controller is required.
 5 At max LED pulsed current, max LED forward voltage (V) = 3.00 for LTRHP3W-R, 4.00 for LTRHP3W-G/B, 3.4 for LTRHP3W-W.

6 To directly drive the LED, current control is necessary. External compatible controller from LTDV series must be used.
 7 At pulse width ≤ 10 ms, duty cycle ≤ 10% condition. Built-in electronics must be bypassed.
 8 At 25°C. At max pulse width (1 ms), max pulse frequency = 15 Hz. Contact us to check other admissible combinations of duty cycle-frequency-temperature.



LTPRHP3W-x models featuring built in electronics with multi-turn trimmer for light intensity dimming and ≈ 3W power intensity.

LTPRHP3W and LTPRXP models are designed for continuous mode and integrate built-in electronics that control the current flow through the LED.

LTPRHP3W models integrate a multi-turn trimmer for light intensity dimming while LTPRXP models have fixed current and cannot be dimmed. For LTPRHP3W models, the built-in electronics can be bypassed in order to directly drive the LED through an external controller.



LTPRXP-x models featuring built in electronics, fixed current output and ≈ 10W power intensity

The LTPRUP series offers the most powerful LED pattern projectors available from Opto Engineering®. These models are used in high speed applications where camera exposure time must be set to the minimum, including planarity control of opaque products and 3D profiling. LTPRUP models are designed for strobe-mode only and can be precisely controlled using compatible LTDV strobe controllers series. LTDV controllers are designed to drive the LED of LTPRUP pattern projectors with perfectly constant current, ensuring repeatable results even when low exposure time is required.



LTPRUP-x models for strobe-only operation featuring ≈ 90W peak power intensity. These models are compatible with CMH0016 clamping mechanics, alternatively three M4 and one M6 threads are available as fixing options.

Mechanical specifications				Compatibility				
External	Length 15	Width	Height	Strobe controllers	Lenses	Cable	Clamping mechanics	Projection patterns
Ø (mm)	(mm)	(mm)	(mm)					
37.5	130.4	-	-	LTDV1CH-17V, LTDVE8CH-20, LTDVE4CH-20	EN2MP series, EN5MP series, TC series, TCLWD series, TCHM series, TCEL series	CB244P1500, CB244P1500L	-	PTPR series
105	158.8	-	-		EN2MP series, EN5MP series	CB244P1501, CB244P1501L	-	PTPR series
37.7	108.9	46	93	LTDV1CH-17V, LTDV6CH, LTDVE8CH-20, LTDVE4CH-20	EN2MP series, EN5MP series, ENVF series, TC series, TCLWD series, TCHM series, TCEL series	CBLT001, CBLT002	CMH0016	PTPR series

9 At 55 °C, 720mA.

10 At 110 °C.

11 At 25° C.

12 2 m cable with straight female connector included (CB244P1500). Optional cable with right angled connector (CB244P1500L) is also available and must be ordered separately

13 2 m cable with straight female connector included (CB244P1501). Optional cable with right angled connector (CB244P1501L) is also available and must be ordered separately

14 5 m cable with straight female connector included (CBLT001).

Optional cable with right angled connector (CBLT002) is also available and must be ordered separately

15 Including connector.

LTPR series

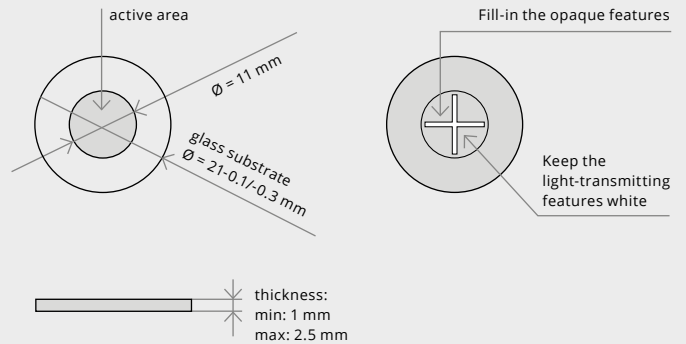
LED pattern projectors

Pattern selection

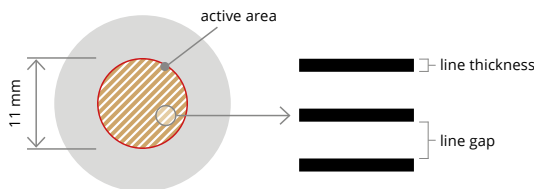


Custom-made pattern

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



The projection pattern can be easily interchanged by unscrewing the retaining ring that holds the pattern. The pattern outer diameter is 21 mm, while the active projection area is a circle of $\varnothing 11 \text{ mm}$.



The pattern drawing could either cover the entire 11 mm diameter area or be of any shape inscribed within this area (such as a square with 7.78 mm sides or a 8.8 x 6.6 mm rectangle).

The projection accuracy depends both on the pattern manufacturing accuracy and the distortion of the projection optics mounted on the LTPR models.

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.

Every kind of shape can be projected

Standard patterns



Stripe 0.5 mm line thickness.



Edge.



Grid 0.05 mm line thickness.



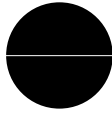
Line 0.5 mm line thickness.

Custom patterns



3D profilometry

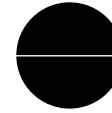
Line & stripes



PT 0000 0100 P
format: line
line thickness 0.05 mm



PT 0000 0300 P
8 lines in projection area
line gap 0.95 mm
line thickness 0.05 mm
line length 7.78 mm



PT 0000 0100 L
format: line
line thickness 0.5 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



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



PTST 010 010 P
550 lines in projection area
line gap 0.01 mm
line thickness 0.01 mm



PTST 020 020 P
275 lines in projection area
line gap 0.02 mm
line thickness 0.02 mm

Stereovision

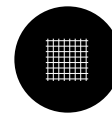
Grids



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



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

Cloud of dots



PTCD 010 P
Format:
Cloud of dots pattern,
density 10.5%



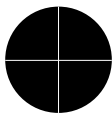
PTCD 020 P
Format:
Cloud of dots pattern,
density 20%



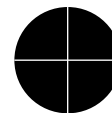
PTCD 035 P
Format:
Cloud of dots pattern,
density 35%

Alignment

Cross

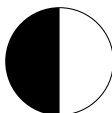


PT 0000 0200 P
format: cross
line thickness 0.05 mm

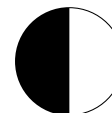


PT 0000 0200 L
format: cross
line thickness 0.5 mm

Edge



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



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

Pattern specifications

	Photolithography	Laser engraved
Substrate	Soda lime glass	Borofloat glass
Coating	Chrome	Dichroic mirror
Geometrical accuracy	2 µm	50 µm
Edge sharpness	1.4 µm	50 µm

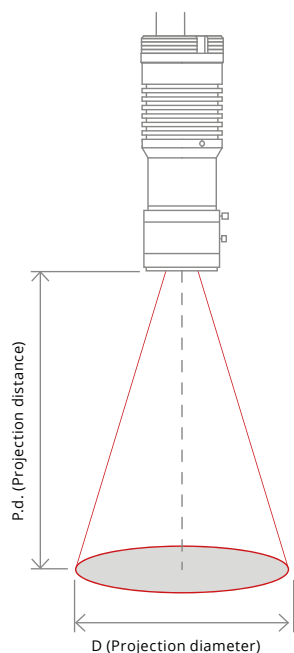
LTPR series

LED pattern projectors

Projection lens selection

Any C-mount optics for 2/3" detectors (11 mm image diagonal) can be interfaced with the LTPR series to project areas with different sizes by means of the mount adaptor included.

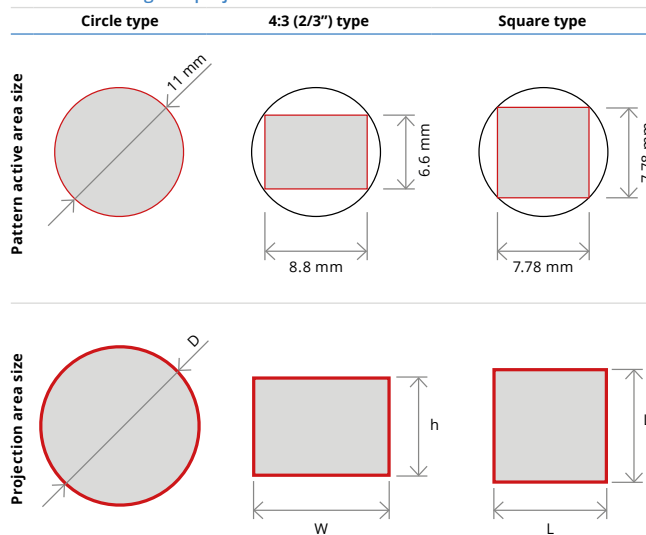
Unless the projection optics introduces significant distortion, the shape of the projected pattern will preserve the features and aspect ratio of the engraved pattern.



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.

Telecentric lenses for 2/3" detectors can also be interfaced with LTPRHP3W and LTPRUP models, thus providing telecentric projection of the pattern and enabling unparalleled performance in 3D measurement applications.

Pattern drawing and projection area



Below follows a list of the projection diameters (D) and the recommended projection distances (P.d.) achieved with different types of optics.

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.

LTPRHP3W



Standard C-mount lenses.

LTPRXP 1



Standard C-mount lenses.

LTPRUP



Standard C-mount lenses.

Telecentric lenses

	TC 23 004	TC 23 007	TC 23 009	TC 23 016	TC 23 024	TC 23 036
P.d. (mm)	56	60.1	62.2	43.1	67.2	102.5
D (mm)	5.5	8.3	11	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)	132.9	157.8	181.8	226.7	226.7	278.6
D (mm)	59.8	70	80	89.9	99.7	117.8







Bi-telecentric lenses.



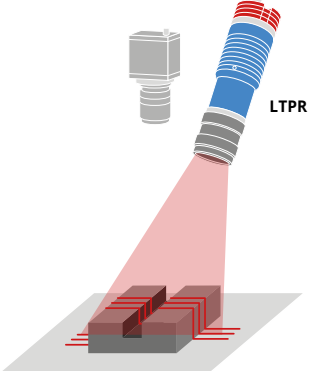
Bi-telecentric lenses.

1 Use of LTPRXP in combination with telecentric lenses is not suggested due to non-homogeneous projection (the light source is a multi-die LED). Contact us to discuss your application and find the most suitable pattern projector.



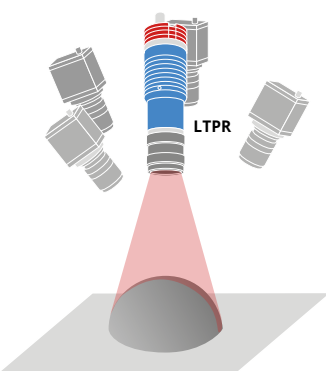
FULL RANGE OF COMPATIBLE PROJECTION OPTICS		
	EN5MP series	p. 76
FULL RANGE OF COMPATIBLE ACCESSORIES		
	Projection patterns PTPR series	p. 243
	Strobe controllers LTDV series	p. 252
	Clamping mechanics CMH0016	p. 248

Application examples



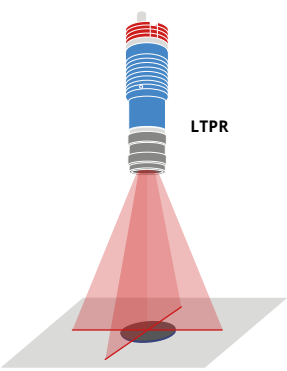
LTPR

3D profilometry



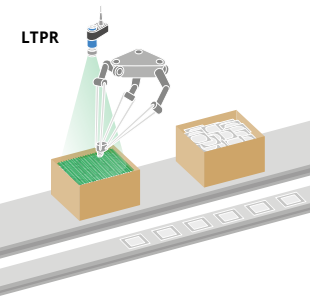
LTPR

Stereovision



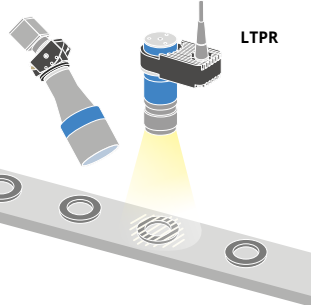
LTPR

Alignment



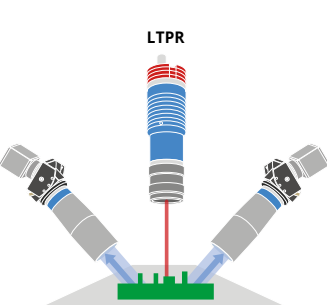
LTPR

Bin picking
(robot guidance for fast pick and place)



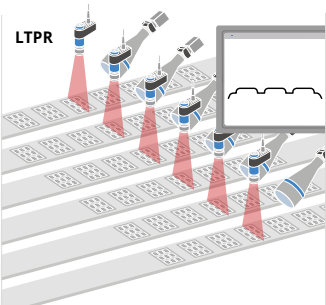
LTPR

Planarity control of black products
(LTPRUP strobe projector suggested)



LTPR

3D inspection of the height
of connector pins



LTPR

Pharmaceutical blister volume
vision control

LTPRSMHP3W series

3W tilting LED pattern projectors



KEY ADVANTAGES

Scheimpflug 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.

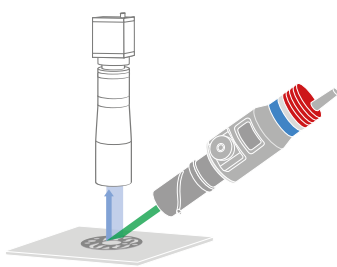
Enhanced optical power

High numerical aperture condenser lens.

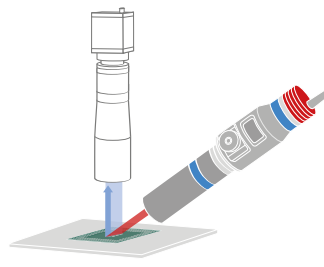
The LTPRSMHP3W series offers LED pattern projectors specifically designed for the most demanding 3D profiling and measurement applications. Triangulation techniques require structured light to be directed onto a sample at a considerable angle from vertical. Tilting the light source pattern becomes essential to ensure that the patterned light is properly focused across the entire sample surface.

LTPRSMHP3W pattern projectors integrate a precision tilting mechanism based on the Scheimpflug condition. This ensures that focus is maintained across the entire part, and reconstruction of the 3D surface is as accurate as possible. Moreover, the internal focus mechanism offers the maximum optical throughput.

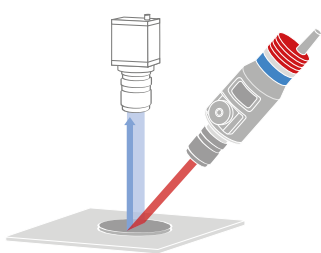
Examples of setup and applications



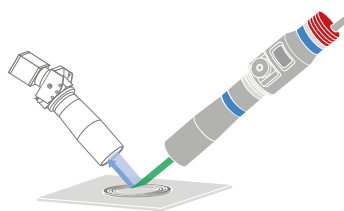
Configuration with zero distortion macro lenses.



Configuration with bi-telecentric lenses.



LTPRSM pattern projector with a standard C-mount lens.

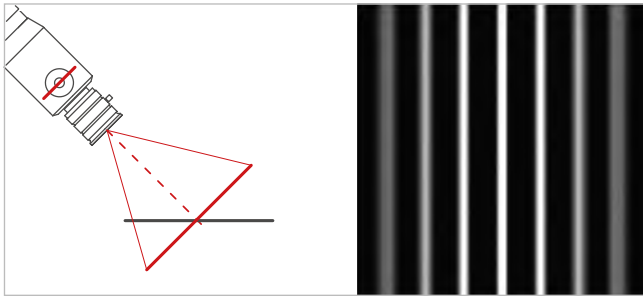


Scheimpflug telecentric optics for both projection and imaging at 90°.

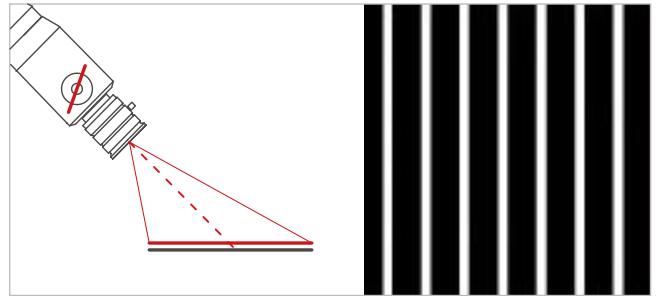


LIGHT SOURCE

- 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.

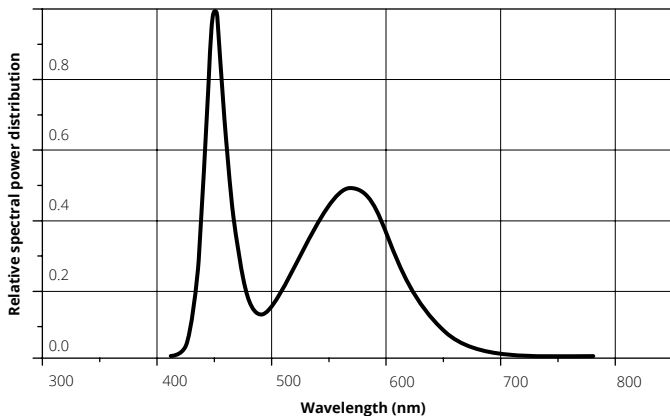


Electrical features

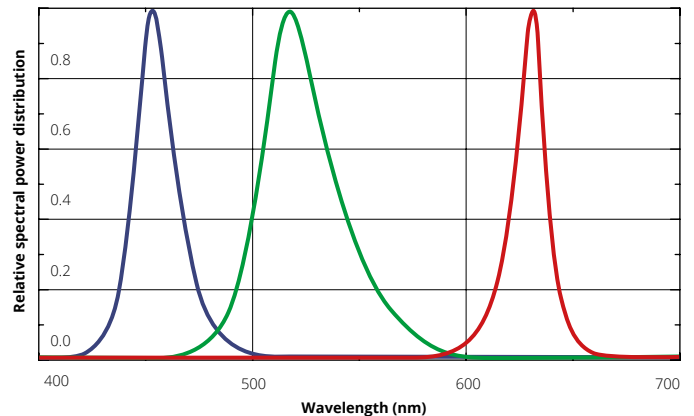
These LED devices integrate built-in switching electronics that control the current flow through the LED and which can be easily tuned by the user. This ensures both light stability and longer lifetime of the product.

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

Typical emission spectrum of white LEDs



Typical emission spectrum of R,G,B LEDs



Part number	Light Light color, wavelength peak	Device power ratings				LED power ratings		
		DC Voltage		Power consumption (W)	Max LED forward current (mA)	Forward voltage		Max pulse current (mA)
		Minimum (V)	Maximum (V)			Typical (V)	Maximum (V)	
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 $\pm 10\%$.
- 2 Used in continuous (not pulsed) mode.
- 3 At max forward current.

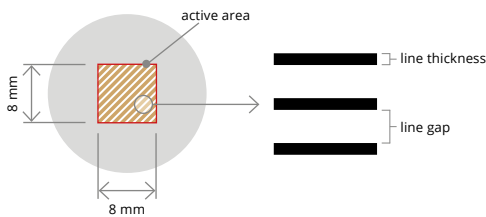
- 4 Tolerance is $\pm 0.06V$ on forward voltage measurements.
- 5 At pulse width ≤ 10 ms, duty cycle $\leq 10\%$ condition.
Built-in electronics board must be bypassed (see tech info online).

LTPRSMHP3W series

3W tilting LED pattern projectors



Pattern selection








The projection pattern placed inside the unit can be changed with ease: just remove the C-mount adaptor by loosening the set-screws and fix the pattern by securing 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 neighbouring 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

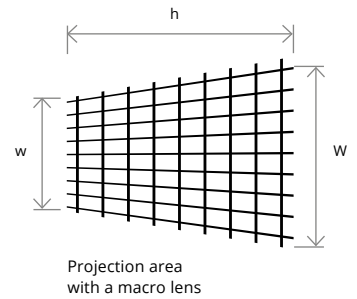
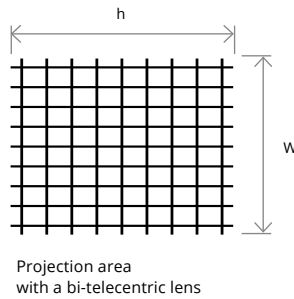
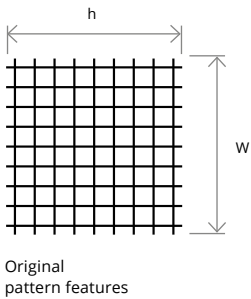
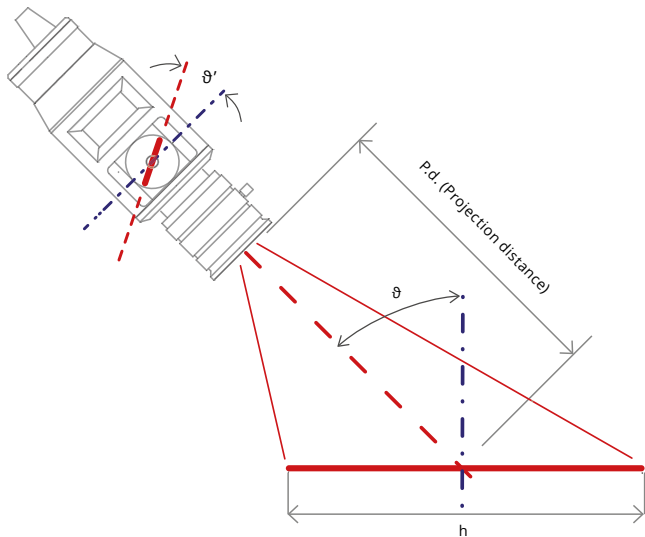
FULL RANGE OF COMPATIBLE PROJECTION OPTICS

	TC series	p. 20
	MC series	p. 78

FULL RANGE OF PROJECTION PATTERNS

	PTPR series	p. 243
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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 for 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 areas shown in the chart are also a good approximation for standard C-mount lenses used as macro lenses.

Projection area with bi-telecentric lenses (TC series)

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

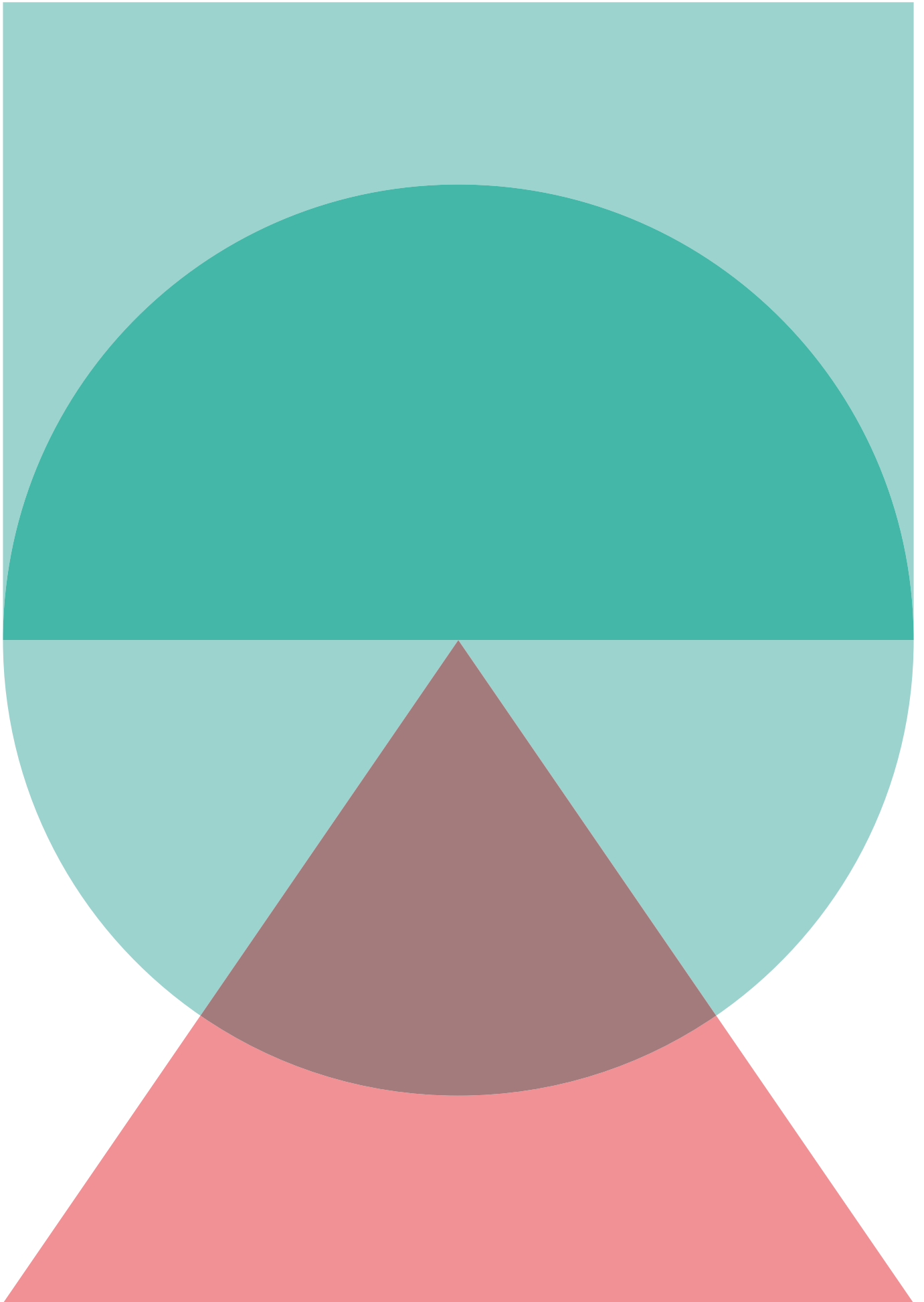
Mag. (x)	Projection distance P.d. (mm)	ϑ = 0°			ϑ = 15°			ϑ = 30°			ϑ = 45°		
		Projection area w (mm)	(W) x h (mm x mm)	Pattern tilt ϑ' (deg)	Projection area w (mm)	(W) x h (mm x mm)	Pattern tilt ϑ' (deg)	Projection area w (mm)	(W) x h (mm x mm)	Pattern tilt ϑ' (deg)	Projection area w (mm)	(W) x h (mm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



Standard C-mount lenses.



Macro lenses.



CAMERAS



Cameras play a major role in defining the stability and reliability of a vision system, as well as its overall performance, and it is no coincidence that design often starts with the camera itself. Opto Engineering® produces and selects high-quality cameras that perfectly match its renowned optics and illuminators to provide a complete bundle of machine vision components: with two decades of experience in the world of industrial automation, we can assist our customers in building a fast, reliable and cost-effective vision system.

Area scan cameras are the most employed because of their high versatility and ease of use, making them ideal for a wide variety of applications. Opto Engineering® offers an extensive range of USB3, Gigabit Ethernet and Camera Link area scan cameras to address all the possible requirements: from high-speed models suitable for fast in line applications to high-resolutions ones. In our portfolio you will find the perfect cameras that answer all your needs.

Line scan cameras are employed for web inspection, such as in printing or packaging quality check, or when large or long objects, such as engine shafts or silicon wafers need to be imaged. Opto Engineering® offers high-resolution line scan cameras featuring Camera Link interface for maximum speed and reliability.

Area scan cameras **188**

Customized machine vision cameras **204**

Line scan cameras **206**

Area scan cameras



GIGE VISION CAMERAS UP TO 12 MP	190 - 193
USB3 VISION CAMERAS UP TO 12 MP	194 - 197
HIGH RESOLUTION CAMERAS FROM 17 TO 71 MP	198 - 203

High quality cameras from a partner you can trust.

Thanks to their high versatility and ease of use, area scan cameras are the most employed in industrial automation with a wide variety of applications that ranges from fast in line inspection to high precision metrology.


With many years of experience in the machine vision industry, Opto Engineering® offers a complete portfolio of high-performance cameras to answer all your needs: following our driving principles, we provide robust, compact, high image quality products for industrial applications including measurement, high-speed inspection, but also security and much more.




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



CAMERA PARAMETERS

 Sensor format

 Frame rate, up to

www.opto-e.com

COE-G series

GenICam® PoE C-mount cameras



The **COE-G series** includes Gigabit Ethernet cameras equipped with the latest sensors, ranging from high speed VGA to the latest 12MP SONY Pregius sensor, which deliver GigE connectivity with high frame rate.

The resulting excellent image quality is ensured by well-matched, excellent Opto Engineering lenses. PoE connectivity allows a single cable to power the camera and connect to the computer for data transfer.

Robust design allows installation into industrial scenarios without the risk of mechanical failure and GenICam® compliant SDK allows easy coding with most software packages.

Available with mono and color options, there are a number of possibilities for most applications.

KEY ADVANTAGES

High quality sensors

New SONY Pregius CMOS Global shutter sensors provide high quality images.

GigEVision® protocol & GenICam® standard

Standard vision SDK platform for easy integration in existing software.

Full GenICam® compliant: easy to integrate

GenICam® compliant SDK package provides more flexibility to Vision Systems.

GigE PoE compliance

With the COE-G cameras, you do not need separate cables to transfer the information to the computer and provide power to the camera.

120 MB RAM and Frame Rate up to 300 fps

High frame rate ideal for high speed applications. The internal memory up to 120 MB guarantees no image loss and enables useful features such as Record / Playback and sequence recordings.

Sensor Sizes from 1/4" to 1.1" to fit all application requirements

Find the exact sensor for your needs.

FULL RANGE OF COMPATIBLE ACCESSORIES



CBETH003.
COE I/O cables

p. 264



Part number	Sensor specifications						Camera specifications				
	Resolution (MP)	Resolution (H x V)	Pixel size (µm)	Sensor format	Sensor	Type	Shutter	Mono/color	Interface	Frame rate (Hz)	Filter
COE-004-M-POE-021-IR-C	0.4	720 x 540	6.9	1/2.9"	Sony IMX287	CMOS	Global shutter	Mono	Gigabit Ethernet	313	Glass
COE-004-C-POE-021-IR-C	0.4	720 x 540	6.9	1/2.9"	Sony IMX287	CMOS	Global shutter	Color	Gigabit Ethernet	313	IR
COE-013-M-POE-030-IR-C	1.3	1280 x 1024	4.8	1/2"	PYTHON 1300	CMOS	Global shutter	Mono	Gigabit Ethernet	90	Glass
COE-013-C-POE-030-IR-C	1.3	1280 x 1024	4.8	1/2"	PYTHON 1300	CMOS	Global shutter	Color	Gigabit Ethernet	90	IR
COE-023-M-POE-050-IR-C	2.3	1920 x 1200	4.8	2/3"	PYTHON 2000	CMOS	Global shutter	Mono	Gigabit Ethernet	52	Glass
COE-023-C-POE-050-IR-C	2.3	1920 x 1200	4.8	2/3"	PYTHON 2000	CMOS	Global shutter	Color	Gigabit Ethernet	52	IR
COE-023-M-POE-060-IR-C	2.3	1920 x 1200	5.86	1/1.2"	Sony IMX249	CMOS	Global shutter	Mono	Gigabit Ethernet	41	Glass
COE-023-C-POE-060-IR-C	2.3	1920 x 1200	5.86	1/1.2"	Sony IMX249	CMOS	Global shutter	Color	Gigabit Ethernet	41	IR
COE-032-M-POE-040-IR-C	3.1	2048 x 1536	3.45	1/1.8"	Sony IMX265	CMOS	Global shutter	Mono	Gigabit Ethernet	37.5	Glass
COE-032-C-POE-040-IR-C	3.1	2048 x 1536	3.45	1/1.8"	Sony IMX265	CMOS	Global shutter	Color	Gigabit Ethernet	37.5	IR
COE-050-M-POE-023-IR-C	5	2592 x 1944	2.2	1/2.5"	MT9P031	CMOS	Rolling shutter	Mono	Gigabit Ethernet	14	Glass
COE-050-M-POE-050-IR-C	5	2448 x 2048	3.45	2/3"	Sony IMX264	CMOS	Global shutter	Mono	Gigabit Ethernet	23.5	Glass
COE-050-C-POE-050-IR-C	5	2448 x 2048	3.45	2/3"	Sony IMX264	CMOS	Global shutter	Color	Gigabit Ethernet	23.5	IR
COE-053-M-POE-070-IR-C	5.3	2592 x 2048	4.8	1"	PYTHON 5000	CMOS	Global shutter	Mono	Gigabit Ethernet	22	Glass
COE-053-C-POE-070-IR-C	5.3	2592 x 2048	4.8	1"	PYTHON 5000	CMOS	Global shutter	Color	Gigabit Ethernet	22	IR
COE-089-M-POE-070-IR-C	8.8	4096 x 2160	3.45	1"	Sony IMX267	CMOS	Global shutter	Mono	Gigabit Ethernet	13	Glass
COE-089-C-POE-070-IR-C	8.8	4096 x 2160	3.45	1"	Sony IMX267	CMOS	Global shutter	Color	Gigabit Ethernet	13	IR
COE-106-M-POE-031-IR-C-2	10.6	3840 x 2748	1.67	1/2.3"	MT9J003	CMOS	Global shutter	Mono	Gigabit Ethernet	7	Glass
COE-106-C-POE-031-IR-C	10.6	3840 x 2748	1.67	1/2.3"	MT9J003	CMOS	Global shutter	Color	Gigabit Ethernet	7	IR
COE-123-M-POE-080-IR-C	12.3	4096 x 3000	3.45	1.1"	Sony IMX304	CMOS	Global shutter	Mono	Gigabit Ethernet	9.4	Glass
COE-123-C-POE-080-IR-C	12.3	4096 x 3000	3.45	1.1"	Sony IMX304	CMOS	Global shutter	Color	Gigabit Ethernet	9.4	IR

Ordering information:

Further models are available on request: contact us to discuss your specific needs.

mvBlueCOUGAR series

GigE / Dual GigE cameras with Smart Features



KEY ADVANTAGES

High quality sensors available

New SONY Pregius CMOS Global shutter sensors are available for GigE vision® cameras.

High speed performance up to 164 fps

High frame rate ideal for high speed inspection.

RAM up to 256 MB

Internal memory guarantees no image loss.

Large FPGA on board

Reduces CPU load and allows more features to be added.

GeniCam® fully compliant

GeniCam® compliant SDK package provides more flexibility to Vision System.

The **mvBlueCOUGAR series** includes Gigabit Ethernet cameras, compliant with the GigE Vision® and GeniCam® image processing standards. The latest building blocks are used in one of the smallest, yet rock-solid housings in the industry.

These cameras are optimised for machine vision applications, relying on high frame rates combined with low latency image transport. Also, the images can be precisely optimised for viewing applications in the life science and medical industries, where it is necessary to achieve the utmost realistic images in terms of grey scale shades and color fidelity, combined with optimum sensitivity and signal-to-noise ratio.

Opto Engineering® selected a number of cameras that are tailored for industrial applications, based on high image quality, compactness, robustness and ease of use.

A large FPGA and extra RAM on board provide quick and reliable image data processing without overloading your CPU, also giving you the opportunity to easily implement custom features.

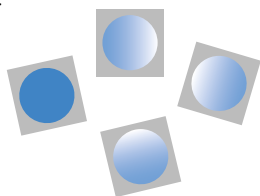
Extra features such as Burst Mode, Counter/Timers and Color Processing can simplify your vision system configuration.

The fully GeniCam® compliant SDK package, mvIMPACT SDK, allows the vision system to be more flexible.

Complete documentation of the SDK gives you access to many special camera features that can simplify the development of your vision system. The driver of mvBlueCOUGAR is supported by a wide range of third-party softwares, Fabimage®, e.g. Halcon, COGNEX, Matlab, Labview...etc.

Suitable filters for your lighting situation or environmental condition.

Choose between daylight cut (Cold Mirror), IR cut (Hot Mirror) or glass (without filter).



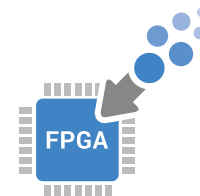
For counting and triggering events, counters are a handy feature for many applications.

The counter allows you to generate variable output signals, control illumination systems, synchronise multiple cameras, and much more.



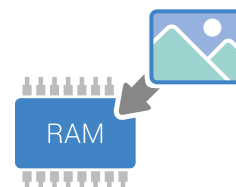
Large camera FPGA reduces the CPU load of your host system.

Extra FPGA space allows more features and modifications to be implemented. Custom features can also be supplied.



With the internal image memory, no image will ever be lost again.

The internal memory buffers images and enables useful features such as Record / Playback, Pre-trigger as well as sequence recordings.



Electronical specifications

	mvBlueCOUGAR-X series	mvBlueCOUGAR-XD series
Interface	Gigabit Ethernet	Dual Gigabit Ethernet
Image buffer	64 MB	256 MB
Power consumption (W)	< 5,5	< 8,5
Operating temperature (°C)	0 to 45	0 to 45
Operating humidity (%RH)	30 to 80	30 to 80
Storage temperature (°C)	-20 to 60	-20 to 60

SPECIAL FEATURES

- Electronic mirror functionality: horizontal / vertical (available for CMOS sensor)
- Internal readable temperature sensor with programmable alarm threshold
- Enhanced color and I/O functionality
- Frame Average
- Binning
- Pre-trigger recording
- Trigger Overlap


Mechanical specifications

	mvBlueCOUGAR-X series	mvBlueCOUGAR-XD series
Dimension (mm)	39.8 x 39.8 x 35	50 x 50 x 32
Weight (g)	110	200
Lens Mount	Adjustable C-mount	Adjustable C-mount
	CS-mount (optional)	CS-mount (optional)
	S-mount (optional)	

MORE FEATURES AVAILABLE FOR MVBLUECOUGAR-XD CAMERAS

- Burst mode
- Storable user configurations (5 config.) and user parameters (512 bytes on EEPROM)

FULL RANGE OF COMPATIBLE ACCESSORIES

	CBETH003 CBGIO001	p. 264
	RT-MV-DC1201-BCSXIO-REV2	p. 262

Part number	Sensor specifications							Camera specifications		
	Resolution (MP)	Resolution (H x V)	Pixel size (µm)	Sensor format	Sensor	Type	Shutter	Mono/color	Interface	Frame rate (Hz)
RT-mvBC-X100w	0.4	752 x 480	6	1/3"	MT9V034	CMOS	Pipelined/Global	Mono, color	Gigabit Ethernet	117
RT-mvBC-X100f	0.4	728 x 544	6.9	1/2.9"	Sony IMX287	CMOS	Global Shutter	Mono, color	Gigabit Ethernet	436.9 / 299.8 ¹
RT-mvBC-X102f	1.6	1456 x 1088	3.45	1/2.9"	Sony IMX273	CMOS	Global Shutter	Mono, color	Gigabit Ethernet	126.3 / 74.9
RT-mvBC-XD102f	1.6	1456 x 1088	3.45	1/2.9"	Sony IMX273	CMOS	Global Shutter	Mono, color	Dual Gigabit Ethernet	226.5 / 149.9 ¹
RT-mvBC-X104f	2.4	1936 x 1216	5.86	1/1.2"	Sony IMX249	CMOS	Global Shutter	Mono, color	Gigabit Ethernet	46.9
RT-mvBC-XD104d	2.4	1936 x 1216	5.86	1/1.2"	Sony IMX174	CMOS	Global Shutter	Mono, color	Dual Gigabit Ethernet	164 / 100.8 ¹
RT-mvBC-X104i	3.2	2064 x 1544	3.45	1/1.8"	Sony IMX265	CMOS	Global Shutter	Mono, color	Gigabit Ethernet	55 / 37.2 ¹
RT-mvBC-XD104h	3.2	2064 x 1544	3.45	1/1.8"	Sony IMX252	CMOS	Global Shutter	Mono, color	Dual Gigabit Ethernet	123 / 74.5 ¹
RT-mvBC-X105	5.0	2592 x 1944	2.2	1/2.5"	MT9P031	CMOS	Rolling/Global Reset	Mono, color	Gigabit Ethernet	14
RT-mvBC-X105b	5.1	2464 x 2056	3.45	2/3"	Sony IMX264	CMOS	Global Shutter	Mono, color	Gigabit Ethernet	35 / 23.4 ¹
RT-mvBC-XD105a	5.1	2464 x 2056	3.45	2/3"	Sony IMX250	CMOS	Global Shutter	Mono, color	Dual Gigabit Ethernet	80 / 46.8 ¹
RT-mvBC-XD107	7.1	3216 x 2208	4.5	1.1"	Sony IMX420	CMOS	Global Shutter	Mono, color	Dual Gigabit Ethernet	60.2 / 33.4 ¹
RT-mvBC-X109b	9.0	4112 x 2176	3.45	1"	Sony IMX267	CMOS	Global Shutter	Mono, color	Gigabit Ethernet	20.6 / 13.2 ¹
RT-mvBC-XD109b	9.0	4112 x 2176	3.45	1"	Sony IMX267	CMOS	Global Shutter	Mono, color	Dual Gigabit Ethernet	31.9 / 26.5 ¹
RT-mvBC-X1010	10.7	3856 x 2764	1.67	1/2.35"	MT9J003	CMOS	Rolling/Global Reset	Mono, color	Gigabit Ethernet	7.3
RT-mvBC-X1012b	12.4	4112 x 3008	3.45	1.1"	Sony IMX304	CMOS	Global Shutter	Mono, color	Gigabit Ethernet	15.0 / 9.6 ¹
RT-mvBC-XD1012b	12.4	4112 x 3008	3.45	1.1"	Sony IMX304	CMOS	Global Shutter	Mono, color	Dual Gigabit Ethernet	23 / 19.2 ¹

¹ Burst mode / streaming. Burst mode buffers the acquired images and decouples the acquisition from the image output. That way you can use the sensor's maximum frame rate regardless of the available bandwidth.

Ordering information

- All cameras are available in Monochrome or Color Version at no extra cost. IR cut filter integrated by default. Other filters can be integrated on request at no extra cost.
- Cameras are available in OEM board version.
- Most cameras are also available in GigE POE version.
- Extended Temperature range -40°C to +65°C optional for some models.
- Industrial connection concept (POE-I) is supported.
- PLC inputs available.
- WiFi function optional.

COE-U series

GenICam® C-mount USB3 cameras

➔ 1/2.5" - 1.1"

🔍 210 fps



The **COE-U series** includes USB3 Vision® cameras equipped with the latest sensors, ranging from high speed VGA to the latest 1.1" 12MP SONY Pregius sensor, which deliver USB 3.0 connectivity with high frame rate. The resulting excellent image quality is ensured by well-matched, excellent Opto Engineering lenses.

The COE-U series allows the best sensors to be available with USB 3.0 at a reasonable cost. Robust design allows installation into industrial scenarios without the risk of mechanical failure. Only one cable is needed as USB 3.0 cable handles both data and power to the camera.

KEY ADVANTAGES

USB 3.0 connectivity

Easy connectivity to most new computers with 5Gbps bandwidth.

USB3 Vision® protocol & GenICam® standard

Standard vision SDK platforms for easy integration in existing software.

Full GenICam® compliant: easy to integrate

GenICam® compliant SDK package provides more flexibility to Vision Systems®.

High quality sensors

New SONY Pregius CMOS Global shutter sensors provide high quality images.

Frame Rate up to 173 fps

High frame rate ideal for high speed applications.

Sensor Sizes from 1/4" to 1.1" to fit all application requirements

Find the exact sensor for your needs.

FULL RANGE OF COMPATIBLE ACCESSORIES



CBETH003.
COE I/O cables

p. 264



Part number	Sensor specifications							Camera specifications			
	Resolution (MP)	Resolution (H x V)	Pixel size (µm)	Sensor format	Sensor	Type	Shutter	Mono/color	Interface	Frame rate (Hz)	Filter
COE-013-M-USB-030-IR-C	1.3	1280 x 1024	4.8	1/2"	PYTHON 1300	CMOS	Global shutter	Mono	USB 3.0	210	Glass
COE-013-C-USB-030-IR-C	1.3	1280 x 1024	4.8	1/2"	PYTHON 1300	CMOS	Global shutter	Color	USB 3.0	210	IR
COE-023-M-USB-060-IR-C	2.3	1920 x 1200	5.86	1/1.2"	Sony IMX249	CMOS	Global shutter	Mono	USB 3.0	41	Glass
COE-023-C-USB-060-IR-C	2.3	1920 x 1200	5.86	1/1.2"	Sony IMX249	CMOS	Global shutter	Color	USB 3.0	40	IR
COE-050-M-USB-050-IR-C	5	2448 x 2048	3.45	2/3"	Sony IMX264	CMOS	Global shutter	Mono	USB 3.0	35	Glass
COE-050-C-USB-050-IR-C	5	2448 x 2048	3.45	2/3"	Sony IMX264	CMOS	Global shutter	Color	USB 3.0	35	IR
COE-050-C-USB-023-IR-C	5	2592 x 1944	2.2	1/2.5"	AR0521	CMOS	Rolling shutter	Color	USB 3.0	45	IR
COE-053-M-USB-070-IR-C	5.3	2592x2048	4.8	1"	PYTHON 5000	CMOS	Global shutter	Mono	USB 3.0	72	Glass
COE-053-C-USB-070-IR-C	5.3	2592x2048	4.8	1"	PYTHON 5000	CMOS	Global shutter	Color	USB 3.0	72	IR
COE-089-M-USB-070-IR-C	8.8	4096 x 2160	3.45	1"	Sony IMX267	CMOS	Global shutter	Mono	USB 3.0	32	Glass
COE-089-C-USB-070-IR-C	8.8	4096 x 2160	3.45	1"	Sony IMX267	CMOS	Global shutter	Color	USB 3.0	32	IR
COE-123-M-USB-080-IR-C	12.3	4096 x 3000	3.45	1.1"	Sony IMX304	CMOS	Global shutter	Mono	USB 3.0	23	Glass
COE-123-C-USB-080-IR-C	12.3	4096 x 3000	3.45	1.1"	Sony IMX304	CMOS	Global shutter	Color	USB 3.0	23	IR

Ordering information:

Further models are available on request: contact us to discuss your specific needs.

mvBlueFOX3-2 series

USB3 cameras with Smart Features



* RT



KEY ADVANTAGES

High quality sensors

New SONY Pregius CMOS Global shutter sensors provide high quality images.

Frame Rate up to 164 Hz

High frame rate ideal for high speed applications.

256 MB RAM

Internal memory up to 256 MB guarantees no image loss.

Large FPGA on board

Reduces CPU load and allows more features to be added.

Full GeniCam® compliance

User friendly GeniCam® compliant SDK package provides more flexibility to Vision Systems.

The **mvBlueFOX3-2 series** includes USB3 Vision® cameras equipped with the latest SONY Pregius Global Shutter CMOS Sensors, which deliver high resolution, high frame rate, low noise and excellent Price / Quality Ratio.

Opto Engineering® selected a set of cameras that are tailored for industrial applications, based on high image quality, compactness, robustness and ease of use. Large RAM and FPGA on board provide quick and reliable image data processing without overloading your CPU, also giving you the opportunity to easily implement custom

features. Extra features like Burst Mode, Counter/Timers, and Color Processing can simplify your multi-function vision system configuration in a snap!

The fully GeniCam® compliant mvIMPACT SDK allows the vision system to be more flexible. Complete documentation of the SDK gives you access to many special camera features that could simplify your vision system development. The driver of the mvBlueFOX3-w cameras is supported by a wide range of third-party software packages, Fabimage®, e.g. Halcon, Matlab, Labview, etc.

Part number	Sensor specifications							Camera specifications		
	Resolution (MP)	Resolution (H x V)	Pixel size (µm)	Sensor format	Sensor	Type	Shutter	Mono/color	Interface	Frame rate (Hz)
RT-mvBF3-2004	0.4	728 x 544	6.9	1/2.9"	Sony IMX287	CMOS	Global Shutter	Mono, color	USB 3.0	436.9
RT-mvBF3-2016	1.6	1456 x 1088	3.45	1/2.9"	Sony IMX273	CMOS	Global Shutter	Mono, color	USB 3.0	226.5
RT-mvBF3-2024a	2.4	1936 x 1216	5.86	1/1.2"	Sony IMX249	CMOS	Global Shutter	Mono, color	USB 3.0	46.9
RT-mvBF3-2024	2.4	1936 x 1216	5.86	1/1.2"	Sony IMX174	CMOS	Global Shutter	Mono, color	USB 3.0	164 / 161.4 ¹
RT-mvBF3-2032a	3.2	2064 x 1544	3.45	1/1.8"	Sony IMX265	CMOS	Global Shutter	Mono, color	USB 3.0	55
RT-mvBF3-2032	3.2	2064 x 1544	3.45	1/1.8"	Sony IMX252	CMOS	Global Shutter	Mono, color	USB 3.0	123.5 / 119.2 ¹
RT-mvBF3-2051a	5.1	2464 x 2056	3.45	2/3"	Sony IMX264	CMOS	Global Shutter	Mono, color	USB 3.0	35
RT-mvBF3-2051	5.1	2464 x 2056	3.45	2/3"	Sony IMX250	CMOS	Global Shutter	Mono, color	USB 3.0	80 / 75 ¹
RT-mvBF3-2064 ²	6.4	3096 x 2080	2.4	1/1.8"	Sony IMX178	CMOS	Rolling Shutter	Mono, color	USB 3.0	60 / 59 ¹
RT-mvBF3-2089a	8.9	4112 x 2176	3.45	1"	Sony IMX267	CMOS	Global Shutter	Mono, color	USB 3.0	31.9
RT-mvBF3-2089	8.9	4112 x 2176	3.45	1"	Sony IMX255	CMOS	Global Shutter	Mono, color	USB 3.0	47 / 42.4 ¹
RT-mvBF3-2124a	12.4	4112 x 3008	3.45	1.1"	Sony IMX304	CMOS	Global Shutter	Mono, color	USB 3.0	23
RT-mvBF3-2124	12.4	4112 x 3008	3.45	1.1"	Sony IMX253	CMOS	Global Shutter	Mono, color	USB 3.0	34 / 30.7 ¹

¹ Burst mode / streaming. Burst mode buffers the acquired images and decouples the acquisition from the image output. That way, you can use the sensor's maximum frame rate regardless of the available bandwidth.

² RT-mvBF3-2064 mount a SONY Starvis CMOS Rolling Shutter sensor.

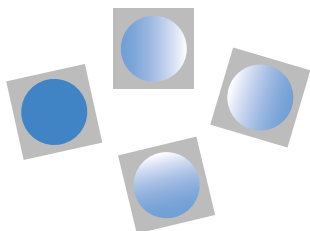
Ordering information

- All cameras are available in monochrome or color version at no extra cost.
- IR cut filter integrated by default. Other filters can be integrated on request at no extra cost.
- I/O port available on request.
- Cameras are available in OEM board version.



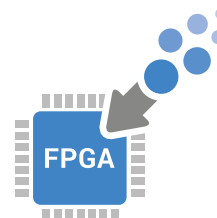
Suitable filters for your lighting situation or environmental condition.

Choose between daylight cut (Cold Mirror), IR cut (Hot Mirror) or glass (without filter).



Large camera FPGA reduces CPU load of your host system.

Extra FPGA space allows more features and modifications to be implemented. Custom features can also be supplied.



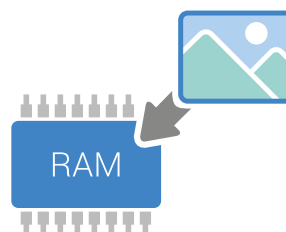
For counting and triggering events, counters are a handy feature for many applications.

The counter allows you to generate variable output signals, control illumination systems, synchronise multiple cameras, and much more.



With the internal image memory, no image will ever be lost again.

The internal memory buffers images and enables useful features like Record / Playback, Pre-trigger as well as sequence recordings.



Mechanical specifications

Dimension (mm)	39.8 x 39.8 x 37.7
Weight (g)	94
Mount	C

Electrical specifications

Interface	USB 3.0 (5 Gb/s)
Image buffer	256 MB
Power consumption (W)	< 4.5
Operating temperature (°C)	0 to 45
Operating humidity (%RH)	30 to 80
Storage temperature (°C)	-20 to 60

SPECIAL FEATURES

- Burst mode
- On board color processing
- Additional information via data stream
- Sequence recording using parameter sets
- Event notifications

FULL RANGE OF COMPATIBLE ACCESSORIES



CBUSB3001
CBGPIO001

p. 264

COE HR AS-X series

20 - 26 MP area scan cameras



COE HR AS-X cameras are ideal for high resolution and high speed inspections. They feature sensors up to APS-H format with large 4.5 um pixels for excellent sensitivity and well matched optics from the Opto Engineering MC8K or TC12M series.

Coupled with GigE, 10GigE or USB 3.0, they offer the fastest frame rates possible with the latest interfaces. COE HR AS-X are GigEVision®, USB3 Vision® and GenICam® compliant."

These cameras are specifically tested to work with the Opto Engineering® lenses and illuminators, to increase measurement accuracy when using telecentric backlighting to pull every last detail out of your inspection while maintaining a cost-effective system.

With many years of experience in the Machine Vision sector, Opto Engineering® offers a series of high resolution, high performance cameras to answer your needs.

KEY ADVANTAGES

The best cameras you can buy right now

The cameras feature the highest resolution sensors and best image quality maintaining an extremely interesting quality/price ratio.

Available in GigE, USB 3.0, CameraLink, 10GigE

GigE allows flexible connectivity, while USB3 offers high speed and easy installation. Camera Link guarantees maximum performance and direct access to the camera sensor while 10GigE provides the highest throughput for Ethernet connectivity.

Full GenICam® compliant: easy to integrate

COE HR AS-X are GigEVision®, USB3 Vision® and GenICam® compliant, making software integration quick and easy.



120 MB On-board image buffer

The internal memory up to 120 MB guarantees no image loss and enables useful features such as Record / Playback and sequence recordings.

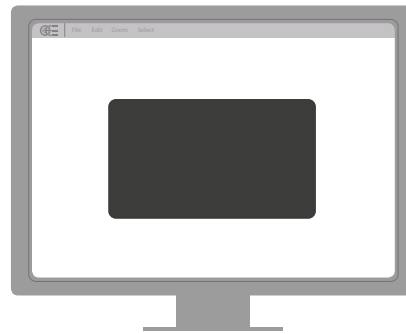
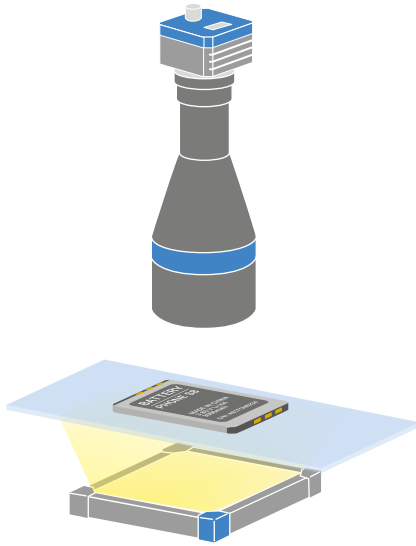
Optics to match

Many Opto Engineering® Telecentric and Macro lenses match these sensors for the best optical performance.

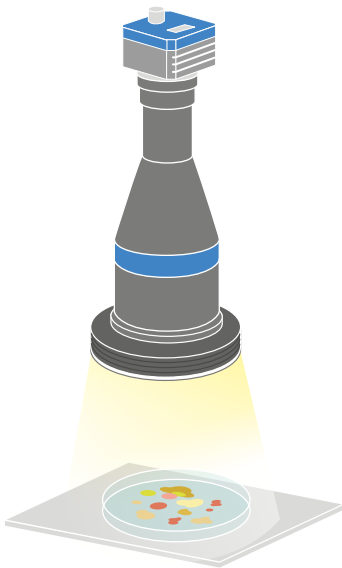
FULL RANGE OF COMPATIBLE ACCESSORIES

	COE I/O cables	p. 264
	CBETH003, CUSB3001	p. 264

Application examples



Smartphone and tablet battery measurement.



Bacterial culture analysis in Petri dishes.

Part number	Sensor specifications							Camera specifications			
	Resolution (MP)	Resolution (H x V)	Pixel size (µm)	Sensor format	Sensor	Type	Shutter	Mono/color	Interface	Frame rate (Hz)	Filter
COE-200-M-POE-070-IR-C	20.4	5472 x 3648	2.4	1"	Sony IMX183	CMOS	Rolling shutter	Mono	Gigabit Ethernet	5.9	Glass
COE-200-C-POE-070-IR-C	20.4	5472 x 3648	2.4	1"	Sony IMX183	CMOS	Rolling shutter	Color	Gigabit Ethernet	5.9	Filter
COE-200-M-USB-070-IR-C	20.4	5472 x 3648	2.4	1"	Sony IMX183	CMOS	Rolling shutter	Mono	USB 3.0	19.2	Glass
COE-200-C-USB-070-IR-C	20.4	5472 x 3648	2.4	1"	Sony IMX183	CMOS	Rolling shutter	Color	USB 3.0	19.2	Filter
COE-260-M-10GIGE-100-IR-F	26	5120 x 5120	4.5	APS-H	PYTHON 25K	CMOS	Global shutter	Mono	10 Gigabit Ethernet	40	Glass
COE-260-M-10GIGE-100-IR-I	26	5121 x 5120	4.5	APS-H	PYTHON 25K	CMOS	Global shutter	Mono	10 Gigabit Ethernet	40	Filter

COE HR AS series

50 - 71 MP area scan cameras



COE High Resolution Area Scan cameras are designed to provide high-resolution images, using the latest High Res sensors that offer both quality and speed. The rugged design allows these high-resolution sensors to perform under harsh conditions in the most demanding environments.

Several image quality enhancing features include pixel correction, column defect correction, flat-field correction, white balancing and much more. Combined with our large format TC16M telecentric optics, or our MC12K Macro Lens, you have a winning solution!

COE HR AS cameras are purpose-built for inspection applications by utilising the highest resolution sensors available. These cameras have all the rugged features, such as industrial design, military derated components, and a CNC machined case.

Fan cooling insures minimum dark current and excellent image quality. Sensors are 3-point mounted for edge-to-edge sharpness and flatness across the entire image. Additional features include: low smear, blooming suppression, 12-bit data paths, advanced triggering and built-in detectors that analyse camera performance, and image processing to remove sensor defects.

COE HR AS cameras are available in USB 3.0 or Camera Link, offering high speeds and reliability. Different filter options and a choice of lens mount allow for easy integration that is perfect for measurement applications, high resolution inspection, security and more.

KEY ADVANTAGES

High quality rugged design

Using the latest industrial components, these cameras are built to last and allow for extended temperature ranges.

Available in USB 3.0 and Camera Link

Offers high speed and easy installation, while Camera Link guarantees maximum performance and direct access to the camera sensor.



Excellent image quality

Built-in features include pixel correction, column defect correction, white balancing, flat-field correction.

Optics to match

Many Opto Engineering® Telecentric lenses match these 35mm sensors for the best optical performance.

FULL RANGE OF COMPATIBLE ACCESSORIES

	COE-6P-MALE, CBUSB3001	p. 264
	COE-PS-UNIVERSAL	p. 262



Part number	Sensor specifications							Camera specifications				Lens Mount
	Resolution (MP)	Resolution (H x V)	Pixel size (µm)	Sensor format	Sensor	Type	Shutter	Mono/color	Interface	Filter	Frame rate (Hz)	
COE50MUSB3IR-K	48	7920 x 6004	4.6	35 mm	ams CMV50000	CMOS	Global Shutter	Mono	USB 3.0	IR filter	6.8	M58x0.75 FD12.96
COE50CUSB3IR-K	48	7920 x 6004	4.6	35 mm	ams CMV50000	CMOS	Global Shutter	Color	USB 3.0	IR filter	6.8	M58x0.75 FD12.96
COE50MUSB3IR-F	48	7920 x 6004	4.6	35 mm	ams CMV50000	CMOS	Global Shutter	Mono	USB 3.0	IR filter	6.8	F
COE50CUSB3IR-F	48	7920 x 6004	4.6	35 mm	ams CMV50000	CMOS	Global Shutter	Color	USB 3.0	IR filter	6.8	F
COE50MCLIR-K	48	7920 x 6004	4.6	35 mm	ams CMV50000	CMOS	Global Shutter	Mono	Camera Link	Skylight/ glass filter	27.3	M58x0.75 FD12.96
COE50CCLIR-K	48	7920 x 6004	4.6	35 mm	ams CMV50000	CMOS	Global Shutter	Color	Camera Link	Skylight/ glass filter	27.3	M58x0.75 FD12.96
COE50MCLIR-F	48	7920 x 6004	4.6	35 mm	ams CMV50000	CMOS	Global Shutter	Mono	Camera Link	Skylight/ glass filter	27.3	F
COE50CCLIR-F	48	7920 x 6004	4.6	35 mm	ams CMV50000	CMOS	Global Shutter	Color	Camera Link	Skylight/ glass filter	27.3	F
COE50MUSB3SK-K	48	7920 x 6004	4.6	35 mm	ams CMV50000	CMOS	Global Shutter	Mono	USB 3.0	IR filter	6.8	M58x0.75 FD12.96
COE50CUSB3SK-K	48	7920 x 6004	4.6	35 mm	ams CMV50000	CMOS	Global Shutter	Color	USB 3.0	IR filter	6.8	M58x0.75 FD12.96
COE50MUSB3SK-F	48	7920 x 6004	4.6	35 mm	ams CMV50000	CMOS	Global Shutter	Mono	USB 3.0	IR filter	6.8	F
COE50CUSB3SK-F	48	7920 x 6004	4.6	35 mm	ams CMV50000	CMOS	Global Shutter	Color	USB 3.0	IR filter	6.8	F
COE50MCLSK-K	48	7920 x 6004	4.6	35 mm	ams CMV50000	CMOS	Global Shutter	Mono	Camera Link	Skylight/ glass filter	27.3	M58x0.75 FD12.96
COE50CCLSK-K	48	7920 x 6004	4.6	35 mm	ams CMV50000	CMOS	Global Shutter	Color	Camera Link	Skylight/ glass filter	27.3	M58x0.75 FD12.96
COE50MCLSK-F	48	7920 x 6004	4.6	35 mm	ams CMV50000	CMOS	Global Shutter	Mono	Camera Link	Skylight/ glass filter	27.3	F
COE50CCLSK-F	48	7920 x 6004	4.6	35 mm	ams CMV50000	CMOS	Global Shutter	Color	Camera Link	Skylight/ glass filter	27.3	F
COE71MUSB3IR-K	71	10000 x 7096	3.1	35 mm	ams CHR70M	CMOS	Rolling Shutter	Mono	USB 3.0	IR filter	4.2	M58x0.75 FD12.96
COE71CUSB3IR-K	71	10000 x 7096	3.1	35 mm	ams CHR70M	CMOS	Rolling Shutter	Color	USB 3.0	IR filter	4.2	M58x0.75 FD12.96
COE71MUSB3IR-F	71	10000 x 7096	3.1	35 mm	ams CHR70M	CMOS	Rolling Shutter	Mono	USB 3.0	IR filter	4.2	F
COE71CUSB3IR-F	71	10000 x 7096	3.1	35 mm	ams CHR70M	CMOS	Rolling Shutter	Color	USB 3.0	IR filter	4.2	F
COE71MCLIR-K	71	10000 x 7096	3.1	35 mm	ams CHR70M	CMOS	Rolling Shutter	Mono	Camera Link	IR filter	4.2	M58x0.75 FD12.96
COE71CCLIR-K	71	10000 x 7096	3.1	35 mm	ams CHR70M	CMOS	Rolling Shutter	Color	Camera Link	IR filter	4.2	M58x0.75 FD12.96
COE71MCLIR-F	71	10000 x 7096	3.1	35 mm	ams CHR70M	CMOS	Rolling Shutter	Mono	Camera Link	IR filter	4.2	F
COE71CCLIR-F	71	10000 x 7096	3.1	35 mm	ams CHR70M	CMOS	Rolling Shutter	Color	Camera Link	IR filter	4.2	F
COE71MUSB3SK-K	71	10000 x 7096	3.1	35 mm	ams CHR70M	CMOS	Rolling Shutter	Mono	USB 3.0	Skylight/ glass filter	4.2	M58x0.75 FD12.96
COE71CUSB3SK-K	71	10000 x 7096	3.1	35 mm	ams CHR70M	CMOS	Rolling Shutter	Color	USB 3.0	Skylight/ glass filter	4.2	M58x0.75 FD12.96
COE71MUSB3SK-F	71	10000 x 7096	3.1	35 mm	ams CHR70M	CMOS	Rolling Shutter	Mono	USB 3.0	Skylight/ glass filter	4.2	F
COE71CUSB3SK-F	71	10000 x 7096	3.1	35 mm	ams CHR70M	CMOS	Rolling Shutter	Color	USB 3.0	Skylight/ glass filter	4.2	F
COE71MCLSK-K	71	10000 x 7096	3.1	35 mm	ams CHR70M	CMOS	Rolling Shutter	Mono	Camera Link	Skylight/ glass filter	4.2	M58x0.75 FD12.96
COE71CCLSK-K	71	10000 x 7096	3.1	35 mm	ams CHR70M	CMOS	Rolling Shutter	Color	Camera Link	Skylight/ glass filter	4.2	M58x0.75 FD12.96
COE71MCLSK-F	71	10000 x 7096	3.1	35 mm	ams CHR70M	CMOS	Rolling Shutter	Mono	Camera Link	Skylight/ glass filter	4.2	F
COE71CCLSK-F	71	10000 x 7096	3.1	35 mm	ams CHR70M	CMOS	Rolling Shutter	Color	Camera Link	Skylight/ glass filter	4.2	F

mvHR series

17 - 31 MP area scan cameras

4/3" - APS-C 90.1 fps

NEW



* RT

KEY ADVANTAGES

High quality sensors available

New SONY Pregius CMOS Global shutter sensors available.

High speed performance

High frame rate ideal for high speed inspection.

RAM up to 256 MB

Internal memory guarantees no image loss.

Large FPGA on board

Reduces CPU load and allows more features to be added.

GenICam® full compliance

GenICam® compliant SDK package provides more flexibility to Vision System.

The **mvHR series** includes high resolution Dual Gigabit Ethernet and USB3 cameras, compliant with the GigE Vision®, USB3 Vision® GenICam® image processing standards. The series features cameras equipped with the latest SONY Pregius Global Shutter CMOS Sensors, which deliver high resolution at high frame rates, low noise and excellent quality-to-price.

The fully GenICam® compliant mvIMPACT SDK allows the vision system to be more flexible. Complete documentation of the SDK gives you access to many special camera features that could simplify your vision system development. The driver of the cameras is supported by a wide range of third-party software packages.

Thanks to their excellent performance, these cameras are ideal for many high resolution applications such as flat panel displays (FPDs) inspection, verification of numbered prints or high precision dimensional measurement.

Part number	Sensor specifications						Camera specifications			
	Resolution (MP)	Resolution (H x V)	Pixel size (µm)	Sensor format	Sensor	Type	Shutter	Mono/color	Interface	Frame rate (Hz) ¹
RT-BF3-4-0169ZG-J	16.9	5472 x 3080	3.45	4/3"	IMX387	CMOS	Global Shutter	Mono	USB 3.2	22.5 / 26.5 / 90.1
RT-BF3-4-0169ZG-F	16.9	5472 x 3080	3.45	4/3"	IMX387	CMOS	Global Shutter	Mono	USB 3.2	22.5 / 26.5 / 90.1
RT-BF3-4-0169ZC-J	16.9	5472 x 3080	3.45	4/3"	IMX387	CMOS	Global Shutter	Color	USB 3.2	22.5 / 26.5 / 90.1
RT-BF3-4-0169ZC-F	16.9	5472 x 3080	3.45	4/3"	IMX387	CMOS	Global Shutter	Color	USB 3.2	22.5 / 26.5 / 90.1
RT-BF3-4-0315ZG-J	31.5	6480 x 4856	3.45	APS-C	IMX342	CMOS	Global Shutter	Mono	USB 3.2	12 / 14.4 / 48.3
RT-BF3-4-0315ZG-F	31.5	6480 x 4856	3.45	APS-C	IMX342	CMOS	Global Shutter	Mono	USB 3.2	12 / 14.4 / 48.3
RT-BF3-4-0315ZC-J	31.5	6480 x 4856	3.45	APS-C	IMX342	CMOS	Global Shutter	Color	USB 3.2	12 / 14.4 / 48.3
RT-BF3-4-0315ZC-F	31.5	6480 x 4856	3.45	APS-C	IMX342	CMOS	Global Shutter	Color	USB 3.2	12 / 14.4 / 48.3
RT-mvBC-XD1031G-J	31.5	6480 x 4856	3.45	APS-C	IMX342	CMOS	Global Shutter	Mono	Dual Gigabit Ethernet	7.5 / 12.1 / 30.1
RT-mvBC-XD1031G-F	31.5	6480 x 4856	3.45	APS-C	IMX342	CMOS	Global Shutter	Mono	Dual Gigabit Ethernet	7.5 / 12.1 / 30.1
RT-mvBC-XD1031C-J	31.5	6480 x 4856	3.45	APS-C	IMX342	CMOS	Global Shutter	Color	Dual Gigabit Ethernet	7.5 / 12.1 / 30.1
RT-mvBC-XD1031C-F	31.5	6480 x 4856	3.45	APS-C	IMX342	CMOS	Global Shutter	Color	Dual Gigabit Ethernet	7.5 / 12.1 / 30.1

¹ Streaming / Burst mode / Max. streaming depending on sensor either with 2x2 Binning or Decimation (Horizontal x Vertical).

Ordering information

- IR cut filter integrated by default. Other filters can be integrated on request at no extra cost.
- I/O port available on request.

Electronical specifications

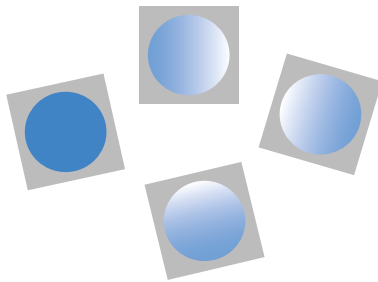
	mvBlueFOX3-4 series	mvBlueCOUGAR-XD series
Interface	USB 3.2	Dual Gigabit Ethernet
Image buffer	256 MB	256 MB
Power consumption (W)	< 4,8	< 8,5
Operating temperature (°C)	0 to 45	0 to 45
Operating humidity (%RH)	30 to 80	30 to 80
Storage temperature (°C)	-20 to 60	-20 to 60

Mechanical specifications

	mvBlueFOX3-4 series	mvBlueCOUGAR-XD series
Dimension (mm)	49,8 x 49,8 x 55,3	50 x 50 x 32
Weight (g)	175	215
Mount	F, M42x1 FD12	F, M42x1 FD12

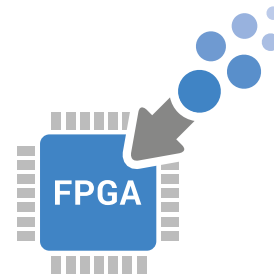
Suitable filters for your lighting situation or environmental condition.

Choose between daylight cut (Cold Mirror), IR cut (Hot Mirror) or glass (without filter).



Large camera FPGA reduces the CPU load of your host system.

Extra FPGA space allows more features and modifications to be implemented. Custom features can also be supplied.



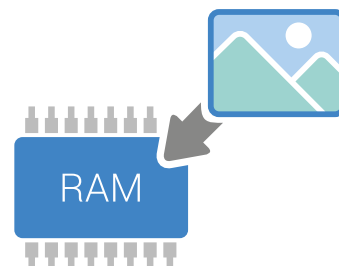
For counting and triggering events, counters are a handy feature for many applications.

The counter allows you to generate variable output signals, control illumination systems, synchronise multiple cameras, and much more.



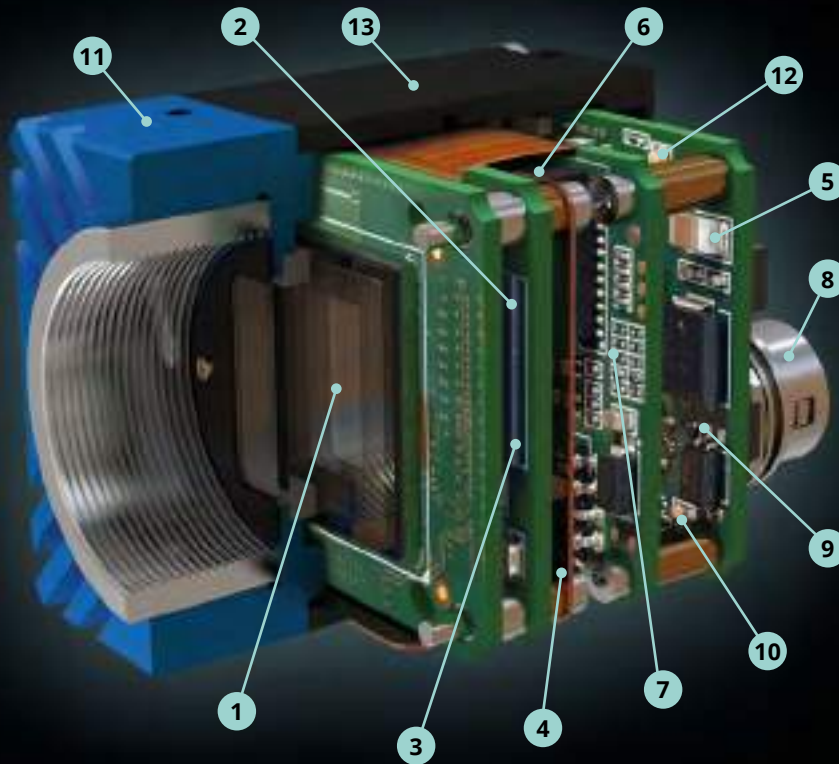
With the internal image memory, no image will be lost again.

The internal memory buffers images and enables useful features such as Record / Playback, Pre-trigger and sequence recordings.



Customized machine vision cameras

Industrial cameras specifically tailored for your needs



KEY FEATURES

1 Premium Quality Sensors

State of the art SONY® Pregius™ CMOS Global Shutter image sensors.

2 Large FPGA

Upgradeable FPGA for custom embedded processing.

3 Large on-board Image Buffer

Never miss a frame and take advantage of burst mode acquisition.

4 Heat Management

Excellent design for maximum reliability and performance.

5 Power Management

Smart power distribution for reduced heat generation.

6 Isolated PoE supply

Simplify your cable harness with data and power over a single cable.

7 Industrial Communication

Robust, high immunity 1000Mbit/s Ethernet PHY for the most reliable connection over long cables in harsh industrial environments.

8 Broad Range of I/Os

Industry standard Hirose 12 pin connector for a broad range of I/Os and special functions.

9 Serial Communication

Combo RS232/485 transceiver for maximum flexibility.

10 Liquid Lens Controller

Seamless operation in a cost-saving, reduced space and integrated device.

11 Robust Design

Milled aluminium body for excellent heat dissipation and robustness.

12 Wide Input Voltage Range

Maximum compatibility with other devices installed on industrial machinery.

13 Wide Temperature Range

Guaranteed operations in most challenging environments.

WHY A CUSTOM CAMERA?

Increased profitability

Components specifically designed to solve a given application offer the best performance-to-price ratio.

Secure investment

Customized products with dedicated part numbers ensure exclusivity and the best after-sales service.

Unmatched quality

Opto Engineering® custom cameras are completely designed and produced in Italy with the renowned quality that distinguishes all of our products.

Trusted partner

With two decades of experience in the world of machine vision, Opto Engineering® is the ideal partner to help you bring your ideas to life.

KEY ADVANTAGES

Wide range of available sensors

High quality Sony sensors for maximum performances.

Powerful scalable hardware

Possibility to support additional algorithms and/or expansion boards to connect different types of actuators and sensors.

Modular software and firmware code

The scalable design allows the development of custom algorithms.

Customizable mechanics

Possibility of modifications for the addition of connectors and/or boards.

Nowadays machine vision is extensively employed in a wide range of sectors and applications, each with its specific requirements and restrictions. Because of this variety of cases, the customization of different components is often needed and, being the core of each vision system, cameras are no exception to this.

With two decades of experience in the field of machine vision, Opto Engineering® offers **customized industrial cameras** specifically tailored to answer every need. Designed and manufactured in Italy by Opto Engineering®, these cameras start from a set of basic common features to provide a wide

range of customizations, both hardware and software/firmware.

Moreover, thanks to our expertise and know-how in optics and lighting, we can deliver vision solutions tuned to your most challenging applications. We can also provide pre-assemblies on request, for example fixed camera and lens combinations.



WHAT WE CAN DO FOR YOU

Below there is a list of possible features and customizations that we can implement: if you cannot find what you are looking for, contact us to discuss your specific needs.

BASIC FEATURES

- Extended voltage range
- Extended temperature range
- Encoder interface
- Multi-protocol serial interface RS232-RS485
- Auto gain, auto exposure
- Filter holder for optical filters
- Configurable logic (sequencer, timers, counters, I/Os, ...)
- Pre-configurations (fast-switch)
- Digital shift and gain
- User sets

HARDWARE CUSTOMIZATIONS

- Integrated light controller
- Enhanced passive cooling system
- Fan cooling system
- Custom mount
- Board level version
- Custom connectors

Sensor	MP	Format	H	V	Pixel size (µm)	Frame rate Streaming/Burst (fps)
IMX265	3.2	1/1.8	2048	1536	3.45	37.2/55.6
IMX252	3.2	1/1.8	2048	1536	3.45	37.2/81.4
IMX264	5.0	2/3"	2448	2048	3.45	23.4/35.7
IMX250	5.0	2/3"	2448	2048	3.45	23.4/52.4
IMX304	12.0	1.1"	4096	3000	3.45	9.6/15.1
IMX253	12.0	1.1"	4096	3000	3.45	9.6/22.2
IMX387	16.9	4/3"	5472	3094	3.45	7/16.9
IMX367	19.7	4/3"	4432	4446	3.45	6/14.5
IMX342	31.5	APS-C	6480	4870	3.45	3.7/9.1

- Other sensors can be integrated on request.
- Mono and color versions available.

SOFTWARE/FIRMWARE CUSTOMIZATIONS

- Burst acquisition
- Multi-ROI acquisition
- On-board custom logic functions
- Autofocus
- Noise reduction
- Defect pixel correction
- Flat field correction
- Anti-aliasing
- Action commands
- Image pre-processing

Line scan cameras

High resolution at high speed.

Line scan cameras are usually employed when moving continuous materials need to be checked, that is for the so-called web inspection, but also when long or large samples are involved. In fact, although a little less simple and more technically demanding with respect to area scan ones, line scan cameras represent the ideal solution for such kind of applications.

Opto Engineering® offers a series of high-resolution line scan cameras to solve the most challenging applications: COE HR LS cameras feature 8k and 16k CMOS sensors that combine quality and speed.


Our cameras are available in a monochrome version, ideal for document scanning, printing and packaging applications, inspection of large flat panel displays and wide area scanning in general. Moreover, the Camera Link interface guarantees a fast and reliable output that makes these cameras suitable for high-speed systems.



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

CAMERA PARAMETERS

 Sensor format

 Line rate, up to

COE HR LS series

8k/16k line scan cameras



KEY ADVANTAGES

High resolution at high speed

Ideally suited for the inspection of large-area flat panel displays and document scanning.

Advanced Power control

With advanced power control, the COE-8K and COE-16K can be used in large arrays with confidence.

Flat Field correction

Dark Signal Non-Uniformity (DSNU) Correction is used to correct dark field offset within the sensor. Photo Response Non-Uniformity (PRNU) is used to correct the difference in pixel response and the change in response due to optical or light source differences.

Camera Link output for reliable, fast performance

Provides maximum speed and resolution.

On-board user data storage

On-board user data storage provides customizations for advanced applications.

COE High Resolution Line Scan cameras are designed to provide high speed capture using one or two lines of pixels to construct an image as the camera or part is moved under the sensor. This allows large areas to be captured for difficult inspections, such as web material, paper products, wire, or flat panel displays, without the need for high speed area scan cameras.



COE HR LS cameras use the latest AMS/Awaiba Dragster sensors that offer unequaled sensitivity, bandwidth and signal-to-noise ratio. With advanced power control, the COE8K and COE16K can be used in large arrays with confidence. On-board user data storage provides customization for advanced applications.

COE HR LS cameras are available with monochrome sensors and are Camera Link only. This guarantees the fastest and most reliable output that makes this camera ideal for large area flat-panel inspection systems, printed material inspection, PCB inspection and much more.

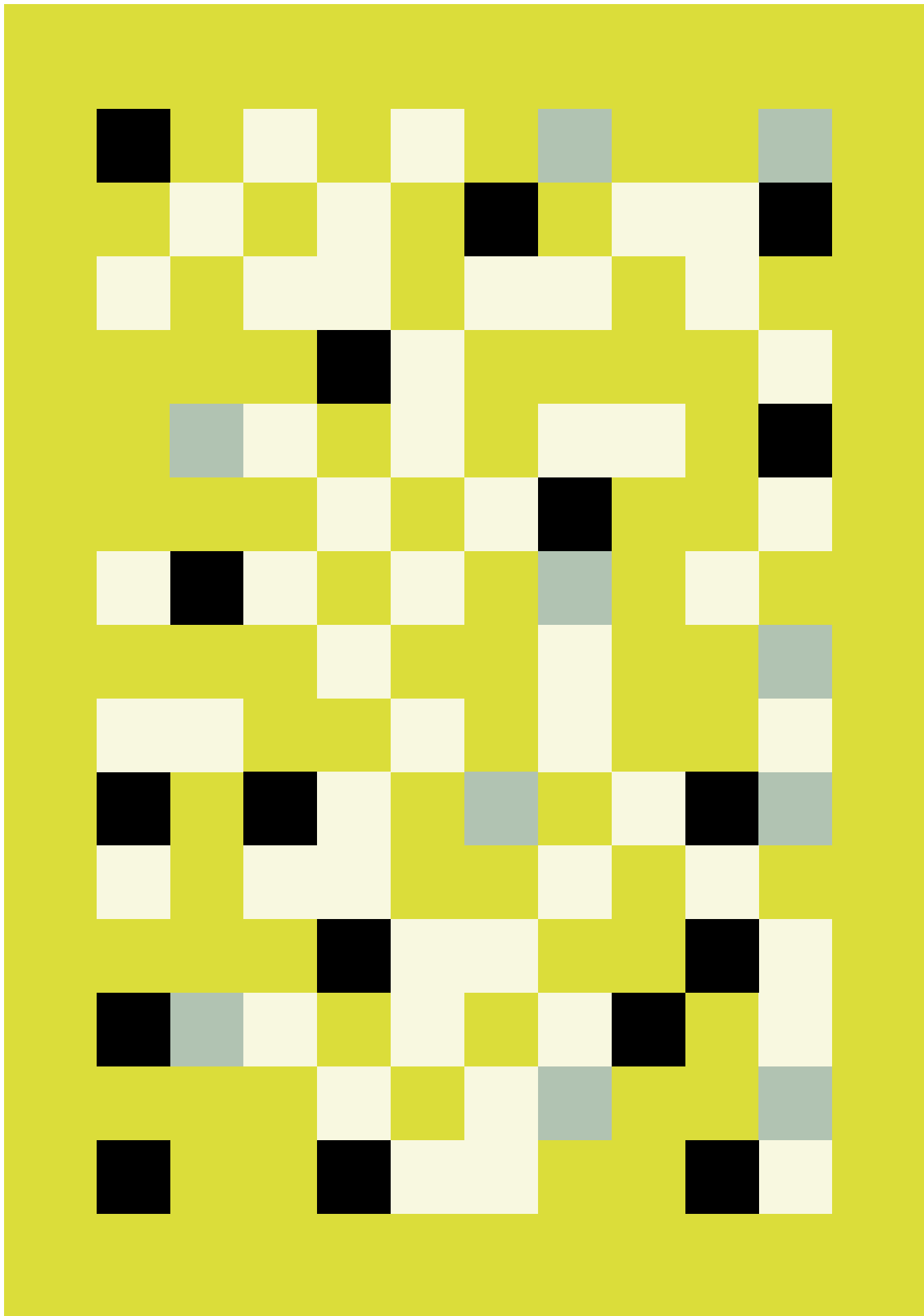
The camera FPGA includes Photo Response Non-Uniformity (PRNU) which is used to correct the difference in pixel response and the change in response due to optical or light source differences. This correction guarantees the highest quality image.

With advanced power control, the COE HR LS cameras can be used in large arrays with confidence.

The M72 mount is ideal to mount our TC12K line scan lenses, and the MC12K macro lenses. Combined with Opto Engineering® lenses and illuminators, we can assist in building a fast, reliable and cost-effective system.

FULL RANGE OF COMPATIBLE ACCESSORIES		
	COE-6P-FEMALE	p. 264
	COE-PS-UNIVERSAL	p. 262

Part number	Sensor specifications						Camera specifications			
	Resolution (MP)	Resolution (H x V)	Pixel size (µm)	Sensor format	Sensor	Type	Shutter	Mono/color	Interface	Line rate (kHz)
COE8KLSMCL-G	8K	8192 x 1	7	57.3 mm	ams DR-8k-7	CMOS	Global Shutter Linear	Mono	Camera Link	77
COE16KLSMCL-G	16K	16384 x 1	3.5	57.3 mm	ams DR-16K-3.5	CMOS	Global Shutter Linear	Mono	Camera Link	55



SOFTWARE



Software is a fundamental tool to design, build and operate a vision system.

During the initial design process, software can support mechanical modeling and simulate the expected behavior of optics and lighting, allowing you to identify potential flaws in the system at an early development stage. In the installation phase, software verifies that all imaging components work smoothly together, also enabling perfect sync with other parts of the system such as conveyors, robotic arms and motion devices. Lastly, software is essential to correct, process and analyze images, ensuring that the output of the vision system satisfies the inspection requirements.

Opto Engineering® products are the foundational elements of any vision systems and software is the final piece of the puzzle, making all parts of the system work together cohesively, reliably and efficiently.

Machine vision software **210**

Machine vision libraries **217**

Machine vision software

Opto Engineering® machine vision software products offer user friendly tools which allow vision engineers to easily solve new challenges.

Whether you're looking for a general purpose developing environment such as **FabImage® Studio Professional**, or more application-specific GUIs like **Horus**, dedicated to metrology, we have the product that suits your needs!

FabImage® Studio Professional

Software for Machine Vision Engineers



FabImage® Studio Professional is a **data-flow based software** designed for machine vision engineers. It does not require any programming skills, but it is still so powerful that it can win even against solutions based on low-level programming libraries.

Also, the architecture is highly flexible, ensuring that users can easily adapt the product to the way they work and to specific requirements of any project.

KEY ADVANTAGES

No low-level programming knowledge required.

Data-flow based software.

Fast and optimized algorithms.

1000+ high performance functions.

Custom machine vision filters.

Intuitive

Drag & Drop

All programming is done by **choosing filters and connecting them with each other**. You can focus all your attention on computer vision.

You Can See Everything

Inspection results are visualized on multiple configurable data previews; and when a parameter in the program is changed, **you can see the previews updated in real time**.

HMI Designer

You can easily **create custom graphical user interfaces** and thus build the entire machine vision application using a single software package.

Powerful

Over 1000 Ready-for-Use Filters

There are over **1000 ready-for-use machine filters tested and optimized** on hundreds of applications. They have many advanced capabilities such as outlier suppression, subpixel precision or any-shape region-of-interest.

Hardware Acceleration

The filters are **aggressively optimized for the SSE technology** and for **multicore processors**. Our implementations are ones of the fastest in the world!

Loops and Conditions

Without writing a single line of code, **you can create custom and scalable program flows**. Loops, conditions and subprograms (macrofilters) are realized with appropriate data-flow constructs in the graphical way.

Adaptable

GigE Vision and GenTL Support

FabImage® Studio is a **GigE Vision compliant** product, supporting the GenTL interface, as well as a number of vendor-specific APIs. Thus, you can use it with **Opto Engineering® cameras** and most cameras available on the market, including models from **Matrix Vision**, Allied Vision, Basler, Baumer, Dalsa, PointGrey, Photon Focus and XIMEA and more.

User Filters

You can use user filters to **integrate your own C/C++ code with the benefits of visual programming**.

C++ Code Generator

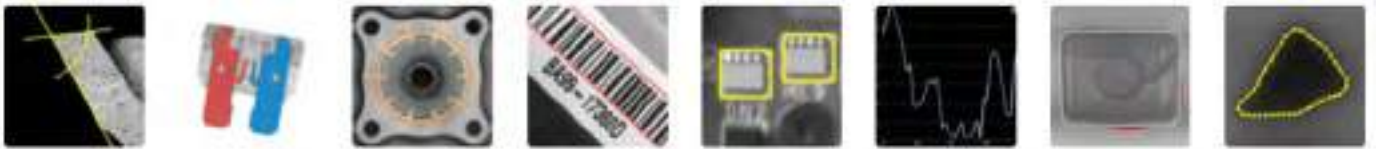
Programs created in FabImage® Studio can be exported to C++ code or to .NET assemblies. This makes it very easy to **integrate your vision algorithms with applications created in C++, C# or VB** programming languages.



CAPABILITIES

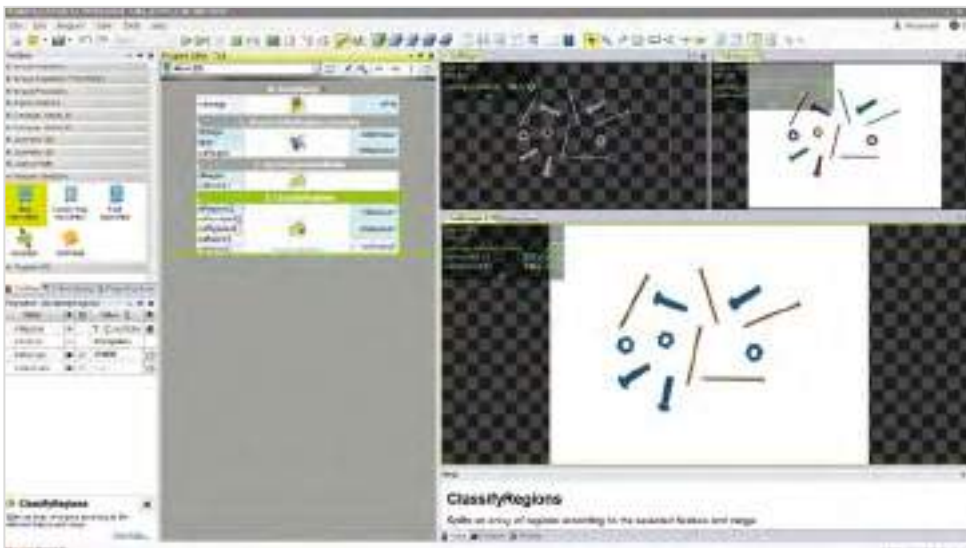
There are over 1000 filters encompassing both basic transformations and specialized machine vision tools.

- Image processing
- Shape fitting
- Barcode reading
- Template Matching
- Support vector machines
- Blob analysis
- Camera calibration
- Data code reading
- Measurements
- GigE Vision and GenTL
- Contour analysis
- Fourier analysis
- Corner detection
- Histogram analysis
- Planar geometry
- Hough transform
- 1D profile analysis
- OCR



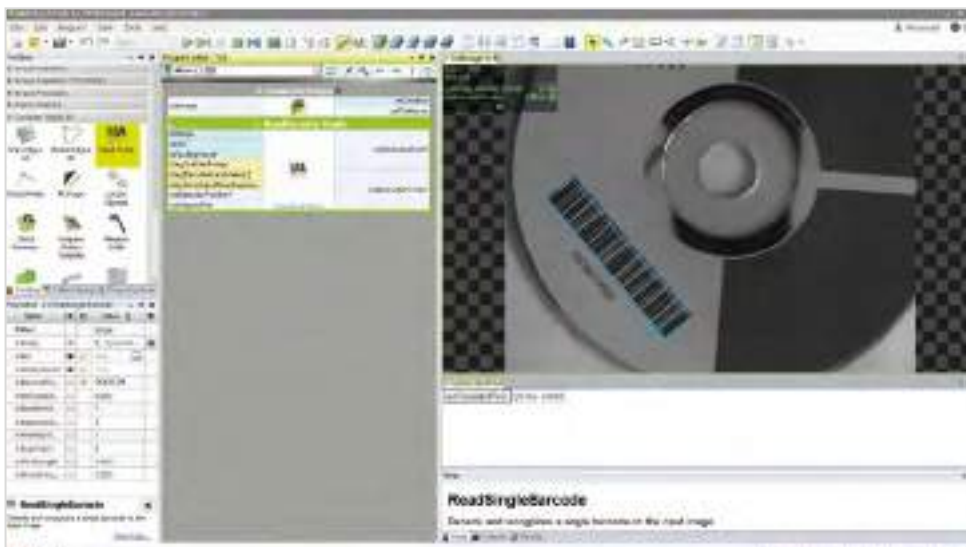
APPLICATION EXAMPLES

FabImage® studio pro



In this application, we need to sort nails amongst nuts and bolts.

The image is thresholded and the resulting regions are split into blobs; finally, the blobs are classified by their elongation and the nails are easily found.



This example shows a basic ReadBarcodes filter.

The tool automatically finds the barcode and gives as output the decoded text.

License types

There are two types of commercial licenses:

- **Development:** assigned to a single engineer. It includes one year of technical support, which can be extended with an annual fee. Valid technical support also gives you the right to upgrade the software to newer versions and provides a discount on runtime licenses.

- **Runtime:** assigned to a single vision system. You can use one license for one multi-camera system, but multiple licenses are required to control multiple independent systems, even if run on a single physical computer.

Product	Type	P/N
FabImage® Studio Professional	Development	FIS-PRO
<ul style="list-style-type: none"> • license assigned to a single user • includes 1 year technical support • delivered on a usb dongle 		
FabImage® Studio + Library bundle	Development	FIS-ADD
<ul style="list-style-type: none"> • license for users who need both FabImage® Studio Professional and FabImage® Library Suite includes generating C++ code from programs in FabImage® Studio Professional • includes 1 year technical support • delivered on a usb dongle 		

Product	Type	P/N
FabImage® Studio Runtime	Runtime	FIS-RUN
<ul style="list-style-type: none"> • can be used to control at most one vision system • the price for integrators / oem: requires a Professional (dev.) license with valid technical support 		
FabImage® Studio Runtime	Runtime	FIS-RTB
<ul style="list-style-type: none"> • can be used to control at most one vision system 		

Additional products	Type	P/N
Multithreading Add-on	Development	FI-PAR
<ul style="list-style-type: none"> • applies to developer licenses. It allows the user to run several macrofilters (worker tasks) in parallel. Multithreaded projects require special runtime licenses. 		
1 Year Support Extension	Development	FIS-EXT, ADD-EXT
<ul style="list-style-type: none"> • applies to all types of development licenses, extends the rights of one development license for another year 		
USB License Dongle	-	USB-DONGLE-FI USB Dongle for FabImage® Developer licenses USB-DONGLE-RUN USB Dongle for FabImage® Runtime licenses
<ul style="list-style-type: none"> • an alternative to the computer-id based licensing mechanism makes it possible to use the software on multiple computers can be used for both Development and Runtime licenses 		

Quickstart guide to FabImage® part numbers:

- FabImage® Studio Professional (FIS-PRO) makes it possible to create complete machine vision applications, including HMI. FabImage® Studio Runtime (FIS-RUN/FIS-RTB) is required to run the applications on each inspection system.
- FabImage® Studio Professional (FIS-PRO) includes the feature of User Filters, which allows for embedding user's C++ code within the graphical programming model. FabImage® Library Suite, FIL-SUI (or the Studio + Library bundle, FIS-ADD) is only required, if one needs to invoke the built-in image analysis tools as C++ functions.
- If you want to prototype applications in FabImage® Studio Professional (FIS-PRO) and then transform them into C++ code, then you need FabImage® Studio + Library bundle (FIS-ADD)
- If the graphical programming environment for fast prototyping is not needed, then FabImage® Library Suite (FIL-SUI) is enough for development.
- In general, there are four possible ways to work with the products:
 1. Programming in the graphical way – this requires an FabImage® Studio Professional (FIS-PRO) for each developer and a FabImage® Studio Runtime (FIS-PRO/FIS-RTB) for each system. One particular advantage of this method is the ease of introducing changes, even directly on the production line.
 2. Programming in the graphical way and then generating C++ code – this requires a FabImage® Studio + Library bundle (FIS-ADD) for each developer and a FabImage® Library Runtime (FIL-RUN/FIL-RTB) for each system. This method allows to integrate the created solutions with bigger software projects.
 3. Programming in the graphical way and then generating .NET Macrofilter Interfaces – this requires FabImage® Studio Professional (FIS-PRO) for each developer and a FabImage® Studio Runtime (FIS-RUN/FIS-RTB) for each system. No library license is needed as .NET Macrofilter Interfaces use the same program execution mechanisms as Studio.
 4. Programming directly in C++ or .NET – this is for people who think in C++ or C# and do not want to do graphical programming. In this case a FabImage® Library Suite (FIL-SUI) is required for each developer and a FabImage® Library Runtime (FIL-RUN/FIL-RTB) for each system.

HORUS

Windows OS desktop application for optical measurement

NEW



Horus is a metrology software application ensuring unpaired system measurement accuracy thanks to its state-of-the-art calibration algorithms and protocols.

Horus is a very intuitive and user-friendly software allowing for real time measurement of parts: its interface and procedures are designed to closely match traditional CAD software approach thus ensuring a quick and easy check of the measurement results.

Parts are automatically recognized and tracked over the entire field of view with no need for reconfiguring the measurement procedure, while tools for automatic geometric primitives and part geometric construction search make metrology information even more easily available.

An advanced approach to edge detection and system calibration ensure maximum accuracy to your measurement system. Statistics are really intuitive and easy to use, allowing for getting complete measurement reports and data extraction.

Horus can be easily configured and released independently by machine builders who want to address the specific type of process and needs of their customers.

Moreover, Horus is suitable for customizations of the program interface, of existing program features as well as creating new application-specific features, according to customer's need, including on-line measurement operation.

KEY ADVANTAGES

Very accurate calibration and measurement over the entire field of view.

Live measurement and tracking of objects placed in any position.

Very intuitive interface, consistent with most CAD environments.

Flexible, configurable and open to the integration with other devices.

FEATURES

Live measurement

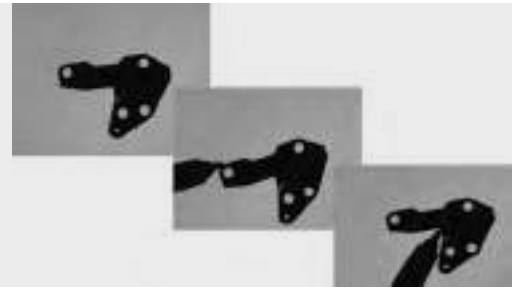
Objects are instantly recognized and measured in real time ensuring very fast measurement operations.

Object tracking by recognition

Synthetic models of multiple objects can be created from images or .dxf files. The software recognizes every object in any position and with whatever rotation within the field-of-view.

Measurement program auto-search

The software can automatically recognize the object and apply its specific pre-defined measurement program. Based on the image, the software searches for all the projects that best fit it, and returns a list of results.



Self-detection of geometric primitives

Geometric primitives can be either automatically identified or defined by the operator. This allows for the analysis tools to be easily created with a simple click from within a dedicated set-up window.

Episcopic measuring tool

This tool is dedicated to measurement on front-illuminated (episcopic) setups. It doesn't require time-consuming parameterization and is extremely robust on variations of illumination and contrast. The tool automatically identifies the object primitives, even if scarcely visible or defined by low contrast, where a clear edge extraction is not easy with standard tools. The resulting measurements are repeatable and stable.



Accurate control of fitting primitives

Geometric primitives can be point-by-point controlled by means of statistical tools: point distribution can be checked and used to apply filtering process.

Creation of part and/or assembly program

With Horus it is possible to create multiple project files related to the same part. With this method, particularly indicated for multi cameras systems, you can use multiple projects to analyze the same part in different ways, e.g. front view vs top view or side view.

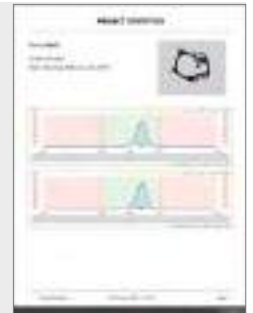
Statistical reports

Measurement values are saved in a database configured for easily checking and reviewing historical and statistical trends. Data can be read, modified, exported in CSV format and the reports printed. Other export format can be developed upon request.



Simple features creation tool

Creating dimensions, geometric shapes and any other feature is always guided by descriptions and commands suggested graphically in the user interface. Horus can easily manage either typical elements of CAD modelling (intersections, axes, perpendicularity and parallelism, etc.) or geometric nominal values and tolerances by automatic or tool-aided creation of dimensional data boxes.



Crosshair (FoV version)

Crosshair function for manual measurements allows for the analysis to be made also in situations where the processing is difficult due to part/environmental conditions and automatic tools might not be enough. The graphical user interface helps as always in defining distances, diameters or angles.

Advanced image edge management

Black-to-white transition curves are analyzed and the most appropriate edge placement and position correction is applied using sub-pixel accurate edge extraction. Different edge corrections can be applied to ensure maximum results and compensate material and shape refraction.

Advanced system calibration and optimization

A complete set of advanced tools ensure the calibration and optimization of all the variables of the system to reach high accuracy and consistency.

Our calibration procedures ensure maximum measurement constancy over the entire field of view, thus making the measurement much less sensitive to object displacement over the field of view. Lens calibration, light alignment, object plane control and adjustment and autofocus tool combined with motorized vertical axis ensure optimum performance by minimizing any measurement issues arising from system asymmetry or misalignment.

Flexible camera interface

Horus supports cameras compliant with GeniCam, GigEVision, USB3 Vision and other main camera standards. Other types of cameras can be very easily integrated upon request.

Motorized axes and light control integration

Horus is compatible with pre-defined motion control units. Z axis, for best image focusing, is driven and controlled by the application. XY translation stage readout, calibration and control, for CNC-type measurement machine, can be easily integrated through proprietary or customer specific axes control, together with a fourth axis providing the rotational degree of freedom. Non-standard motion controllers can be integrated upon request.

Smart light control integration

Horus is compatible with pre-defined illumination control units. The light control tool manages illuminators and specifically ring lights with 1, 4 or 8 sectors. A smart control of multi-sector ring lights is possible, where specific sectors are turned on depending on the part orientation and location on the FoV. Non-standard illumination controllers can be integrated upon request.

Touch support

Horus is designed to be used with ease even without keyboard or mouse. All menus, functions, filters and tools are right at your fingertips.

Multilanguage support

Horus comes in 5 different languages: EN, DE, FR, IT, ZH.

Circle calibration

Instead of using a chess calibration, with this feature it is possible to use a plate with circles as a calibration reference, enlarging the possibility of the calibration. In the example it is possible to check how the calibration is performed and the adjustment done by the software.

DXF Camera

The DXF Camera plugin allows to upload a .dxf file from the local storage and transform it into a analyzable image in Horus. Technical applications result much easier and time saving using this tool. As shown in the pictures, first a .dxf is imported and then the analysis is performed using quotes, tolerances and so on. As the other tools and features in Horus the access is simple and clear: from the camera setting, select dxf camera and the .dxf file that has to be loaded.

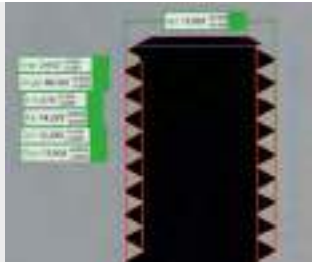
Thread

The thread tool is a plugin that allows to highlight the conformity of a thread. It points out the measurements, as distances, diameters or angles, outside the tolerances.

Thread ISO

The thread ISO tool has the capability to visualize steps, angles and diameters (internal and external) quotes of a thread just by selecting an area containing the object.

The main difference between THREAD and THREAD ISO is the level of detail, THREAD shows the part faults, THREAD ISO measures every element in the object.



Gear

In the detail it is possible to see how the object is treated by the analysis. A label is assigned to every element recognized, in the side menu is specified a quote corresponding to the assigned name.

Once a gear is detected, the tool shows by default the main parameters into several labels allowing a fast and precise insight.

Advanced tool O-Ring

The aim of this tool is to perform a dimensional analysis of O-Rings, reporting the relative quotes of the external diameter, internal diameter, section and concentricity.



Photometry

The photometric analysis is executed by hitting the target with a light beam from different shooting angles in order to highlight the presence of ruffle on the surfaces.

From this test, it is possible to obtain two types of data, the first one is the joint of the frames from different shooting angles and the second that shows the ruffles through a graphical elaboration.

Depth from focus

With certain objects there is the risk to lose the focus on some part of the analyzed target. The example shows one of the most common situations where a strong zoom is performed, which drives to lose the focus on the wither the closer or the further the object. The following tool is created to overcome this problem by taking and elaborating several images with different zooming level (the number and the zooming are decided by the user). The result is a compound of the pictures.

Stitch

The stitching tool allows to obtain an image that is a stitching of several images. This tool is created for machines controlled by encoders that have two degrees of freedom through two axis parallel with the object plane. One of the features is the possibility to choose the referring coordinates: either the encoder reference or, in case to not depend on that, an optical reference, called marker which is decided by the user (as shown in the picture). The acquisition could be manual or automatic, whilst the number of picture taken is always decided by the user. Once the stitching is performed, the resulting image can be used in Horus as a normal input for a new program.

Tielab

Tielab is a software development kit (SDK) focused on artificial vision projects through which the developer can use all the features and potentiality of Horus, inside its own application. In particular, Tielab is a flexible tool that allows to make the integration of Horus possible inside a custom application, in order to adapt it with all the different customer requests. Through Tielab it is possible to access the devices control such as drives, industrial cameras, light controllers and plc. Interact with them with the aim to create, edit and load measurement project, making it, in fact, a perfectly integrated tool inside the programming environment.

Moreover, Tielab supports .NET applications such as **C#**, **VB .Net**, **C++** and **F#**; in addition, both parallel programming and multitasking are easily implementable in some line of code. In the end, Tielab supports applications written in **LabView**, transforming them as elements usable inside the machine cycle.

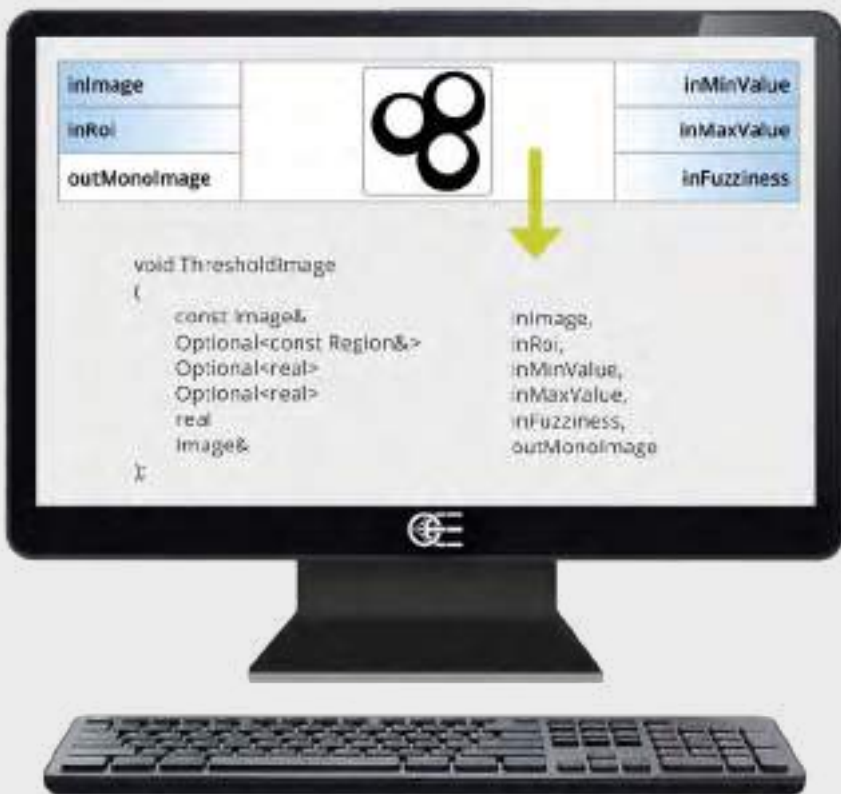


Opto Engineering® machine vision libraries are the perfect choice for advanced users who require complete freedom in creating their own software.

Our products encompass industrial-grade tools such as the functions part of FabImage® Library Suite, together with application-specific algorithms such as TCLIB and 360LIB, dedicated to the optimization of telecentric and pericentric setups.

FabImage® Library Suite

Machine Vision Library for C++ and .NET



KEY ADVANTAGES

Highest performance.

Modern design.

Simple Structure.

FabImage® Library Suite is a machine vision library for C++ and .NET programmers. It provides a comprehensive set of functions for creating industrial image analysis applications - from standard-based image acquisition interfaces, through low-level image processing routines, to ready-made tools such as template matching, measurements or barcode readers.

The main strengths of the product include the highest performance, modern design and simple structure making it easy to integrate with the rest of your code. The functions available in FabImage® Library Suite closely correspond to the filters of FabImage® Studio. Therefore, it is possible to prototype your algorithms quickly in a graphical environment and then translate them to C++ or .NET, or even generate the C++ code automatically.

FabImage® Library Suite gives you instant access to the highest quality, well optimized and field-tested code that you need for your machine vision projects!

Features

Performance

In FabImage® Library Suite careful design of algorithms goes hand in hand with extensive hardware optimizations, resulting in performance that puts the library among the fastest in the world. Our implementations make use of SSE instructions and parallel computations on multicore processors.

Modern Design

All types of data feature automatic memory management, errors are handled explicitly with exceptions and optional types are used for type-safe special values. All functions are thread-safe and use data parallelism internally, when possible.

Simplicity & Consistency

The library is a simple collection of types and functions, provided as a single DLL file with appropriate headers. For maximum readability functions follow consistent naming convention (e.g. the VERB + NOUN form as in: SmoothImage, RotateVector). All results are returned via reference output parameters, so that many outputs are always possible.

CAPABILITIES

There are over 1000 filters encompassing both basic transformations and specialized machine vision tools.

- Image processing
- Shape fitting
- Barcode reading
- Template Matching
- Support vector machines
- Blob analysis
- Camera calibration
- Data code reading
- Measurements
- GigE Vision and GenTL
- Contour analysis
- Fourier analysis
- Corner detection
- Histogram analysis
- Planar geometry
- Hough transform
- 1D profile analysis
- OCR



LICENSING MODEL

License types

There are two types of commercial licenses:

• **Development:** assigned to a single engineer. It includes one year of technical support, which can be extended with an annual fee. Valid technical support also gives you the right to upgrade the software to newer versions and provides a discount on runtime licenses.

• **Runtime:** assigned to a single vision system. You can use one license for one multi-camera system, but multiple licenses are required to control multiple independent systems, even if run on a single physical computer.

Product	Type	P/N
FabImage® Library Suite (C++ and .NET) • available distribution for Windows license assigned to a single user • includes 1 year technical support • delivered on a usb dongle	Development	FIL-SUI
FabImage® Studio + Library bundle • license for users who need both FabImage® Studio Professional and FabImage® Library Suite includes generating C++ code from programs in FabImage® Studio Professional • delivered on a usb dongle	Development	FIS-ADD

Product	Type	P/N
FabImage® Library Runtime • license assigned to a single computer can be used to control at most one vision system • the price for integrators / oem: requires a Professional (dev.) license with valid technical support	Runtime	FIL-RUN With dev. License and valid tech support
FabImage® Studio Runtime • license assigned to a single computer can be used to control at most one vision system	Runtime	FIL-RTB With dev. License and valid tech support

Additional products	Type	P/N
Multithreading Add-on • applies to developer licenses. It allows the user to run several threads in parallel. Multithreaded projects require special runtime licenses.	Development	FIL-PAR
1 Year Support Extension • applies to all types of development licenses, extends the rights of one development license for another year	Development	FIL-EXT, ADD-EXT
USB License Dongle • an alternative to the computer-id based licensing mechanism makes it possible to use the software on multiple computers, can be used for both Development and Runtime licenses	-	USB-DONGLE-FI USB Dongle for FabImage® Developer licenses USB-DONGLE-RUN USB Dongle for FabImage® Runtime licenses

Quickstart guide to FabImage® part numbers:

- FabImage® Studio Professional (FIS-PRO) makes it possible to create complete machine vision applications, including HMI. FabImage® Studio Runtime (FIS-RUN/FIS-RTB) is required to run the applications on each inspection system.
- FabImage® Studio Professional (FIS-PRO) includes the feature of User Filters, which allows for embedding user's C++ code within the graphical programming model. FabImage® Library Suite, FIL-SUI (or the Studio + Library bundle, FIS-ADD) is only required, if one needs to invoke the built-in image analysis tools as C++ functions.
- If you want to prototype applications in FabImage® Studio Professional (FIS-PRO) and then transform them into C++ code, then you need FabImage® Studio + Library bundle (FIS-ADD)
- If the graphical programming environment for fast prototyping is not needed, then FabImage® Library Suite (FIL-SUI) is enough for development.
- In general, there are four possible ways to work with the products:
 - Programming in the graphical way – this requires an FabImage® Studio Professional (FIS-PRO) for each developer and a FabImage® Studio Runtime (FIS-PRO/FIS-RTB) for each system. One particular advantage of this method is the ease of introducing changes, even directly on the production line.
 - Programming in the graphical way and then generating C++ code – this requires a FabImage® Studio + Library bundle (FIS-ADD) for each developer and a FabImage® Library Runtime (FIL-RUN/FIL-RTB) for each system. This method allows to integrate the created solutions with bigger software projects.
 - Programming in the graphical way and then generating .NET Macrofilter Interfaces – this requires FabImage® Studio Professional (FIS-PRO) for each developer and a FabImage® Studio Runtime (FIS-RUN/FIS-RTB) for each system. No library license is needed as .NET Macrofilter Interfaces use the same program execution mechanisms as Studio.
 - Programming directly in C++ or .NET – this is for people who think in C++ or C# and do not want to do graphical programming. In this case an FabImage® Library Suite (FIL-SUI) is required for each developer and a FabImage® Library Runtime (FIL-RUN/FIL-RTB) for each system.

APPLICATION EXAMPLES

FabImage® Library Suite

Below is an elementary, yet complete, example of acquiring images from a GigE Vision camera, thresholding them and saving to files on disk, all done with FabImage® Library Suite (C++).

```

#include <iostream>
#include "Genicam.h"
#include "FIL.h"

using namespace fti;
using namespace fil;

int main(void)
{
    try
    {
        // Find devices
        Array< GigEVision_DeviceDescriptor > deviceList;
        GigEVision_FindDevices(800, 1, deviceList);
        if (deviceList.Size() >= 1)
        {
            // Connect to the first found
            String addr = deviceList[0].IpAddress;
            GigEHandle hDev = GigEVision_OpenDevice(addr);
            GigEVision_StartAcquisition(hDev, "Mono8");

            // Main loop
            Image image1, image2;
            for (int i = 0; i < 100; ++i)
            {
                // Grab image
                GigEVision_ReceiveImage(hDev, image1);

                // Process image
                ThresholdImage(image1, NIL, 128.0f, NIL, 0.0f, image2);

                // Save to file
                char fileName[16];
                sprintf(fileName, "%05d.png", i);
                SaveImage(image2, ImageFileFormat::PNG, fileName, false);
            }

            // Finalize acquisition
            fil::GigEVision_StopAcquisition(hDev);
            fil::GigEVision_CloseHandle(hDev);
            return 0;
        }
        else
        {
            return -1;
        }
    }
    catch (fti::Error& error)
    {
        std::cout << error.Kind() << ": " << error.Message() << std::endl;
        return -2;
    }
}

```

TCLIB Suite

Software library and stand-alone tools for the optimization of telecentric setups _____



KEY ADVANTAGES

State-of-the-art algorithms for distortion calibration.

Ensure the best focus and alignment with fast and intuitive stand-alone tools.

Maximize the system performance to achieve the best measurement results.

FULL RANGE OF COMPATIBLE CAMERAS



Area scan cameras

p. 188-203

TCLIB Suite is a C++ based computer vision software designed to optimize the optical performances of a telecentric setup, typically used for measurement purposes. With the use of both a .dll library and dedicated stand-alone tools, TCLIB makes it easy to take care of all aspects of a typical telecentric setup (focusing, alignments, distortion calibration) which, if not properly addressed, can affect negatively the results of measurements.

TCLIB Suite helps improve the quality of the system, providing the best possible images for your chosen metrology software to get the best achievable measurement results.

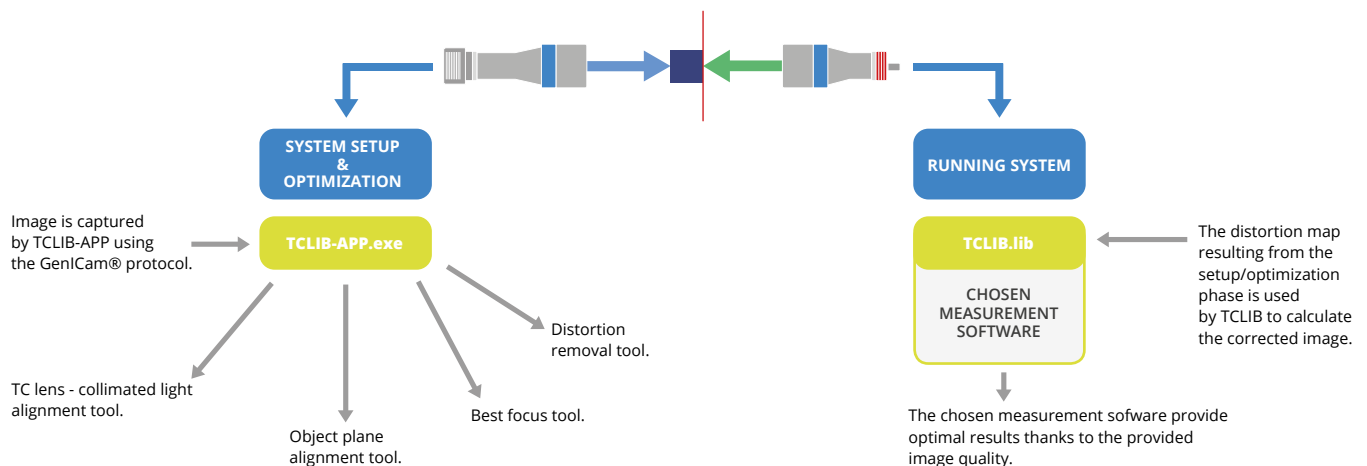
TCLIB Suite helps improve the quality of the system, providing the best possible images for your chosen metrology software to get the best achievable measurement results. In fact, any edge detection, pattern matching and calibration software will be more accurate and reliable if based on well aligned, homogeneously backlit, undistorted images.

1 Tested compatibility includes, but is not limited to, the following brands of cameras: Opto Engineering® (COE-G and COE-U series), Matrix Vision, Basler, HikVision, SenTech.

TCLIB Suite includes:

- Dedicated tools to take care of the basics of a measurement system setup: alignment of telecentric lens and collimated light, alignment of the object plane, best focus (TCLIB-APP)
- A set of algorithms (C++ library) to calculate the distortion map of a system and correct in live mode every new image acquired by the system (TCLIB), plus all the functions developed in the TCLIB-APP.

The stand-alone tools and the distortion calibration functions are used offline, when the initial optimization and calibration of the machine is needed. The distortion correction, on the other hand, is based on fast and reliable algorithms which allow the system to stream adjusted images in live mode.



What is distortion calibration?

Every time we use an optical system, i.e. a lens and matching camera, we must face the issue of **distortion**. The optical distortion of the system can be defined as a bias which causes a set of points to be imaged in different relative positions than the real ones.

A typical example is a straight line which is imaged as curved because of the lens distortion Fig.1 shows the effect of distortion on a calibration pattern.

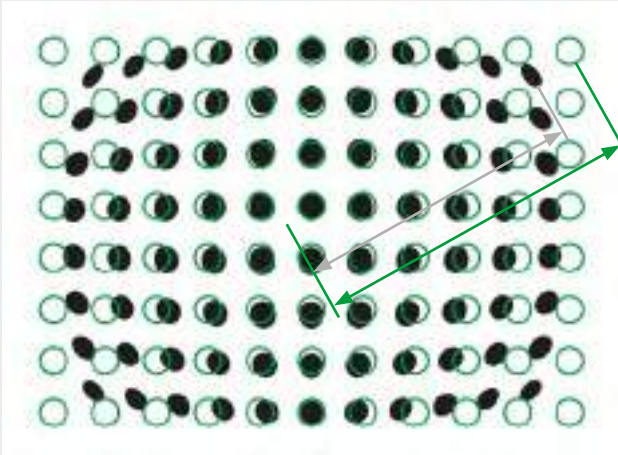


Fig. 1 Undistorted real pattern (green circles) vs. Imaged (black dots) distortion pattern.

The mathematical transformation connecting the original undistorted field of view to the distorted image can be very hard to model, also considering that it can change considerably through the field of view itself.

The first effect of distortion on metrology is the loss of repeatability of the measurements: since an object feature “looks” slightly different depending on where the object is located on the FoV because of distortion, the value of a measurement on that feature will be likely to change every time the object is removed and put back again.

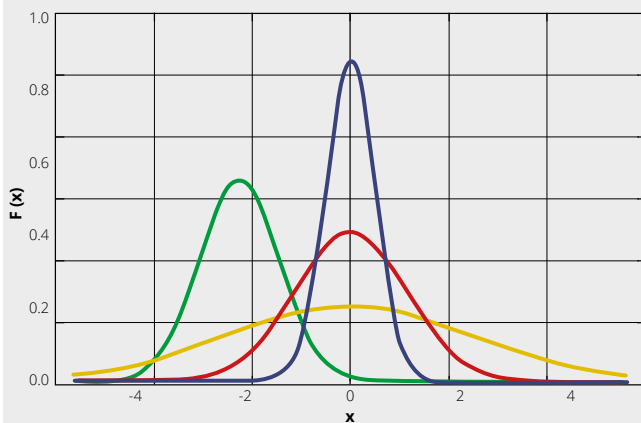


Fig. 2 Gaussian distribution of repeated measures. Blue, red and orange distributions represent the same result ($\mu = 0$) with different repeatability (best for blue). The green bell curve represents a wrong (but repeatable) result, e.g. biased by a fixed offset.

- $\mu = 0, \sigma^2 = 0.2$
- $\mu = 0, \sigma^2 = 1.0$
- $\mu = 0, \sigma^2 = 5.0$
- $\mu = -2, \sigma^2 = 0.5$

Repeatability of a measurement system

If we measure a through-hole diameter 100 times, the distribution of the results can be approximated by a gaussian curve: results close to the average are very frequent, whereas very different results are unlikely.

The repeatability of the measure is related to the width of the bell: the thinner the width, the harder it will be to find a measure far away from the average. In other words, a certain feature (e.g. a length) will be «almost the same, almost every time».

On the other hand, a wide bell represents the situation in which we can't tell whether a measure is actually different from the expected value (e.g. because it's a defective part) or it's a statistically expected outlier given by the low repeatability of our measurement system.

The typical width used is called **sigma** (or “full width at half maximum”, FWHM), and it's directly related to the repeatability.

We can thus establish a direct method to compare the accuracy requirements: if the tolerance on a measurement is given as multiples of its specific sigma value, we consequently state the likelihood of an out-of-tolerance part to present itself. A two sigma compliant object will be within tolerance 95% of the times. A three sigma object will have a 99.7% confidence level, rising to 99.99999% at 5 sigma.

Suppose your distribution has an average value of 150 mm and sigma = 1 mm. The associated error depends on the confidence value for your application. In fact, we can state in the feature specs that its length is 150 mm +/- 3 mm, and this will be true 99.7% of the time. On the other hand, if we want 1 mm to be a 3 sigma tolerance, we must improve our measurement process until 1 sigma = 0.33 mm.

Results of an optimized telecentric system

We tested the result of using TCLIB Suite to optimize different sets of possible telecentric systems. Results concern the four tools of the Suite as follows:

- lens-light alignment is given in terms of homogeneity of the illumination (standard deviation of the average grey level)
- lens-object plane alignment is given as the lowest value obtained, in degrees
- focus accuracy is given as the sensitivity in mm on the working distance
- distortion calibration is given as repeatability on 20 measurements of a 5 mm gauge block.

TCCP3MHR144-C + LTCLCP144-G + PTCP-S1-HR1-C							
Lens-light alignment as Background homogeneity	Object plane alignment as Best (lowest) angle between planes	Best focus as Best (lowest) uncertainty on WD	Distortion calibration as Result of 20 repeated measurements				
			Nominal	Measured	Min	Max	σ
191 +/- 7	0.012°	+/- 0.5 mm	5.000 mm	5.001 mm	4.998 mm	5.005 mm	1.7 μ m

TC3MHR144-C + LTCL144-GZ + PT120-240 (legacy)							
Lens-light alignment as Background homogeneity	Object plane alignment as Best (lowest) angle between planes	Best focus as Best (lowest) uncertainty on WD	Distortion calibration as Result of 20 repeated measurements				
			Nominal	Measured	Min	Max	σ
192 +/- 5	0.014°	+/- 0.5 mm	5.000 mm	4.999 mm	4.996 mm	5.003 mm	1.6 μ m

TC3MHR144-C + LTCL144-GZ + PTCP-S1-HR1-C							
Lens-light alignment as Background homogeneity	Object plane alignment as Best (lowest) angle between planes	Best focus as Best (lowest) uncertainty on WD	Distortion calibration as Result of 20 repeated measurements				
			Nominal	Measured	Min	Max	σ
192 +/- 5	0.003°	+/- 0.5 mm	5.000 mm	4.999 mm	4.997 mm	5.001 mm	0.9 μ m




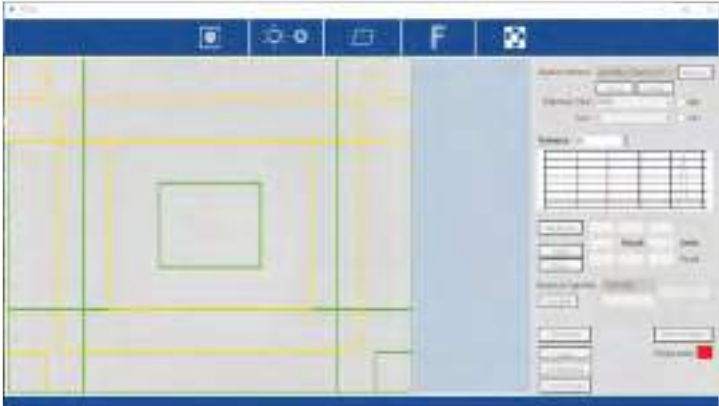
TCCR3M064-C + LTCLCR064-GZ + PT064-096							
Lens-light alignment as Background homogeneity	Object plane alignment as Best (lowest) angle between planes	Best focus as Best (lowest) uncertainty on WD	Distortion calibration as Result of 20 repeated measurements				
			Nominal	Measured	Min	Max	σ
210 +/- 7	0.001°	+/- 0.5 mm	5.000 mm	5.000 mm	5.000 mm	5.000 mm	0.3 μ m

Aligning of lens and collimated light source

This tool assists the operator in getting the most homogeneous illumination possible.

Getting the best homogeneity of the illumination is the first fundamental step for a good measurement system, since this spec affects the reliability of any set of edge detection algorithms.

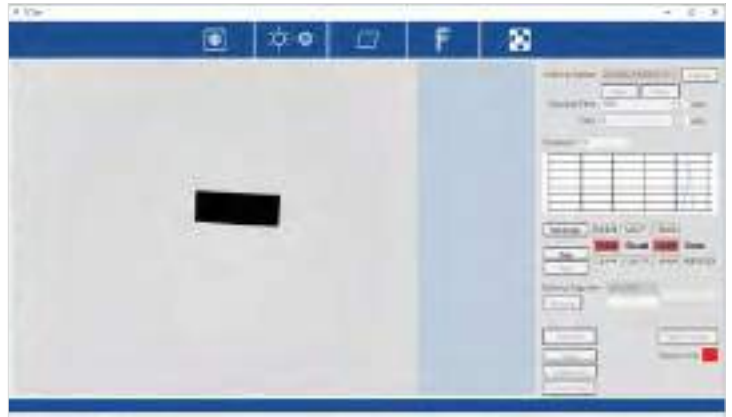
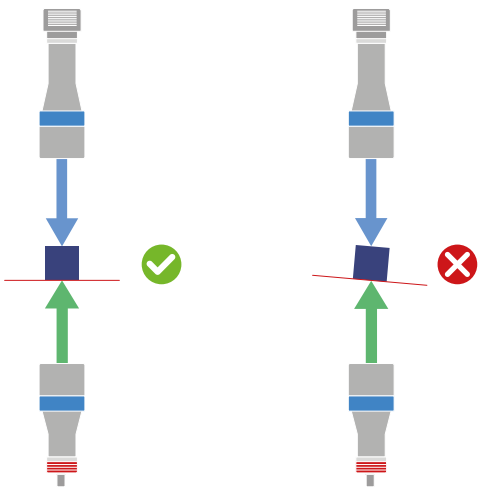
The tool works in live mode, giving a visual feedback on the alignment. The FOV is divided in ROIs, each one having a color feedback regarding the alignment:

RED: not homogeneous	YELLOW: discrete homogeneity	GREEN: good homogeneity
		
		

Aligning the object plane

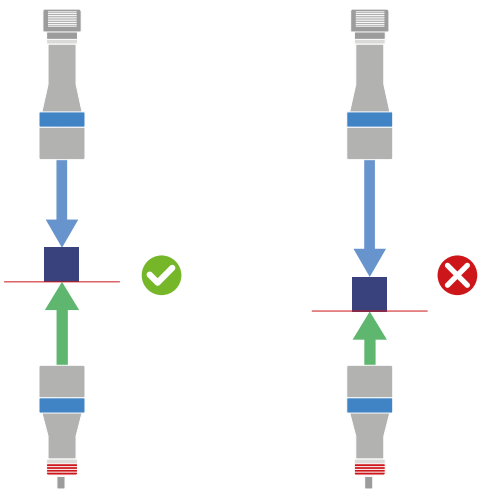
A good alignment of the object plane with the optical axis is essential. Consequences of misalignment are:

- In a backlighting condition we are looking at the object projection, not at its actual profile, hence the image might be affected by some compressions along certain directions
- Some features might not be at the best focus at the same time, thus compromising the quality of the edge for the measurement.



Best Focus

This tool gives a numeric index for every image, indicating the proximity to the best focus.

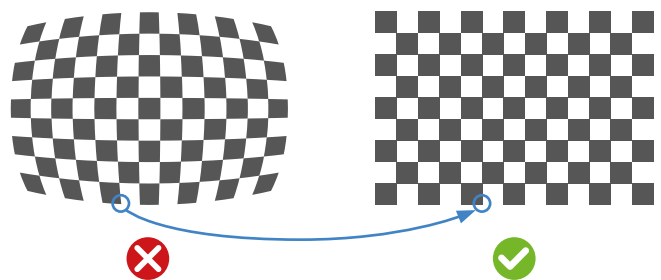


Distortion correction

This tool allows to eliminate the residual optical distortion from telecentric lens – however small, this value must be as close to zero as possible to achieve optimum results. From a single picture of a chessboard pattern covering the whole FoV (such as Opto Engineering® PT series), we get all the information needed to get rid of distortion.

The procedure steps are the following:

- **Acquire a single image of the calibration pattern** (offline)
- **From the picture, a distortion map is created** (offline)
- **The distortion map is saved on a reference file**
- **The distortion is eliminated on every new image acquired, recalling the saved distortion map** (online).



Step 1. and 2. mean to calibrate the system, hence they are needed just once. Step 4. is repeated on every new image acquired.

All these functions are integrated in the library .dll file and in a demo stand-alone software. The demo application can be used for test purpose or to obtain the distortion map, whereas for the actual online correction, the integration of the .dll file is recommended.

360LIB Suite


Software library and stand-alone tools for the optimization of 360° optics setups _____



State-of-the-art algorithms for unwrapping and correction of decentring.

Ensure the best image for OCR/OCV/barcode reading with pericentric optics.

Maximize the system performances to achieve the best results with 360° optics.

FULL RANGE OF COMPATIBLE CAMERAS	
	Area scan cameras p. 188-203

360LIB Suite is a C++ based computer vision software designed to optimize the performances of a 360° optics setup, as the ones typically used for single camera, lateral inspection purposes. With the use of both a .dll library and dedicated stand-alone tools, 360LIB makes it easy to take care of all the aspects of a typical 360° optics setup (correction of decentring and unwrapping) which, if not properly addressed, can affect negatively the results of the inspection, such as OCR/OCV/barcode reading.

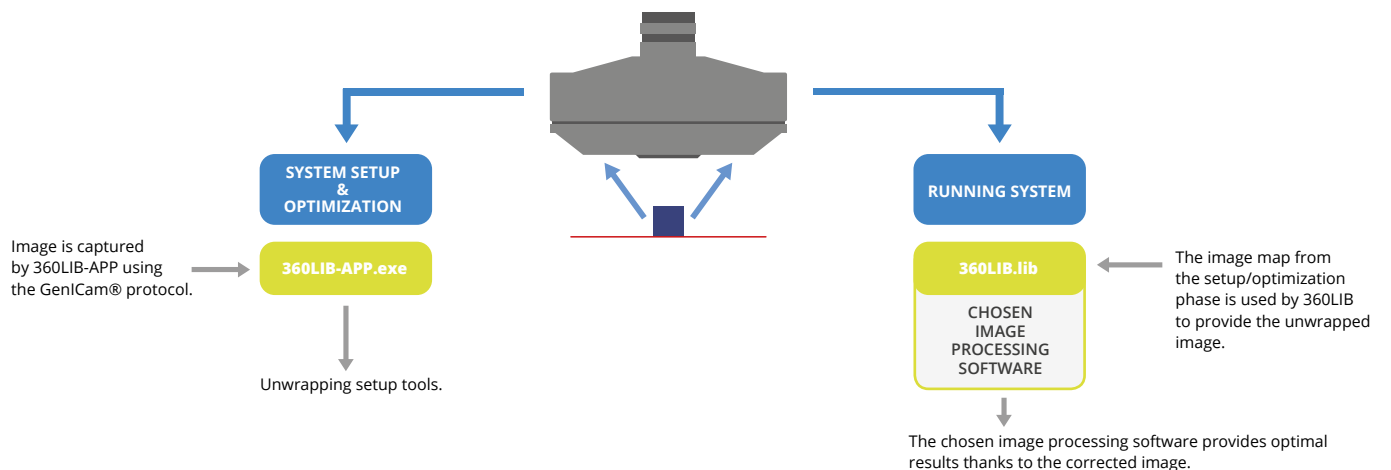
360LIB APP is a full GenTL compliant software. Any GenTL compliant camera device can be used with this software. Camera manufacturer drivers need anyway to be installed in order for the program to operate correctly.¹

¹ Tested compatibility includes, but is not limited to, the following brands of cameras: Opto Engineering® (COE-G and COE-U series), Matrix Vision, Basler, HikVision, SenTech.

360LIB Suite includes:

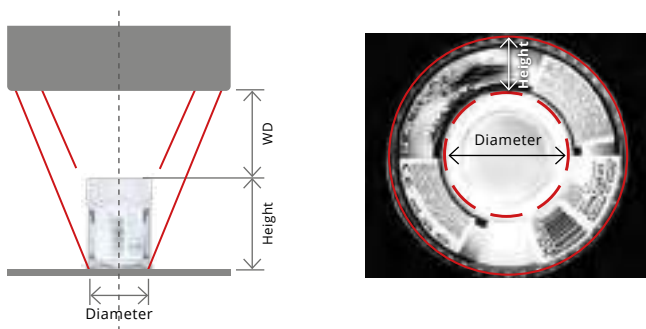
- A dedicated tool to create and save a correction map for objects seen from a pericentric lens (PC/PCHI/PCCD) when there is a slight decentring (360LIB-APP)
- A set of algorithms (library) to apply the correction map to live images and also unwrap them, outputting the rectified lateral view together with the original top view of the object (360LIB).

Although specific for lenses of the Pericentric family (PC, PCCD and PCHI), the library is open to customization dedicated to other lenses of the 360° optics family, to help you even more.

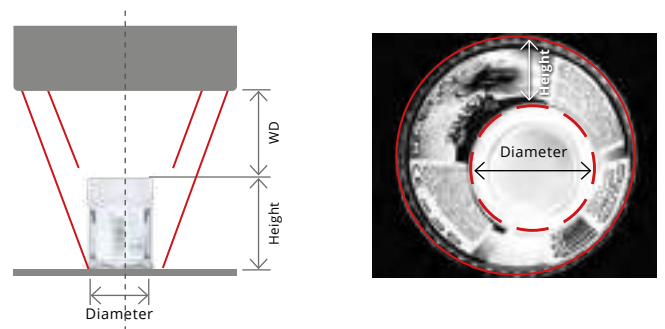




Raw image: object is well centred under the lens.



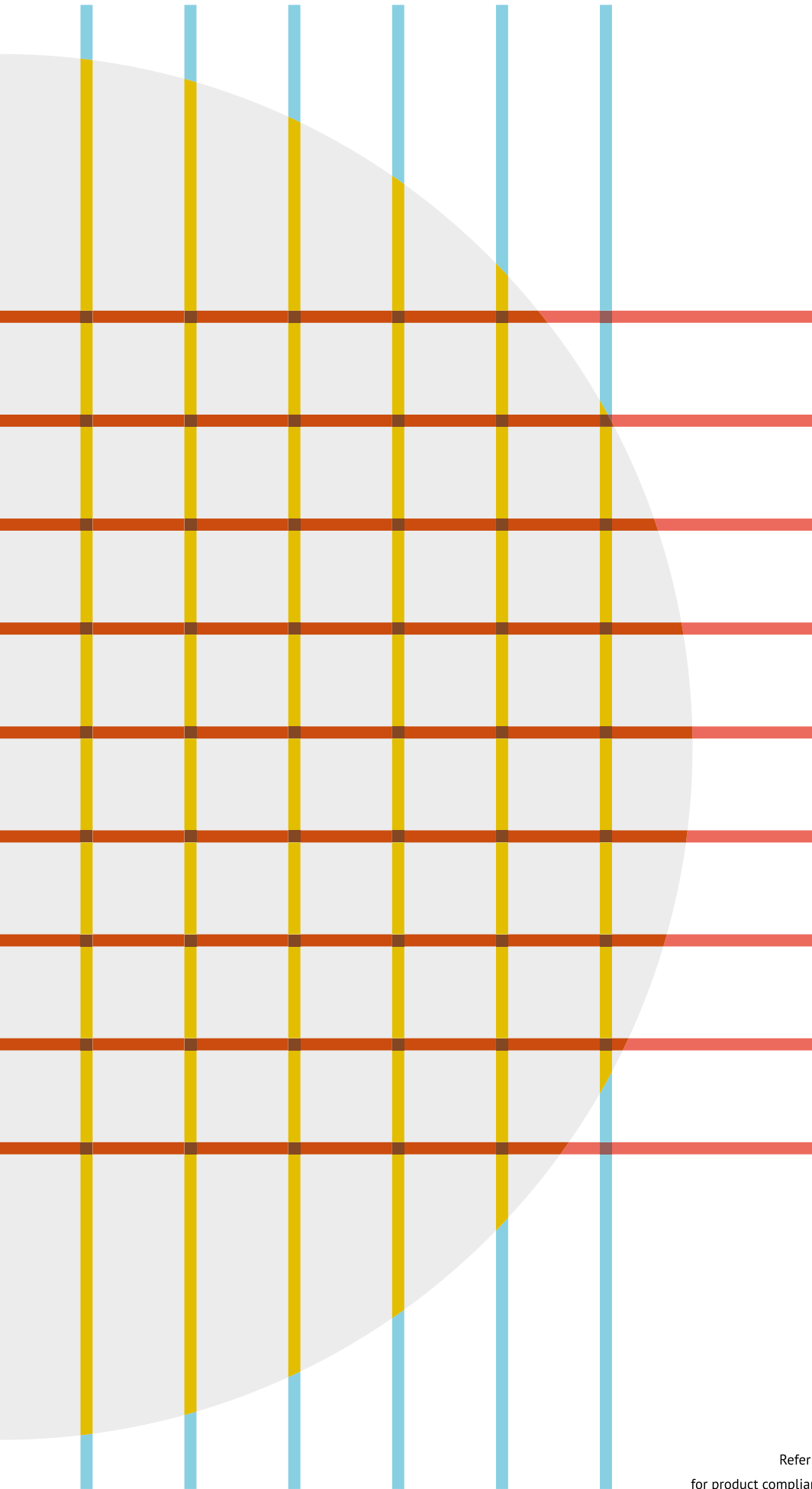
Raw image: object is slightly decentred under the lens.



Unwrapped image: a single continuous image of lateral surfaces of the object is automatically generated.



TCLIB corrects distortion and unwraps the image even when the object is slightly off-centred. The lateral and top surfaces of the objects are captured within the same image.



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

ACCESSORIES

Although accessories are often considered optional, they are in fact essential in many applications to efficiently use a product or even to enhance its performance.

Opto Engineering®'s extensive range of accessories has been designed and selected to ensure hassle-free and quick integration of our imaging components into your vision system. Our accessories perfectly complement our product range and have been specifically tested in combination with our products to maximise performance.

Our selection includes mounting mechanics, filters, protective windows, first surface mirrors and beam splitters, calibration patterns, projection patterns, in addition to strobe controllers and stepper motor controllers. Please check our website to view the entire range and get the most updated information.

Optical filters for lenses	228
Windows, mirrors & beamsplitters	231
Diffusing & polarizing plates for lighting	239
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Optical filters for lenses

Light filtering is a typical need in machine vision applications. Together with LED illuminators, filters can improve image contrast by blocking unwanted light and increase the accuracy and repeatability of the vision system.

Opto Engineering® offers a **wide range of optical filters** for many different lens mount options spanning from **Infrared to UV**.

Optical filters

Filters for telecentric lenses and fixed focal length lenses



Light filtering is a typical need in machine vision applications. Together with LED illuminators, filters can improve image contrast by blocking unwanted light and increase the accuracy and repeatability of the vision system.

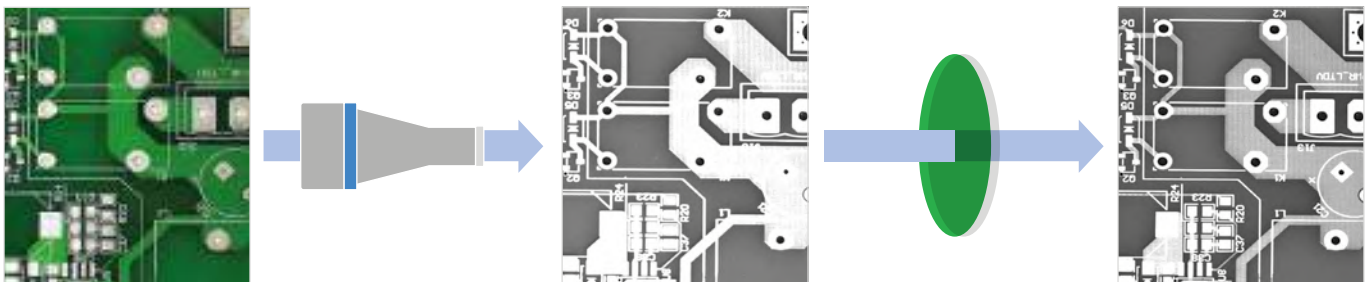
Ambient light is very frequently causing errors in imaging systems due to unwanted reflections off the surface of the parts being measured. In these cases, a band pass or long pass filter that matches the emission wavelength of the illuminator is usually integrated in front of the imaging lens: this 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 monochrome illumination in order to enhance or suppress particular object features: under these conditions, only the features with a certain color are imaged and inspected.

KEY ADVANTAGES

- High and precise transmission.
- Wide range selection.
- Available for fixed focal length lenses and telecentric lenses.
- Increase resolution.
- Block unwanted light.
- Tolerate high temperature environment.

Application examples



PCB Inspection:

The layout of the printed circuit would be difficult to distinguish without the filter. A high transmission green band pass filter increases contrast and improves system accuracy.



FULL RANGE OF FIXED FOCAL LENGTH LENSES

EN2MP series, EN5MP series, EN-2RT series,
EN-5RT series

p. 74-77

Band pass filters for fixed focal length lenses

Part number	Description	Useful wavelength range (nm)	FWHM (nm)	Peak transmission	Tolerance (nm)	Compatible LED wavelength (nm)
			1			
FTBP470	Blue (470 nm) band pass filter	400 - 490	90	> 90%	+/- 10	460, 465, 470
FTBP525	Green (525 nm) band pass filter	500 - 550	50	> 90%	+/- 10	520, 525, 530
FTBP635	Red (635 nm) band pass filter	600 - 675	75	> 90%	+/- 10	630, 635
FTBP660	Red (660 nm) band pass filter	645 - 700	55	> 90%	+/- 10	660, 670
FTBP850	IR (850 nm) band pass filter	800 - 850	80	> 90%	+/- 10	830, 840, 850

1 FWHM: Full width at half maximum.

Short pass filters and long pass filters for fixed focal length lenses

Part number	Description	Useful wavelength range (nm)	Peak transmission	Tolerance (nm)
FTSP450	Dark blue (450 nm) short pass filter	375 - 450	> 90%	+/- 10
FTSP500	Blue (500 nm) short pass filter	370 - 500	> 90%	+/- 10
FTSP570	Cyan (570 nm) shortpass filter	330 - 570	> 90%	+/- 10
FTSP700	UV + NIR cut off filter	400 - 700	> 90%	+/- 10
FTLP510	Yellow (510 nm) longpass filter	510 - 1100	> 90%	+/- 10
FTLP550	Orange (550 nm) longpass filter	550 - 1100	> 90%	+/- 10
FTLP590	Orange (590 nm) longpass filter	590 - 1100	> 90%	+/- 10
FTLP640	Red (635 nm) longpass filter	635 - 1100	> 90%	+/- 10

Filter thread compatible to fixed focal length lenses

Mount name	Description	Diameter (mm)	Aperture
C25.4	C-mount industrial camera	25.4	19.5
M27	Filter thread M27 x P 0.5	30	22.5
M30.5	Filter thread M30.5 x P 0.5	33.5	25.5
M35.5	Filter thread M35.5 x P 0.5	38.5	30.5
M37.5	Filter thread M37.5 x P 0.5	39.5	32.5
M40.5	Filter thread M40.5 x P 0.5	42.5	35.5
M43	Filter thread M43 x P 0.75	46	38
M52	Filter thread M52 x P 0.75	55	47

Ordering information

When ordering a filter for a C-mount fixed focal length lens, the part number must include the filter name and the mount name.

For example: if you need a green filter for a lens with M27 x P 0.5 filter thread, the part number would be **FTBP525M27**:

- **FTBP525** - Green (525 nm) bandpass interference filter

- **M27** - Filter thread M27 x P 0.5

- Customized products are available

Optical filters

Filters for telecentric lenses and fixed focal length lenses



Band pass filters for telecentric lenses (filter mount included) *

Part number	Description	Useful wavelength range (nm)	FWHM (nm) 1	Peak transmission	Tolerance (nm)	Matching LED wavelength (nm)	Compatibility
FTBP470TC	Blue (470 nm) band pass filter for TC lenses	400 - 490	90	> 90%	+/- 10	460, 465, 470	OE Telecentric lenses
FTBP525TC	Green (525 nm) band pass filter for TC lenses	500 - 550	50	> 90%	+/- 10	520, 525, 530	TC 12yyy, TCCR 12yyy, TCCR 23yyy
FTBP635TC	Red (635 nm) band pass filter for TC lenses	600 - 675	75	> 90%	+/- 10	630, 635	TC 23yyy 2
FTBP660TC	Red (660 nm) band pass filter for TC lenses	645 - 700	55	> 90%	+/- 10	660, 670	TC 23yyy 2
FTBP830TC	IR (850 nm) band pass filter for TC lenses	800 - 880	80	> 90%	+/- 10	830, 840, 850	TCxMHRyyy-C, TCCRxMyyy-C 3
FTBP880TC	IR (880 nm) band pass filter for TC lenses	845 - 930	130	> 90%	+/- 10	880	TCxMHRyyy-C, TCCRxMyyy-C 3

1 FWHM: Full width at half maximum.

2 Except TC 23 004, TC 23 007, TC 23 009, TC 23 012.

3 Some vignetting may occur, depending on sensor size.

* Filters for TC lens without TC filter mount can be ordered separately on request.

Optical filters for telecentric lenses (filter mount included) *

Part number	Description	Useful wavelength range (nm)	Peak transmission	Tolerance (nm)	Compatibility
FTSP450TC	Dark Blue (450 nm) short pass filter for TC lenses	375 - 450	> 90%	+/- 10	OE Telecentric lenses
FTSP500TC	Blue (500 nm) short pass filter for TC lenses	370 - 500	> 90%	+/- 10	TC 12yyy, TCCR 12yyy, TCCR 23yyy
FTSP570TC	Cyan (570 nm) short pass filter for TC lenses	330 - 570	> 90%	+/- 10	TC 12yyy, TCCR 12yyy, TCCR 23yyy
FTSP700TC	UV + NIR cut off filter	400 - 700	> 90%	+/- 10	TC 12yyy, TCCR 12yyy, TCCR 23yyy
FTLP510TC	Yellow (510 nm) long pass filter for TC lenses	510 - 1100	> 90%	+/- 10	TC 23yyy 1
FTLP550TC	Orange (550 nm) long pass filter for TC lenses	550 - 1100	> 90%	+/- 10	TC 23yyy 1
FTLP590TC	Orange (590 nm) long pass filter for TC lenses	590 - 1100	> 90%	+/- 10	TC 23yyy 1
FTLP640TC	Red (635 nm) long pass filter for TC lenses	635 - 1100	> 90%	+/- 10	TCxMHRyyy-C, TCCRxMyyy-C 2
FTLP920TC	IR (920 nm) long pass filter for TC lenses	930 - 1100	> 90%	+/- 10	TCxMHRyyy-C, TCCRxMyyy-C 2

1 Except TC 23 004, TC 23 007, TC 23 009, TC 23 012.

2 Some vignetting may occur, depending on sensor size.

* Filters for TC lens without TC filter mount can be ordered separately on request.

Windows, mirrors & beamsplitters

Quite often in the design of a vision system various modifications of the optical path of incoming light is required. There might be many reasons, but space restrictions and specific illumination requirements are likely the most common. Not only, because in many applications dedicated protections against harsh environments are needed to preserve the integrity of the components.

Opto Engineering® has **a complete range of windows, mirrors and beam splitters to help you in the design and implementation of your vision systems.**

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.

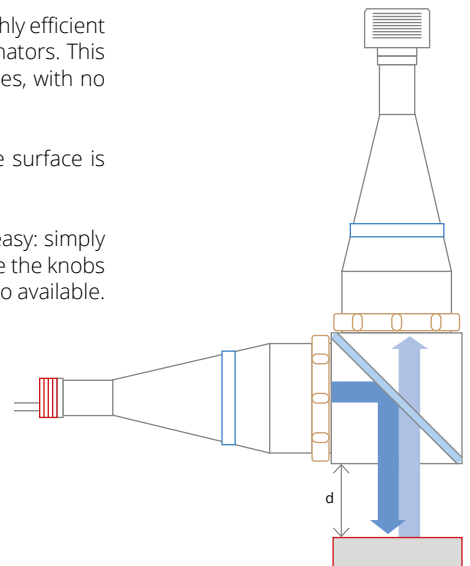
Compatible with telecentric lenses and illuminators.

The **CMBS series** is a collection of **50/50 plate beam splitter modules** designed to create highly efficient coaxial illumination solutions with Opto Engineering® telecentric lenses and collimated illuminators. This particular configuration allows for almost perfect coaxial illumination of shiny or matte surfaces, with no stray light or hot spots.

The CMBS series is designed for 45° angle of incidence in the 430 - 670 nm waveband: one surface is beam-splitter coated while the other side features anti-reflective VIS coating.

With the CMBS series, building the perfect coaxial illumination telecentric setup is extremely easy: simply mount the telecentric lens and the collimated illuminator into the appropriate ports, then rotate the knobs to tighten the compression rings and secure the lenses. Compatible protective windows are also available.

Coaxial illumination is especially useful 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, the CMBS series is the ideal choice.



CMBS object distances (d) in mm

Compatible products	TC series						TCLWD series	TC1MHR-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

CMBS series

45° beam splitter

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.

Part number	Optical specifications			Mechanical specifications					Compatibility	
	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	64.0	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	88.0	TCxx036, TC1MHR036-x, TC2MHR036-x, TC3MHR036-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	119.0	119.0	102.0	TCxx048, TC1MHR048-x, TC2MHR048-x, TC3MHR048-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	108.0	TCxx056, TC1MHR056-x, TC2MHR056-x, TC3MHR056-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	128.0	TCxx064, TC1MHR064-x, TC2MHR064-x, TC3MHR064-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	144.0	TC23072, TCxx080, TC1MHR080-x, TC2MHR080-x, TC3MHR080-x, TC4MHR080-x, TC16080-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.

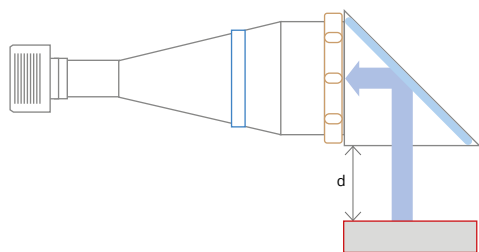
FULL RANGE OF COMPATIBLE WINDOWS	
	Protective windows WI series p. 233

Production environments often present size constraints, limiting the choice of optics and causing the user to trade optical performance for size. **CMMR series** is the Opto Engineering® answer to tight space integration issues, opening new installation options for your application.

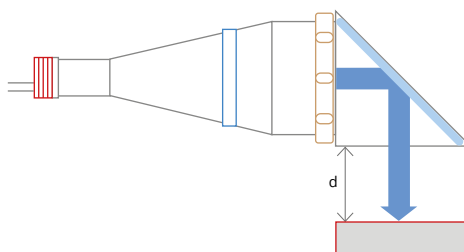
The CMMR series is a family of first surface mirrors designed for our telecentric lenses and illuminators which enable the lens to image the sample at 90° with respect to the optical axis.

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

The CMMR series features a precise locking 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, the CMMR series is the ideal choice.



CMMR first surface mirror combined with a telecentric lens.



CMMR first surface mirror combined with a telecentric illuminator.

Compatible products	CMMR object distances (d) in mm*								
	TC series								
	036	048	056	064	072	080	085	13096	xx96
CMMR 036	20.1								
CMMR 048		37.0							
CMMR 056			50.7						
CMMR 064				63.8					
CMMR 080					90.1	90.1			
CMMR 096							124.0	124.0	123.0

Compatible products	TC1MHR-4MHR series					TC16M series					TC12K series			
	036	048	056	064	080	096	036	048	056	064	080	096	064	080
CMMR 036	20.1						19.6							
CMMR 048		37.0						29.4						
CMMR 056			50.7						41.4					
CMMR 064				63.8						52.5			44.3	
CMMR 080					90.1						60.4			19.8
CMMR 096												106.4		

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

CMMR series

45° first surface mirrors

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 combination examples



CMMR080 combined with TC23080



CMMR056 combined with LTCLHP056-G

Part number	Optical specifications		Mechanical specifications						Compatibility		Optional accessories
	Coating	Deviation angle (deg)	Clamping diameter (mm)	Clamping system	Length (mm)	Width (mm)	Height (mm)	Weight (g)	Telecentric lenses	Telecentric illuminators	Protective windows
	1										2
CMMR 036	Aluminium reflective coating	90	61	lockring	88.0	88.0	107.2	595	TCxx036, TC1MHR036-x, TC2MHR036-x, TC3MHR036-x, TC4MHR036-x, TC16M036-x	LTCLHP036-x	WI 036
CMMR 048	Aluminium reflective coating	90	75	lockring	102.0	102.0	121.1	508	TCxx048, TC1MHR048-x, TC2MHR048-x, TC3MHR048-x, TC4MHR048-x, TC16M048-x	LTCLHP048-x	WI 048
CMMR 056	Aluminium reflective coating	90	80	lockring	108.0	108.0	131.3	586	TCxx056, TC1MHR056-x, TC2MHR056-x, TC3MHR056-x, TC4MHR056-x, TC16M056-x	LTCLHP056-x	WI 056
CMMR 064	Aluminium reflective coating	90	100	lockring	128.0	128.0	141.3	779	TCxx064, TC1MHR064-x, TC2MHR064-x, TC3MHR064-x, TC4MHR064-x, TC16M064-x, TC12K064	LTCLHP064-x	WI 064
CMMR 080	Aluminium reflective coating	90	116	lockring	144.0	144.0	160.9	1605	TC23072, TCxx080, TC1MHR080-x, TC2MHR080-x, TC3MHR080-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

45° first surface mirrors



CMMR4K-L



CMMR4K-V

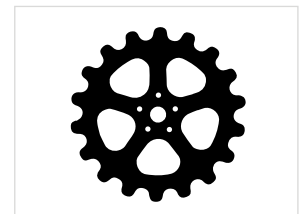
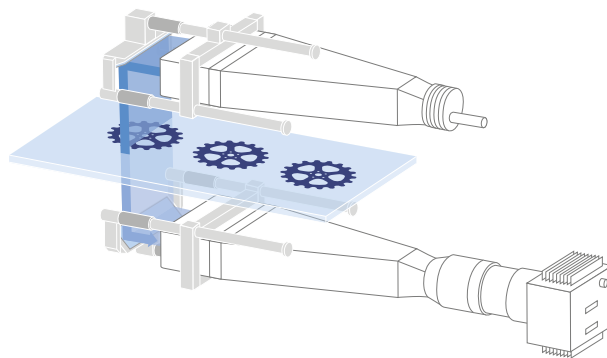
CMMR4K are 45° first surface mirrors that produce a right angle bend of the light path.

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, the design of the CMMR4K series allows the user to flexibly adjust the distance between the mirror and the front end of TC4K/LTCL4K optics. Refer to the schematics for further details.

FULL RANGE OF COMPATIBLE TELECENTRIC LENSES		
	TC4K series	p. 52
FULL RANGE OF COMPATIBLE TELECENTRIC ILLUMINATORS		
	LTCL4K series	p. 136

Application examples



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

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

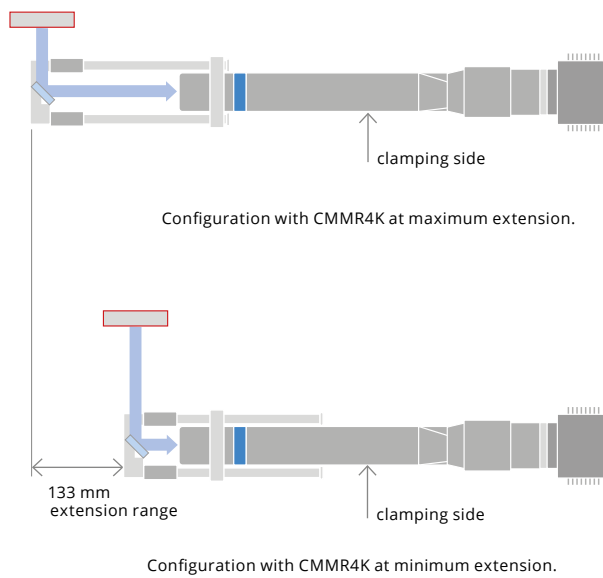
CMMR series

45° first surface mirrors

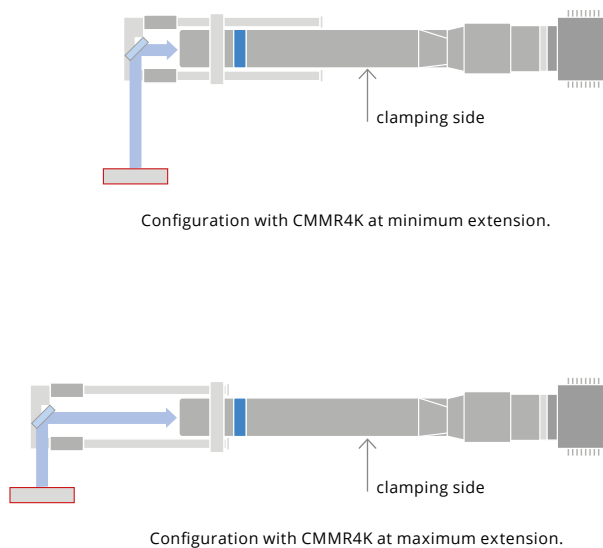
CMMR4K-V schematics

CMMR4K-V bends the light rays vertically.

UPWARD BEND



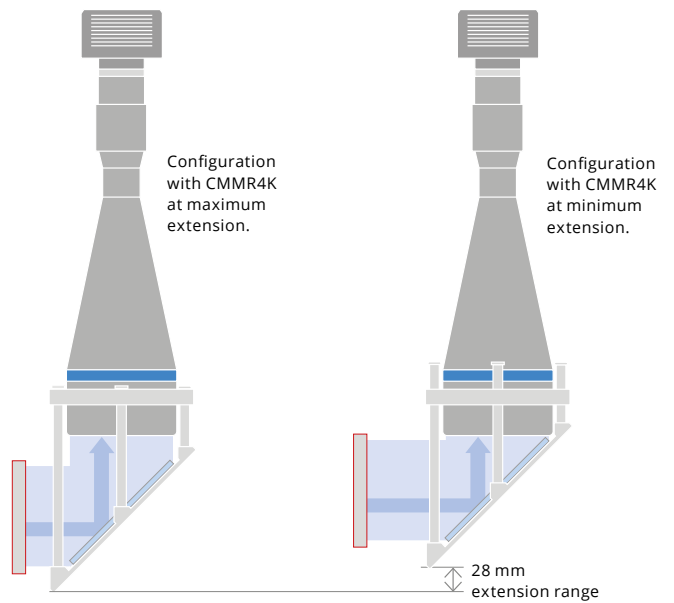
DOWNWARD BEND



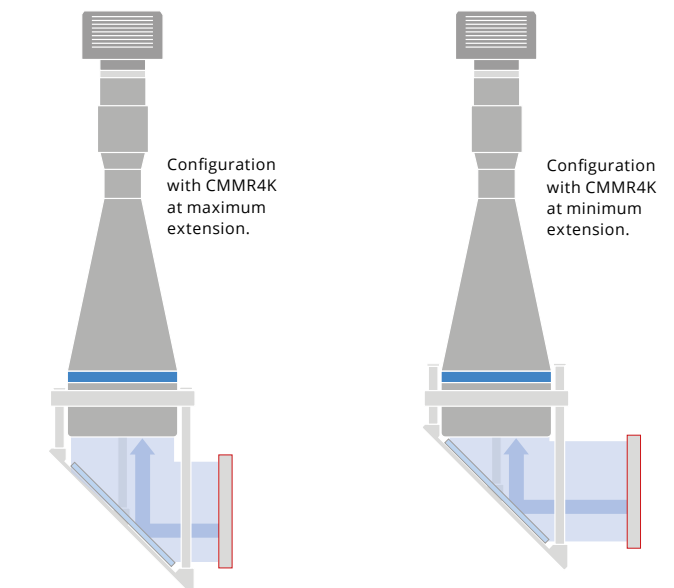
CMMR4K-L schematics

CMMR4K-L bends the light rays laterally.

LEFT BEND



RIGHT BEND



WI series

Protective windows for lenses



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 degrade the optical performance. These plano-plano windows effectively shield telecentric lenses from the outside environment, preserving the quality of your imaging system without changing the optical magnification. The 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 locking 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 combination examples



WI080 + CMWF080 + TC23080.



WI056 + CMWF056 + LTCLHP056-G.

WI windows Part number	Optical specifications Transmittance band (nm)	Mechanical specifications			Compatibility		
		Substrate	Diameter (mm)	Thickness	Telecentric lenses (mm)	Telecentric illuminators	CMMR
WI 036	430 - 670	Borofloat	61	6±0.2	TCxx036, TC2MHR036-x, TC4MHR036-x, TC16M036	LTCLHP036-x	CMMR036
WI 048	430 - 670	Borofloat	75	6±0.2	TCxx048, TC2MHR048-x, TC4MHR048-x, TC16M048	LTCLHP048-x	CMMR048
WI 056	430 - 670	Borofloat	80	6±0.2	TCxx056, TC2MHR056-x, TC4MHR056-x, TC16M056	LTCLHP056-x	CMMR056
WI 064	430 - 670	Borofloat	100	6±0.2	TCxx064, TC2MHR064-x; TC4MHR064-x, TC16M064	LTCLHP064-x	CMMR064
WI 080	430 - 670	Borofloat	116	5±0.3	TC23072, TCxx080; TC2MHR080-x, TC4MHR080-x, TC16M080	LTCLHP080-x	CMMR080
WI 096	430 - 670	Borofloat	143	5±0.3	TC23085, TCxx096, TC2MHR096-x, TC4MHR096-x, TC16M096	LTCLHP096-x	CMMR096

¹ CMWF mounting mechanics required (must be ordered separately). When a WI window is placed in front of a lens, its working distance increases by approximately 1/3 of the window thickness.

The CMHO series clamping mechanics may be used prior to verification of mechanical compatibility (see CMHO series mechanical drawings available online).

CMHO is not compatible with the combination of the following: WI + CMWF assembly and TC13xxx.

CMWF holders Part number	Technical details Description	Optical spec Active area diameter (mm)	Mechanical specifications			Compatibility WI series
			Clamping diameter (mm)	Height (mm)	Weight (g)	
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

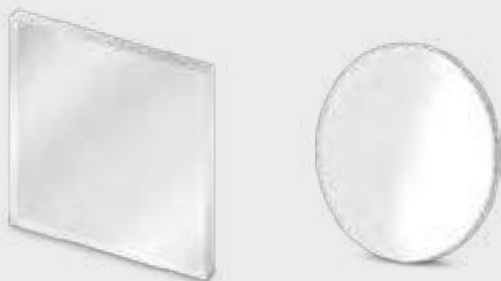
For example, if you need a protective window for a **TC12036** telecentric lens, you have to order both of the following items:

- **WI036** protective window
- **CMWF036** holder

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

Flat optics

Customized protective windows and mirrors



KEY ADVANTAGES

High quality for machine vision industry use
The material is suitable for vision system use.

Customized size based on the need
Intuitive on line tool for designing your personal protective window or mirrors.

Wide product range
Different type of materials are available for various applications.

Flat optics is a simple component that could provide you with the possibility of letting your vision system become smarter, quicker and more compact. Opto Engineering® provides the possibility of designing your own protection window and mirrors based on your need through the online tool.

A wide range of materials, options for anti-reflection coating and customized dimensions for you to choose from. Once the specification is defined, a mechanical design drawing will be created automatically in accordance with ISO10110.

The front surface mirrors offered by Opto Engineering® are coated with a high reflectivity aluminium and are suitable for use in optical and display systems. The maximum dimension can reach 600 x 400 mm based on the requested thickness.

The protection window or glass round plate offers a variety of choices from Float to Quartz, which provides different levels of hardness. The maximum dimension can reach 1000 x 1000 mm based on the requested material and thickness.

All the flat optics can choose the cutting tolerance from hand cut (+/- 0.4 mm) or CNC cut (+/- 0.1 mm). Please visit the website for the on-line tool at: <https://www.opto-e.com/tools/draw>

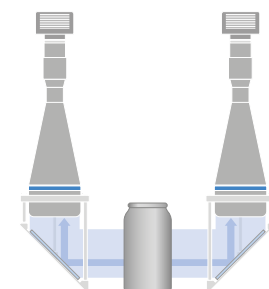
Products	Material	Max length (mm)	Max width (mm)	Thickness (mm)		
Mirror	Front surface mirror	300	200	1.1		
		300	200	1.5		
		300	200	1.6		
		600	400	3		
		600	400	5		
		600	400	6		
		600	400	10		
		1000	1000	0.7		
		1000	1000	1		
		1000	1000	1.6		
Window	Float	1000	1000	2		
		1000	1000	2.3		
		1000	1000	3		
		1000	1000	4		
		1000	1000	6		
		Borosilicate	300	300	1	
			300	200	1.1	
			400	400	1.7	
		Window	BK7	100	100	0.5
				300	300	1
161	161			1.2		
B270	130		130	1.5		
	300		300	1		
	100		100	1		
Quartz	200		200	1.5		
	300		300	2.2		
	100		100	3		
	110		110	4		
Quartz UV	150	150	6			
	180	180	1			
Quartz IR	100	100	3			
	190	80	1			

This table is subject to change without notice. Please refer to the online tool for the latest specification provided.

Opto Engineering® online tool preview



Application Examples



Object inspection from multi-angle.



Glass turntable for small object inspection.

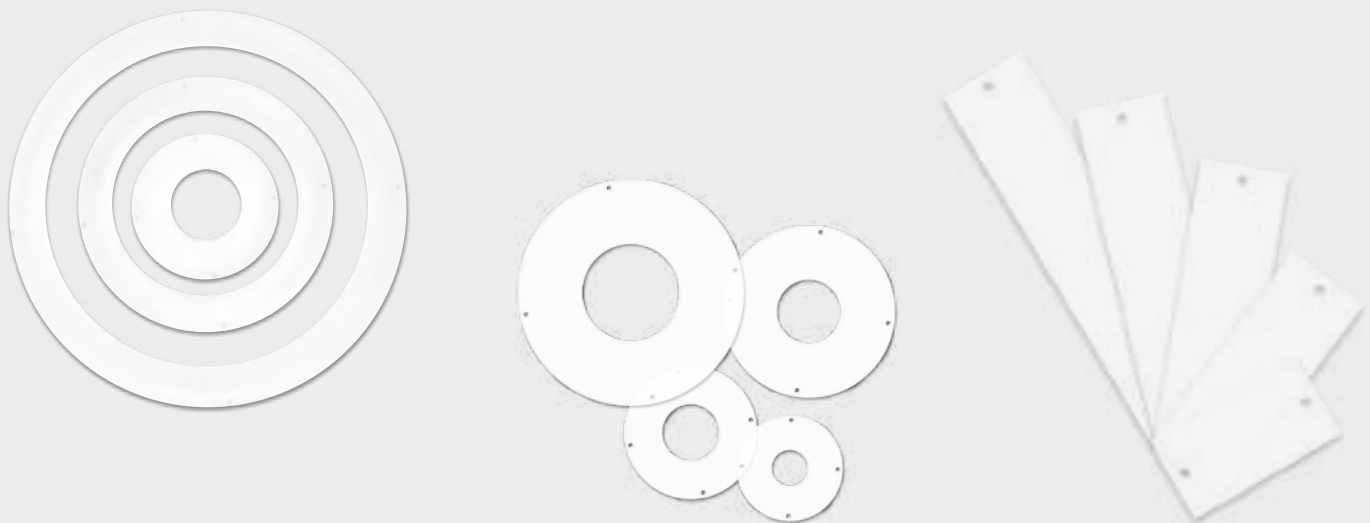
Diffusing & polarizing plates for lighting

Opto Engineering® offers **accessories for illumination including diffusers and polarizers**. Diffusers are designed to improve light uniformity while polarizers can help reduce unwanted reflections when used in combination with a polarizing filter on the camera.

DFLT series

Diffusion plates for lighting

NEW



Opto Engineering® offers a series of diffusion plates available as accessories to be positioned between the LED sources of our illuminators and the workpieces to be inspected.

Diffusers can help avoid the formation of hot spots, especially on glossy workpieces, and provide better light uniformity.

Part number	Description	Thickness (mm)	Compatible products
For ring lights			
DFLTZGK040-00-2	Diffuser for LED ring light, 2 LED rows, outer diameter 43 mm, 0°	2	LTZGK040-00-2-x-24V
DFLTZGK050-00-2	Diffuser for LED ring light, 2 LED rows, outer diameter 44 mm, 0°	2	LTZGK050-00-2-x-24V
DFLTZGK070-00-3	Diffuser for LED ring light, 3 LED rows, outer diameter 70 mm, 0°	3	LTZGK070-00-3-x-24V
DFLTZGK090-00-4	Diffuser for LED ring light, 4 LED rows, outer diameter 92 mm, 0°	4	LTZGK090-00-4-x-24V
DFLTZGK050-15-2	Diffuser for LED ring light, 2 LED rows, outer diameter 50 mm, 15°	2	LTZGK050-15-2-x-24V
DFLTZGK070-15-3	Diffuser for LED ring light, 3 LED rows, outer diameter 70 mm, 15°	2	LTZGK070-15-3-x-24V
DFLTZGK090-15-4	Diffuser for LED ring light, 4 LED rows, outer diameter 92 mm, 15°	2	LTZGK090-15-4-x-24V
DFLTZGK100-15-5	Diffuser for LED ring light, 5 LED rows, outer diameter 103 mm, 15°	2	LTZGK100-15-5-x-24V
DFLTZZO130-75-3	Diffuser for LED low angle ring light, 3 LED rows, outer diameter 131 mm, 75°	2	LTZZO130-75-3-x-24V
DFLTZZO170-75-3	Diffuser for LED low angle ring light, 3 LED rows, outer diameter 175 mm, 75°	2	LTZZO170-75-3-x-24V
For bar lights			
DFLTZPFL040-00-6	Diffuser for LED bar light, 6 LED rows, 40x26.3 illumination area	2	LTZPFL040-00-6-x-24V
DFLTZPFL080-00-6	Diffuser for LED bar light, 6 LED rows, 80x26.3 illumination area	2	LTZPFL080-00-6-x-24V
DFLTZPFL120-00-6	Diffuser for LED bar light, 6 LED rows, 120x26.3 illumination area	2	LTZPFL120-00-6-x-24V
DFLTZPFL160-00-6	Diffuser for LED bar light, 6 LED rows, 160x26.3 illumination area	2	LTZPFL160-00-6-x-24V
DFLTZPFL200-00-6	Diffuser for LED bar light, 6 LED rows, 200x26.3 illumination area	2	LTZPFL200-00-6-x-24V

PLLT series

Polarizing plates for lighting

NEW



Opto Engineering® offers a series of polarizers available as accessories to be positioned between the LED sources of our illuminators and the workpieces to be inspected. Polarizers can help reduce reflections when used in combination with a polarizing filter on the camera, especially on glossy workpieces. Polarizers can be very useful in applications inspecting workpieces packed in transparent plastic bags.

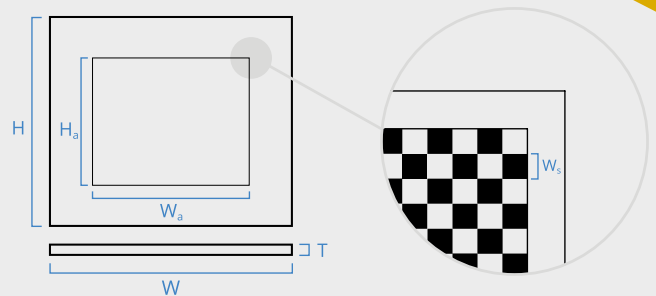
Part number	Description	Thickness (mm)	Compatible products
For ring lights			
PLLTZGK040-00-2	Polarizer for LED ring light, 2 LED rows, outer diameter 43 mm, 0°	0.8	LTZGK040-00-2-x-24V
PLLTZGK050-00-2	Polarizer for LED ring light, 2 LED rows, outer diameter 54 mm, 0°	0.8	LTZGK050-00-2-x-24V
PLLTZGK070-00-3	Polarizer for LED ring light, 3 LED rows, outer diameter 68 mm, 0°	0.8	LTZGK070-00-3-x-24V
PLLTZGK090-00-4	Polarizer for LED ring light, 4 LED rows, outer diameter 92 mm, 0°	0.8	LTZGK090-00-4-x-24V
PLLTZGK050-15-2	Polarizer for LED ring light, 2 LED rows, outer diameter 50 mm, 15°	0.8	LTZGK050-15-2-x-24V
PLLTZGK070-15-3	Polarizer for LED ring light, 3 LED rows, outer diameter 70 mm, 15°	0.8	LTZGK070-15-3-x-24V
PLLTZGK090-15-4	Polarizer for LED ring light, 4 LED rows, outer diameter 92 mm, 15°	0.8	LTZGK090-15-4-x-24V
PLLTZGK100-15-5	Polarizer for LED ring light, 5 LED rows, outer diameter 103 mm, 15°	0.8	LTZGK100-15-5-x-24V
PLLTZO130-75-3	Polarizer for LED low angle ring light, 3 LED rows, outer diameter 131 mm, 75°	0.8	LTZO130-75-3-x-24V
PLLTZO170-75-3	Polarizer for LED low angle ring light, 3 LED rows, outer diameter 175 mm, 75°	0.8	LTZO170-75-3-x-24V
For bar lights			
PLLTZPFL040-00-6-H	Horizontal polarizer for LED bar light, 6 LED rows, 40x26.3 illumination area	0.8	LTZPFL040-00-6-x-24V
PLLTZPFL040-00-6-V	Vertical polarizer for LED bar light, 6 LED rows, 40x26.3 illumination area	0.8	LTZPFL040-00-6-x-24V
PLLTZPFL080-00-6-H	Horizontal polarizer for LED bar light, 6 LED rows, 80x26.3 illumination area	0.8	LTZPFL080-00-6-x-24V
PLLTZPFL080-00-6-V	Vertical polarizer for LED bar light, 6 LED rows, 80x26.3 illumination area	0.8	LTZPFL080-00-6-x-24V
PLLTZPFL120-00-6-H	Horizontal polarizer for LED bar light, 6 LED rows, 120x26.3 illumination area	0.8	LTZPFL120-00-6-x-24V
PLLTZPFL120-00-6-V	Vertical polarizer for LED bar light, 6 LED rows, 120x26.3 illumination area	0.8	LTZPFL120-00-6-x-24V
PLLTZPFL160-00-6-H	Horizontal polarizer for LED bar light, 6 LED rows, 160x26.3 illumination area	0.8	LTZPFL160-00-6-x-24V
PLLTZPFL160-00-6-V	Vertical polarizer for LED bar light, 6 LED rows, 160x26.3 illumination area	0.8	LTZPFL160-00-6-x-24V
PLLTZPFL200-00-6-H	Horizontal polarizer for LED bar light, 6 LED rows, 200x26.3 illumination area	0.8	LTZPFL200-00-6-x-24V
PLLTZPFL200-00-6-V	Vertical polarizer for LED bar light, 6 LED rows, 200x26.3 illumination area	0.8	LTZPFL200-00-6-x-24V

Whoever had the chance to work in the metrology field is perfectly aware that calibration is a fundamental step in the setup of a vision system: having a good lens, a good camera and a proper illumination geometry is not enough when high levels of accuracy is needed. Although calibration is performed via software, the algorithms behind it require a dedicated hardware: Opto Engineering® provides a **wide range of calibration and resolution patterns** to achieve the best possible performance.

PTTC, PTCP series

Accurate calibration patterns for machine vision

NEW MODELS



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.

The range of available chessboard patterns is compatible with most Opto Engineering® telecentric lenses.

Imaging and metrology applications are often required to minimise distortion, which can be software-corrected by analysing the image of a precision pattern whose geometrical features are well known. For this reason Opto Engineering® offers chrome-on-glass patterns optimised for software calibration, featuring extremely high geometrical accuracy thanks to photolithography techniques.



PTTC series - Calibration patterns for telecentric lenses

Part number	Compatibility		Mechanical specifications				Photomask type	Class	Grade number	Certificate
	Compatible telecentric lenses	Compatible pattern mounts	Dimensions w x h (mm x mm)	Thickness (mm)	Active area w x h (mm x mm)	Squares width (mm)				
PT004-009	004, 007 and 009	CMPH004-024	33 x 26	3	15 x 13	0.20	Chrome-on-glass	1	-	No
PT016-024	016, 024	CMPH004-024	33 x 26	3	31 x 24	0.60	Chrome-on-glass	1	-	No
PT036-056	036, 048 and 056	CMPH036-056	66 x 52	3	64 x 51	1.35	Chrome-on-glass	1	-	No
PT064-096	064, 072, 080, 085 and 096	CMPH064-096, CMTS064-096	107 x 83	3	105 x 79	2.20	Chrome-on-glass	1	-	No
PT120-144	110, 120, 130 and 144	-	180 x 140	3	170 x 140	3.00	Chrome-on-glass	2	-	No
PT192-240	192, 200, 240	-	300 x 240	3	260 x 200	4.00	Chrome-on-glass	2	-	No
PT260-310	-	-	340 x 280	3	320 x 260	5.00	Chrome-on-glass	2	-	No

1 Class number for film-on-glass photomasks differs from usual chrome-on-glass ones. Specifications are in the table on the next page.

PTTC series - Calibration patterns for telecentric lenses

Part number	Compatibility		Mechanical specifications				Photomask type	Class	Grade number	Certificate
	Compatible telecentric lenses	Compatible pattern mounts	Dimensions w x h (mm x mm)	Thickness (mm)	Active area w x h (mm x mm)	Squares width (mm)				
PT004-009-C	004, 007 and 009	CMPH004-024	33 x 26	3	15 x 13	0.20	Chrome-on-glass	2	-	Yes
PT016-024-C	016, 024	CMPH004-024	33 x 26	3	31 x 24	0.60	Chrome-on-glass	2	-	Yes
PT036-056-C	036, 048 and 056	CMPH036-056	66 x 52	3	64 x 51	1.35	Chrome-on-glass	2	-	Yes
PT064-096-C	064, 072, 080, 085 and 096	CMPH064-096, CMTS064-096	107 x 83	3	105 x 79	2.20	Chrome-on-glass	2	-	Yes
PT120-144-C	110, 120, 130 and 144	-	180 x 140	3	170 x 140	3.00	Chrome-on-glass	2	-	Yes
PT192-240-C	192, 200, 240	-	300 x 240	3	260 x 200	4.00	Chrome-on-glass	2	-	Yes
PT260-310-C	-	-	340 x 280	3	320 x 260	5.00	Chrome-on-glass	2	-	Yes
PT004-009-P	004, 007 and 009	CMPH004-024	33 x 26	3	15 x 13	0.20	Emulsion-on-glass	-	4	No
PT016-024-P	016, 024	CMPH004-024	33 x 26	3	31 x 24	0.60	Emulsion-on-glass	-	4	No
PT036-056-P	036, 048 and 056	CMPH036-056	66 x 52	3	64 x 51	1.35	Emulsion-on-glass	-	4	No
PT064-096-P	064, 072, 080, 085 and 096	CMPH064-096, CMTS064-096	107 x 83	3	105 x 79	2.20	Emulsion-on-glass	-	4	No
PT120-144-P	110, 120, 130 and 144	-	180 x 140	3	170 x 140	3.00	Emulsion-on-glass	-	4	No
PT192-240-P	192, 200, 240	-	300 x 240	3	260 x 200	4.00	Emulsion-on-glass	-	4	No
PT260-310-P	-	-	340 x 280	3	320 x 260	5.00	Emulsion-on-glass	-	4	No

1 Class number for film-on-glass photomasks differs from usual chrome-on-glass ones. Specifications are in the tables below.

PTCP series - Calibration patterns for CORE PLUS lenses

Part number	Compatibility		Mechanical specifications				Photomask type	Class	Grade number	Certificate
	Compatible telecentric lenses	Compatible pattern mounts	Dimensions w x h (mm x mm)	Thickness (mm)	Active area w x h (mm x mm)	Squares width (mm)				
PTCP-S1-HR1-C	TCCP12144, TCCP23144, TCCP3MHR144, TCCP5MHR144	-	180 x 140	3	167.4 x 129.6	1.35	Chrome-on-glass	2	-	Yes
PTCP-M1-LR1-C	TCCP12192, TCCP23192t	-	245 x 195	3	237.6 x 184.8	2.20	Chrome-on-glass	2	-	Yes
PTCP-M1-HR1-C	TCCP3MHR192, TCCP5MHR192	-	245 x 195	3	237.6 x 189	1.35	Chrome-on-glass	2	-	Yes
PTCP-L1-LR1-C	TCCP12260, TCCP23260	-	300 x 240	3	281.6 x 228.8	2.20	Chrome-on-glass	2	-	Yes
PTCP-L1-HR1-C	TCCP3MHR260, TCCP5MHR260	-	300 x 240	3	286.2 x 226.8	1.35	Chrome-on-glass	2	-	Yes
PTCP-S1-HR1-P	TCCP12144, TCCP23144, TCCP3MHR144, TCCP5MHR144	-	180 x 140	3	167.4 x 129.6	1.35	Emulsion-on-glass	-	4	No
PTCP-M1-LR1-P	TCCP12192, TCCP23192	-	245 x 195	3	237.6 x 184.8	2.20	Emulsion-on-glass	-	4	No
PTCP-M1-HR1-P	TCCP3MHR192, TCCP5MHR192	-	245 x 195	3	237.6 x 189	1.35	Emulsion-on-glass	-	4	No
PTCP-L1-LR1-P	TCCP12260, TCCP23260	-	300 x 240	3	281.6 x 228.8	2.20	Emulsion-on-glass	-	4	No
PTCP-L1-HR1-P	TCCP3MHR260, TCCP5MHR260	-	300 x 240	3	286.2 x 226.8	1.35	Emulsion-on-glass	-	4	No

1 Class number for film-on-glass photomasks differs from usual chrome-on-glass ones. Specifications are in the tables below.

$$Dimensional\ Tolerance = \pm (A + B \cdot C) \text{ where } A = \text{Positioning error} \cdot B = \text{Speed factor} \cdot C = \text{Dimension of interest}$$

For chrome-on-glass photomask

Class	Resolution	Dimensional Tolerances	
	Min feature dimensions; Min spacing (µm)	Positioning error ± (µm)	Speed factor (µm/mm)
1	1.4	6.4	0.016
2	0.8	1.6	0.008
3	0.4	0.6	0.004
4	0.2	0.2	0.001

For film-on-glass photomask

Class	Resolution	Dimensional Tolerances	
	Min feature dimensions; Min spacing (µm)	Positioning error ± (µm)	Speed factor (µm/mm)
1	9.6	9.6	0.015
2	4.8	9.6	0.015
3	2.4	9.6	0.015
4	1.2	9.6	0.015

Calibration & resolution patterns

RC series

Resolution and calibration targets



* RT

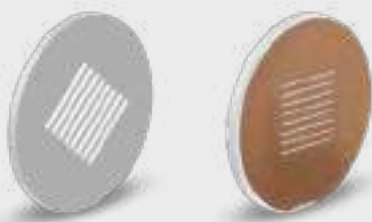
Part number	Description
RT-T-20-P-CG	USAF 1951 Resolution test chart
RT-T-21-P-CG	USAF 1951 Resolution test chart (inches)
RT-T-50-2-P-TM	Star sector test target
RT-T-62-1-P-CG	Linear test pattern
RT-AP-D50-P-CG	Calibration dot grid
RT-AP-DD100-P-CG	Multi-zone calibration dot grid

Projection patterns

Opto Engineering® offers a **wide range of interchangeable chrome on glass patterns** compatible with our LED pattern projectors. Many formats are available as standard off-the-shelf products, including “**line & stripes**” for 3D profilometry, “**grids**” and “**cloud of dots**” for stereovision applications or “**crosses**” for simple alignment purposes. **Custom patterns can also be supplied on request** to project any desired shape.

PTPR series

Projection patterns for LED projectors



Opto Engineering® supplies a comprehensive range of projection patterns compatible with our LED pattern projectors. PT projection patterns can be either laser-engraved, with 50 µm geometrical accuracy, or photolithography-engraved for more demanding applications (2 µm accuracy). Custom geometry patterns can also be provided on request.

Part number	Format	Process	Substrate (mm)	Coating (mm)	Line spacing (mm)	Thickness (mm)	Geometrical accuracy (µm)	Edge sharpness (µm)	With LTPRHP, LTPRXP and LTPRUP projectors (circular aperture)			With LTPRSMHP projectors (square aperture)		
									Active area (mm)	Number of lines	Max line length (mm)	Active area (mm)	Number of lines	Line length (mm)
PT 0000 0100 P	Line	Photolithography	Soda lime glass	Chrome	-	0.05	2	1.4	11	1	11	8 x 8	1	8
PT 0000 0100 L	Line	Laser engraving	Borofloat glass	Dichroic mirror	-	0.5	50	50	11	1	11	8 x 8	1	8
PT 0000 0200 P	Line	Photolithography	Soda lime glass	Chrome	-	0.05	2	1.4	11	-	11	8 x 8	-	8
PT 0000 0200 L	Line	Laser engraving	Borofloat glass	Dichroic mirror	-	0.5	50	50	11	-	11	8 x 8	-	8
PT 0000 0300 P	Stripes	Photolithography	Soda lime glass	Chrome	0.95	0.05	2	1.4	11	8	7.78	8 x 8	8	7.78
PT 0000 0300 L	Stripes	Laser engraving	Borofloat glass	Dichroic mirror	0.5	0.5	50	50	11	8	7.78	8 x 8	8	7.78
PT 0000 0400 P	Grid	Photolithography	Soda lime glass	Chrome	0.95	0.05	2	1.4	11	8 x 8	7.78	8 x 8	8 x 8	7.78
PT 0000 0400 L	Grid	Laser engraving	Borofloat glass	Dichroic mirror	0.8	0.2	50	50	11	8 x 8	7.78	8 x 8	8 x 8	7.78
PT 0000 0500 P	Edge	Photolithography	Soda lime glass	Chrome	-	-	2	1.4	11	-	-	8 x 8	-	-
PT 0000 0500 L	Edge	Laser engraving	Borofloat glass	Dichroic mirror	-	-	50	50	11	-	-	8 x 8	-	-
PTST 050 450 P	Stripes	Photolithography	Soda lime glass	Chrome	0.45	0.05	2	1.4	11	22	11	8 x 8	16	8
PTST 050 200 P	Stripes	Photolithography	Soda lime glass	Chrome	0.2	0.05	2	1.4	11	44	11	8 x 8	32	8
PTST 050 100 P	Stripes	Photolithography	Soda lime glass	Chrome	0.1	0.05	2	1.4	11	73	11	8 x 8	53	8
PTST 050 050 P	Stripes	Photolithography	Soda lime glass	Chrome	0.05	0.05	2	1.4	11	110	11	8 x 8	80	8
PTST 010 010 P	Stripes	Photolithography	Soda lime glass	Chrome	0.01	0.01	2	1.4	11	550	11	8 x 8	400	8
PTST 020 020 P	Stripes	Photolithography	Soda lime glass	Chrome	0.02	0.02	2	1.4	11	275	11	8 x 8	200	8
PTGR 050 450 P	Grid	Photolithography	Soda lime glass	Chrome	0.45	0.05	2	1.4	11	22 x 22	11	8 x 8	16 x 16	8
PTGR 050 200 P	Grid	Photolithography	Soda lime glass	Chrome	0.2	0.05	2	1.4	11	44 x 44	11	8 x 8	32 x 32	8
PTGR 050 100 P	Grid	Photolithography	Soda lime glass	Chrome	0.1	0.05	2	1.4	11	73 x 73	11	8 x 8	53 x 53	8
PTGR 050 050 P	Grid	Photolithography	Soda lime glass	Chrome	0.05	0.05	2	1.4	11	110 x 110	11	8 x 8	80 x 80	8
PTCD 010 P 1	Grid	Cloud of dots pattern density 10.5%	Soda lime glass	Chrome	-	0.05	2	1.4	-	-	-	8 x 8	-	-
PTCD 020 P 2	Grid	Cloud of dots pattern density 20%	Soda lime glass	Chrome	-	0.05	2	1.4	-	-	-	8 x 8	-	-
PTCD 035 P 2	Grid	Cloud of dots pattern density 35%	Soda lime glass	Chrome	-	0.05	2	1.4	-	-	-	8 x 8	-	-

1 Dot size = 0.04 mm x 0.04 mm

2 Dot size = 0.08 mm x 0.08 mm



Grid 0.05 mm line thickness.



Stripe 0.5 mm line thickness.



Edge.



Line 0.5 mm line thickness.

PTPR series

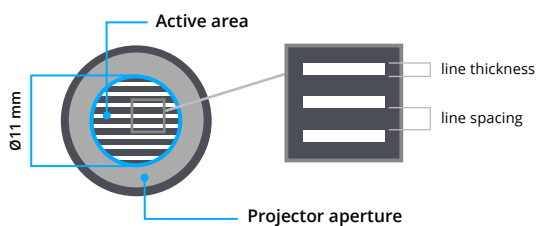
Projection patterns for LED projectors

Compatible pattern projectors for machine vision

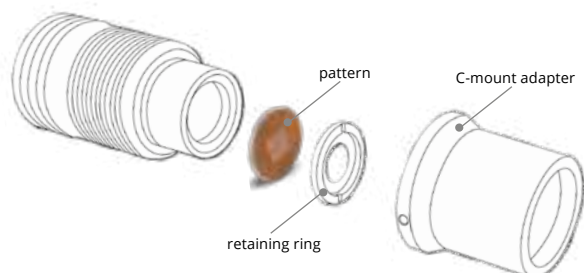
Circular aperture



LTPRHP3W, LTPRXP, LTPRUP pattern projectors.



Pattern mounted on projector with circular aperture and active area.

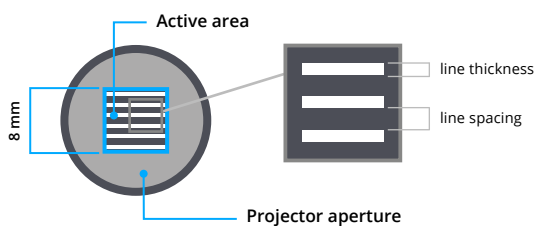


Pattern projector with circular aperture disassembled.

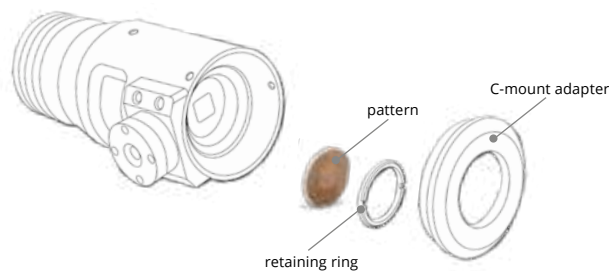
Square aperture



LTPRSMHP3W pattern projectors.



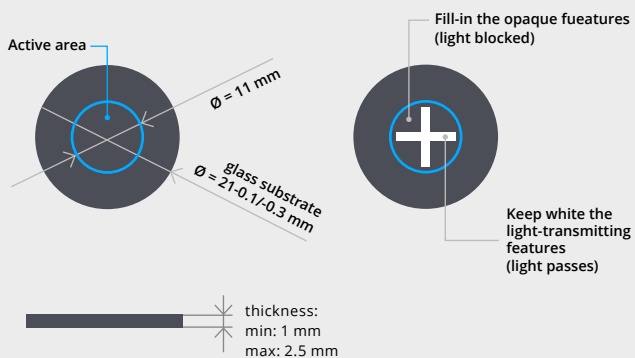
Pattern mounted on projector with square aperture and active area.



Pattern projector with square aperture disassembled.

Custom-made pattern

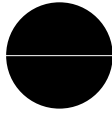
Custom-made patterns can be supplied on request. A drawing with accurate geometrical information must be submitted (please refer to the instructions here below).



Every kind of shape can be projected.

3D profilometry

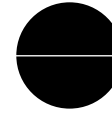
Line & stripes



PT 0000 0100 P
format: line
line thickness 0.05 mm



PT 0000 0300 P
8 lines in projection area
line gap 0.95 mm
line thickness 0.05 mm
line length 7.78 mm



PT 0000 0100 L
format: line
line thickness 0.5 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



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



PTST 010 010 P
550 lines in projection area
line gap 0.01 mm
line thickness 0.01 mm



PTST 020 020 P
275 lines in projection area
line gap 0.02 mm
line thickness 0.02 mm

Stereovision

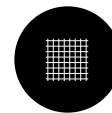
Grids



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



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

Cloud of dots



PTCD 010 P
Format:
Cloud of dots pattern,
density 10.5%



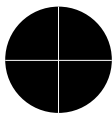
PTCD 020 P
Format:
Cloud of dots pattern,
density 20%



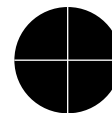
PTCD 035 P
Format:
Cloud of dots pattern,
density 35%

Alignment

Cross

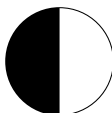


PT 0000 0200 P
format: cross
line thickness 0.05 mm

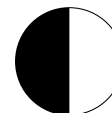


PT 0000 0200 L
format: cross
line thickness 0.5 mm

Edge



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



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

Pattern specifications

	Photolithography	Laser engraved
Substrate	Soda lime glass	Borofloat glass
Coating	Chrome	Dichroic mirror
Geometrical accuracy	2 µm	50 µm
Edge sharpness	1.4 µm	50 µm

Having the right machine vision components is not enough if you do not have the right tools to correctly integrate them in your system. Opto Engineering® offers **a wide range of mounting mechanics to help in the correct installation of its products**: from clamps to pattern holders, from mounting brackets to precision alignment mechanics, we have the perfect answer to your needs!

CMT series

Precision alignment mechanics for lenses

NEW



In many precision measurement applications, telecentric optics are the preferred solution. Correct alignment between the lens, the illuminator and the object plane is paramount to maximising the telecentric effect and capabilities of the system.

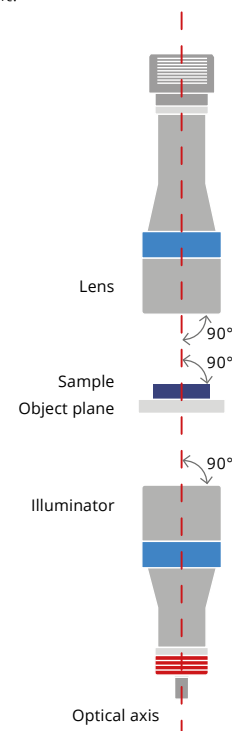
Hardware and software in perfect alignment

Adjustable mounting mechanics are extremely helpful in aligning lenses and lights, but how do you assess the quality of the alignment itself?

Thanks to built in tools designed to achieve optimal alignment, TCLIB Suite by Opto Engineering® is the perfect answer to this question. Combining the power of the hardware and software, it will maximise the system, to work at its peak, with little effort.



In order to facilitate such an alignment, Opto Engineering® designed a line of mounting mechanics featuring a tilting mechanism for easy and precise installation, allowing small adjustments to refine the optical alignment.

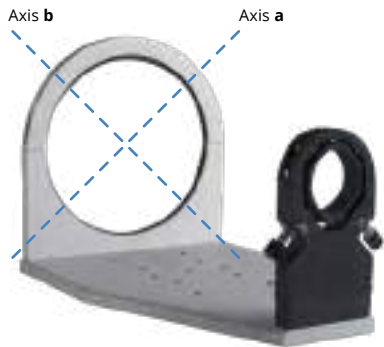


Scheme of the alignment in a telecentric vision system.

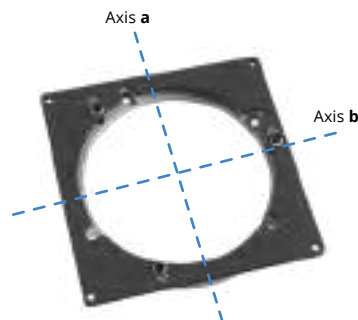


Part number	Compatibility Compatible PNs	Mechanical specifications					
		Length (mm)	Width (mm)	Height (mm)	Optical Axis height (mm)	Tilting range	
						Axis a (°)	Axis b (°)
CMTH064	TCxx064, TCxMHR064, LTCLHP064-x	175	137	145	80	±1.2	±1.2
CMTH080	TCxx080, TCxMHR080, LTCLHP080-x	230	152	153.5	80	±0.9	±0.9
CMTH096	TCxx096, TCxMHR096, LTCLHP096-x	265	179	187	100	±0.8	±0.8
CMTHCR064	TCCRxx064, TCCRxM064, LTCLCR064-x	126	126	17.5	-	2.3	2.3
CMTHCR080	TCCRxx080, TCCRxM080, LTCLCR080-x	143	143	17.5	-	2.0	2.0
CMTHCR096	TCCRxx096, TCCRxM096, LTCLCR096-x	176	176	17.5	-	1.6	1.6
CMTS064-096	PT064-096, PT064-096-C, PT064-096-P	145.5	145	28.5	-	1.3	1.3

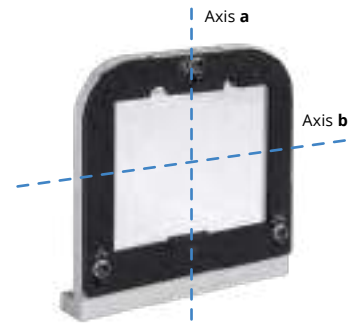
CMT series: axis orientation



CMTHxxx alignment mechanics.



CMTHCRxxx alignment mechanics.



CMTS064-096 pattern/sample holder.

Suggested configurations

Optics	Lighting	Suggested configuration
Telecentric lens	Collimated backlight	Alignment mechanics on the illuminator + adjustable pattern holder
Telecentric lens	Diffused backlight	Adjustable pattern holder
Fixed focal length lens	Diffused backlight	Adjustable pattern holder

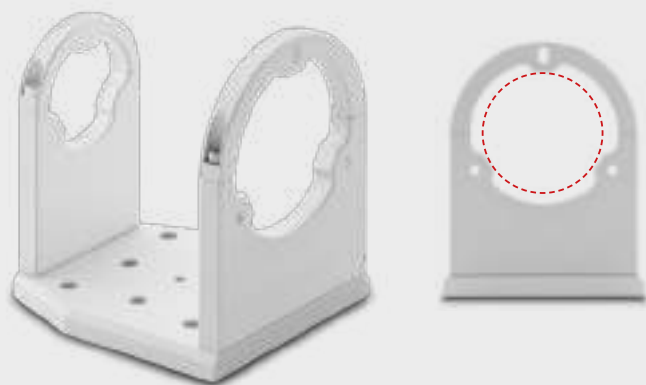
Important:

Because of the installation method, the use of CMTH064, CMTH080 and CMTH096 voids the warranty on the cleaning of the compatible lenses. For this reason installation on the illuminators is preferable and strongly recommended.

CMHO series

Clamping mechanics for lenses

Assembling a TC lens on a CMHO clamping support



The accurate alignment of optical components is crucial to the accuracy of a measurement system. In addition to the stability of the optical components, the system's mechanical design must ensure that the optical axis is orthonormal to the measurement plane.

For this purpose Opto Engineering® supplies **CMHO series** clamping mechanics, compatible with our telecentric lenses and collimated illuminators. Three-point mounting grants very precise and stable alignment of the optical components, also making the assembly process quick and simple.

Part number	Optics and robotics	Compatibility		Mechanical specifications			
		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, TC12M016-F, LTCLHP016-x, TCLWD series	016-024	20.0	62.5	71.2	40.0	
CMHO 024	TCxx024, TCxMHR024-x, TC12M024-F, LTCLHP024-x	016-024	20.0	62.5	71.2	40.0	
CMHO 036	TCxx036, TCxMHR036-x, TC12M036-F, TC16M036-x, LTCLHP036-x	036	110.0	97.0	125.5	80.0	
CMHO 048	TCxx048, TCxMHR048-x, TC12M048-F, TC16M048-x, LTCLHP048-x	048	140.0	111.0	132.5	80.0	
CMHO 056	TCxx056, TCxMHR056-x, TC12M056-F, 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, TC12M120-F, TC16M120-x, LTCLHP120-x	-	204.0	220.0	240.0	130.0	
CMHO 144	TC23130, TCxx144, TCxMHR144-x, TC12M144-F, TC16M144-x, LTCLHP144-x	-	204.0	232.0	247.0	130.0	
CMHO 192	TC23172, TCxx192, TCxMHR192-x, TC12M192-F, TC16M192-x, TC12K192, LTCLHP192-x	-	255.0	330.0	303.1	173.0	
CMHO 240	TC23200, TC23240, TCxMHR240-x, TC12M240-F, TC16M240-x, LTCLHP240-x, TC12K240	-	170.0	410.0	377.2	216.2	
For 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	
For 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	
For 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	
For PCCD							
CMHO PCCD	PCCDxxx	-	139.0	76.0	20.0	92.0	
For Robotics							
CMHO RBCR 048	TCCRxx048, TCCRxM048-x, LTCLCR048-x	-	292.0	117.0	160.5	105.0	

CMHOCR series

Clamping mechanics for CORE lenses



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

Part number	Compatibility	Mechanical specifications					
	Opto Engineering® optics	Compatible Illuminator	Depth (mm)	Width (mm)	Height (mm)	Optical axis height (mm)	Weight (g)
CMHOCR 048	TCCR12048, TCCR23048, TCCR2M048-x, TCCR4M048-x, LTCLCR048-x	LTRN048-x	80	130.0	195.0	130.0	779
CMHOCR 056	TCCR12056, TCCR23056, TCCR2M056-x, TCCR4M056-x, LTCLCR056-x	LTRN056-x	80	130.0	180.0	115.0	709
CMHOCR 064	TCCR12064, TCCR23064, TCCR2M064-x, TCCR4M064-x, LTCLCR064-x	LTRN064-x	80	150.0	200.0	125.0	822
CMHOCR 080	TCCR12080, TCCR23080, TCCR2M080-x, TCCR4M080-x, LTCLCR080-x	LTRN080-x	80	160.0	210.0	130.0	860
CMHOCR 096	TCCR12096, TCCR23096, TCCR2M096-x, TCCR4M096-x, LTCLCR096-x	LTRN096-x	84	200.0	240.0	140.0	1297

CMPH series

Holders for calibration patterns



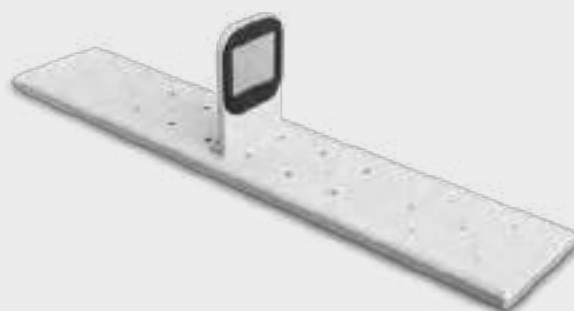
Software calibration is accurate if **pattern placement** is accurate too. To achieve that, Opto Engineering® offers **specific CMPH pattern holders** to easily and precisely mount each calibration pattern on its holding mechanics. The pattern is assembled on a frame held by three magnets: this floating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

FULL RANGE OF COMPATIBLE CALIBRATION PATTERNS



PTTC series

p. 241



Part number	Compatibility	Mechanical specifications			
	Patterns PTTC	Width (mm)	Height (mm)	Thickness (mm)	Weight (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

CMPT series

Mounting plates for optical benches

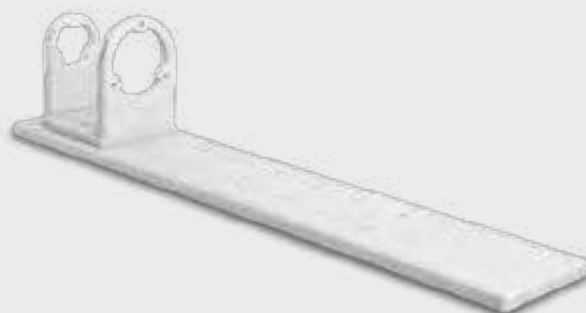


CMPT plates are mechanical components designed to build optical benches for measurement applications.

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 mounted in front of the lens with the CMPH pattern holders, enabling perfect calibration of the optical system.

Part number	Compatibility		Mechanical specifications			
	Clamping mechanics	Pattern holders	Length	Width	Thickness	Weight
	CMHO	CMPH	(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



CMPTCR series

Mounting plates for CORE optical benches



The CMPTCR series offers mechanical components designed for CORE Series telecentric lenses and illuminators. The specific design allows the user to precisely mount CORE series telecentric lenses and illuminators directly onto the plates without mounting clamps.

Part number	Compatibility		Mechanical specifications			
	Clamping mechanics		Length	Width	Thickness	Weight
	CMHO		(mm)	(mm)	(mm)	(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

CMLT series

Mounting brackets for lighting

NEW
MODELS



To simplify the mounting process of LED illuminators within any machine vision system, Opto Engineering® offers a series of brackets designed for positioning lights below, above or around the optics.

Part number	Description	Mechanical specifications					Compatibility
		N of brackets included	Fixing holes diameter (mm)	Length (mm)	Width (mm)	Height (mm)	
CMLT2PFL	L-bracket, 40 x 30 x 12 mm	2X	2X Ø 3.20	30	12	40	LTBRDC series
CMLT2QOG040	Bracket 84 x 53 x 35 mm	1X	4X Ø 3.20	84	35	53	LT2QOG040-00-X-24V
CMLT5WRG050-00-X	Bracket for LED dome light, 68 mm outer diameter	1X	6X Ø 3.50, 2X M4	79	70	20	LT5WRG050-00-1-x-24V, LT5WRG050-00-1-IR850-24V
CMLT5WRG070-00-X	Bracket for LED dome light, 95 mm outer diameter	1X	6X Ø 3.50, 2X M4	110.5	100	20	LT5WRG070-00-1-x-24V, LT5WRG070-00-1-IR850-24V
CMLT5WRG100-00-X	Bracket for LED dome light, 118 mm outer diameter	1X	6X Ø 3.50, 2X M4	134.5	125	20	LT5WRG100-00-1-x-24V, LT5WRG100-00-1-IR850-24V
CMLT5WRG150-00-X	Bracket for LED dome light, 185 mm outer diameter	1X	7X Ø 3.50, 4X M4	200	190	25	LT5WRG150-00-1-x-24V, LT5WRG150-00-1-IR850-24V
CMLT5WRG200-00-X	Bracket for LED dome light, 232 mm outer diameter	1X	4X Ø 3.50, 3X Ø 5.50, 4X M5	250	240	30	LT5WRG200-00-1-x-24V, LT5WRG200-00-1-IR850-24V
CMLT5WRG250-00-X	Bracket for LED dome light, 284 mm outer diameter	1X	4X Ø 3.50, 3X Ø 6.50, 4X M6	302	290	25	LT5WRG250-00-1-x-24V, LT5WRG250-00-1-IR850-24V
CMLTJA-M6-01	L-bracket for vertical mounting	2X	3X Ø 6.50	51	27	51	LTBC series
CMLTVA-M6-01	L-bracket for horizontal mounting	2X	3X Ø 6.50	51	40	51	LTBC series (4 brackets required for LTBC114114-x, LTBC174174-x, LTBC234234-x)
CMLTOA-M6-00	Join bracket	1X	1X Ø 8.70	-	40	-	LTBC series (2 brackets required for LTBC114114-x, LTBC174174-x, LTBC234234-x)

LED controllers

Opto Engineering® offers a **wide range of industrial LED controllers** designed to accurately set the current intensity, pulse duration and delay of machine vision LED illuminators (in strobe, pulse or continuous mode). High performance LED controllers are key to obtaining consistent light levels and to guaranteeing stable and repeatable performances in any machine vision system.

LTDV series

LED lighting strobe controllers

NEW
MODELS



KEY ADVANTAGES

Compatible with most of the LED lighting solutions available.

Ethernet, RS485 interface.

Up to 8 independently controlled output channels.

Max output current up 20A pulsed.

Easy configuration.

Small, compact units with DIN rail mounting.

NEW LTDVE2CH-20F MODEL

LED Strobe controller 2 channels,
20A/40A pulsed - 2A/4A continuous.

Opto Engineering® range of strobe controllers offer repeatable fast pulsing for quick and accurate strobing of a wide variety of LED lightings available today.

The **LTDV series** comprises models with up to eight channels either with Ethernet and/or RS485 interfaces and a single channel controller with analogue interface.

Opto Engineering® strobe controllers include LTDVE8CH-20 and LTDVE4CH-20 with Ethernet and RS485 interfaces featuring respectively eight and four output channels driving lights with currents up to 20A (pulsed) and 2A (continuous), LTDV6CH featuring six channels and RS485 interface to drive lights up to 17A (pulsed)

and LTDV1CH featuring one single channel, simple DIP switch interface and designed to drive lights with currents from 5mA up to 17A.

LTDV controllers accurately set current intensity, pulse duration and delay of LED illuminators, they offer filtering options for trigger signals and easily synchronise the strobe pulses with the camera exposure to meet today's machine vision high speed demands.

These controllers are designed to get the very best out of Opto Engineering® LED lighting solutions, in terms of both brightness stability and precise control.

Easy configuration

Easily configure and manage strobe, trigger and camera signals.

LTDVExCH-20



Opto Engineering® LTDVE series of controllers can be configured via Ethernet or RS485.

With the Ethernet interface, you can configure the controller with either the Modbus/TCP, Modbus /UDP slave protocol or the internal web browser. The second option allows for a very easy configuration of the controller using a common web browser to visually change the parameters and/or inspect the device status.

- Easily set the output current intensity of each connected illuminator in small steps (1 mA, 4mA or 20mA depending on current range)
- Set the pulse duration and pulse delay of each illuminator in small steps as low as 1µs
- Control the connected illuminators with up to 8 synchronisation inputs
- Control up to 8 synchronisation outputs (e.g. up to 8 cameras)
- Communication library available (with C source code)

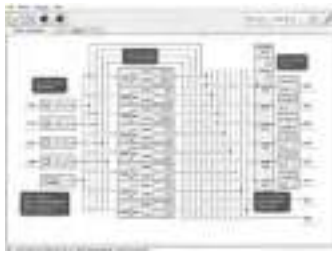
The LTDVE series can also be configured via the RS485 communication port interface that implements the Modbus/RTU slave protocol.

The configuration is stored in a non-volatile memory to maintain your settings even when the Ethernet or RS485 connection is removed.

Main page of LTDVE configuration software via web browser.

Opto Engineering® produces custom controller features for specific applications. Contact us to discuss your needs.

LTDV6CH



Main page of LTSW configuration software.

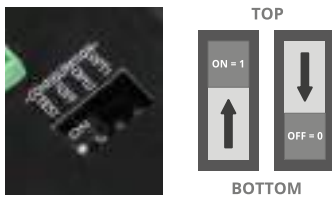
LTDV6CH can be configured via RS485. You can either download and use our free LTSW software to configure the controller from your PC or directly send low-level commands from a PC using the Modbus/RTU slave protocol (all the Modbus function codes supported by the controller are listed in the manual available online).

The LTSW software offers a very intuitive and graphical user interface where you can:

- Set the output current intensity of each connected illuminator in steps of 98 mA
- Set the pulse duration and pulse delay of each illuminator in steps of 1 µs
- Control the connected illuminators with up to 4 synchronisation inputs
- Control up to 2 synchronisation outputs (e.g. up to 2 cameras)
- Write and save different configurations depending on your application

To use LTSW configuration software your PC must have a native RS485 communication interface or a suitable RS485/USB converter must be used (PN: ADPT001).

LTDV1CH



DIP switches interface for simple and fast configuration.

LTDV1CH is simply configured from the front panel via DIP switches. You can easily set the intensity of the LED lights driving current (from 5mA to 17A), filtering option for the trigger signal (select between 10 µs or 100 µs time constant) and delay for synchronisation output (select between 0 or 100 µs).

Part number		LTDV1CH-17V	LTDVE2CH-20F	LTDVE4CH-20	LTDV6CH	LTDVE8CH-20
Electrical specifications						
Status LEDs		Yes (for power on and trigger)	Yes (for all I/Os)	Yes (for all I/Os)		Yes (for all I/Os)
User interface		12-way DIP switch	Ethernet 100 Mbps (using a Web browser or Modbus/TCP slave or Modbus/UDP slave) Ethernet 100 Mbps RS485 (via Modbus/RTU slave)		RS485 (via Modbus/RTU slave)	Ethernet 100 Mbps (using a Web browser or Modbus/ TCP slave or Modbus/UDP slave) Ethernet 100 Mbps RS485 (via Modbus/RTU slave)
Configuration software		-	-	-	LTSW included	-
Output channels n°		1 constant current output	2 independent constant current outputs	4 independent constant current outputs	6 independent constant current outputs	8 independent constant current outputs
Output current range 2	(A)	5 mA-160 mA (in steps of 5 mA) pulsed or continuous 100 mA-3.2 A (in steps of 100 mA) pulsed 1.5 A-17 A (in steps of 500 mA) pulsed	2 independent channels: Pulsed up to 20A per channel, Continuous up to 2A per channel 1 shared channel: Up to 40A Pulsed or 4A Continuous (in steps of 1mA from zero to 250 mA and 20 mA from 250 mA to 20A)	Up to 20A pulsed or 2A continuous (in steps of 1mA from zero to 200 mA, and 20 mA from 4001mA to 20A)	3.5A - 17.0 pulsed (in steps of 98 mA)	Up to 20A pulsed or 2A continuous (in steps of 1mA from zero to 200 mA, 4 mA from 201 mA to 4000 mA and 20 mA from 4001 mA to 20A)
Max dissipable thermal power per channel	(W)	8	4	4	5	4
Synchronisation inputs n°		1 opto-isolated digital input	2 opto-isolated digital inputs 1	4 opto-isolated digital inputs 1	4 opto-isolated digital inputs 1	8 opto-isolated digital inputs 1
Synchronisation outputs n°		1 opto-isolated digital output	2 opto-isolated digital outputs	4 opto-isolated digital outputs	2 opto-isolated digital outputs	8 opto-isolated digital outputs
Lighting pulse delay	(µs)	-	0 - 1.000.000 2	0 - 1.000.000 2	0 - 65535 3	0 - 1.000.000 2
Lighting pulse width	(µs)	-	2 - 1.000.000 2	10 - 1.000.000 2	10 - 65535 3	10 - 1.000.000 2
Timing repeatability for pulse delay	(µs)	-	0.1 4	0.1 4	0.1 4	0.1 4
Timing repeatability for pulse width	(µs)	-	0.1 4	0.1 4	0.1 4	0.1 4
Supply voltage	(V, DC)	24 5	24	24 - 48	24 5	24 - 48
Output voltage	(V)	0 - 12 (with step-up disabled) or 0 - 36 (with step-up enabled)	5-195	0 - 36	0 - 36	0 - 36
Mechanical specifications						
Dimensions 6	Length (mm)	70	128	195 6	205	255 6
	Height (mm)	82	50	75 6	84	75 6
	Width (mm)	119	120	135 6	123	135 6
Mounting		DIN rail	4 fixing slots	DIN rail	DIN rail	DIN rail
Accessories		-	-	-	ADPT001 7	-
Compatible products		Compatible with most LED lightings available			LTDM series, LTLA series, LTDMLA series, View-through system	Compatible with most LED lightings available

1 Operate from 3.3V to 24V.

2 In variable resolution depending on selected value.

3 In steps of 1 µs.

4 Digital processing.

5 Regulated ± 10%.

6 Including DIN fixing.

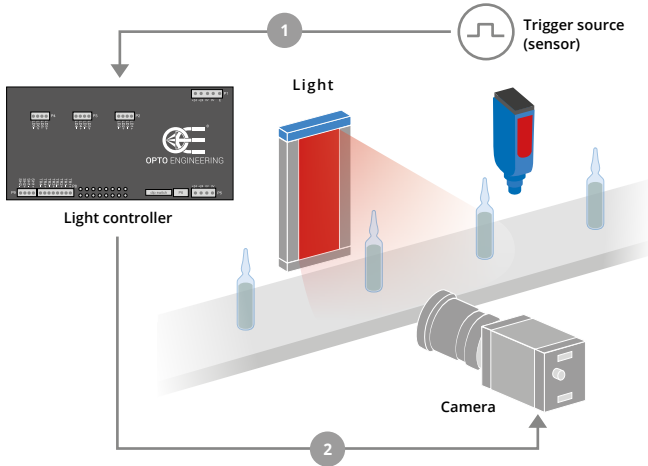
7 To be ordered separately. ADPT001 consists of - one RS485-USB adapter and - one cable for connection with LTDV6CH. In order to configure LTDV6CH via software a RS485 port must be provided.

LTDV series - LED lighting strobe controllers

Triggering options and wiring diagrams

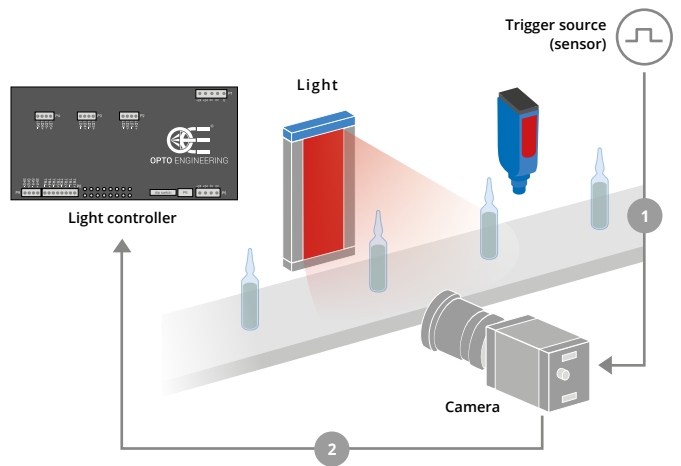
Two typical camera triggering arrangement (Option A and B) are illustrated for each controller model. Triggering Option A is preferred because the controller directly filters the trigger signals getting rid of unwanted noise. This configuration is possible because Opto Engineering® controllers feature dedicated synchronisation outputs which are not commonly available from other manufacturers.

A • Controller triggers camera



Option A - shows a triggering arrangement where the light controller is triggered by trigger source(s) (sensor positioned on the manufacturing line) and the lighting controller then triggers the camera(s). This arrangement has the advantage that the controller can filter the trigger signals before passing the command to the camera and the light.

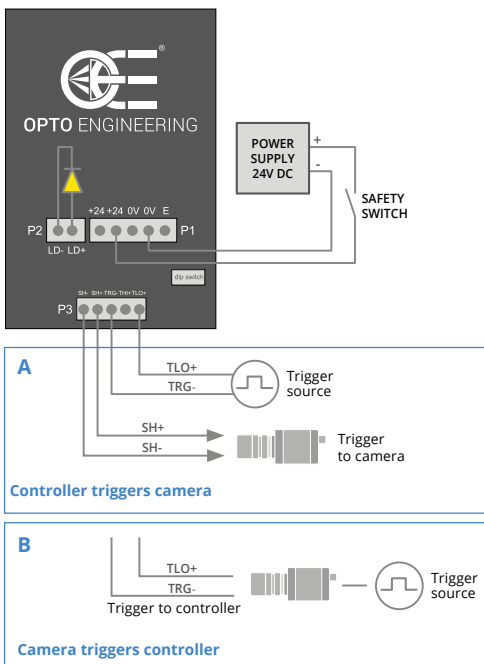
B • Camera triggers controller



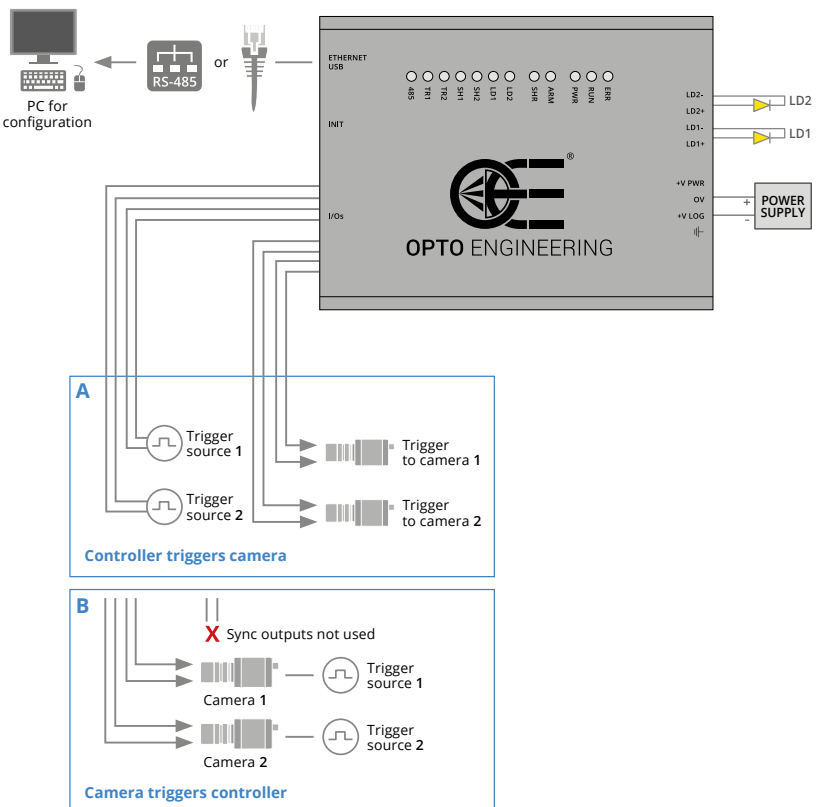
Option B - shows an arrangement where each camera is triggered by a trigger source (sensor), the camera then triggers the light controller and starts its exposure.

The following diagrams explain how to connect Opto Engineering® strobe controllers with the other machine vision components: LED lights, cameras, power supply and PC (for the configuration of all the parameters).

LTDV1CH-17V

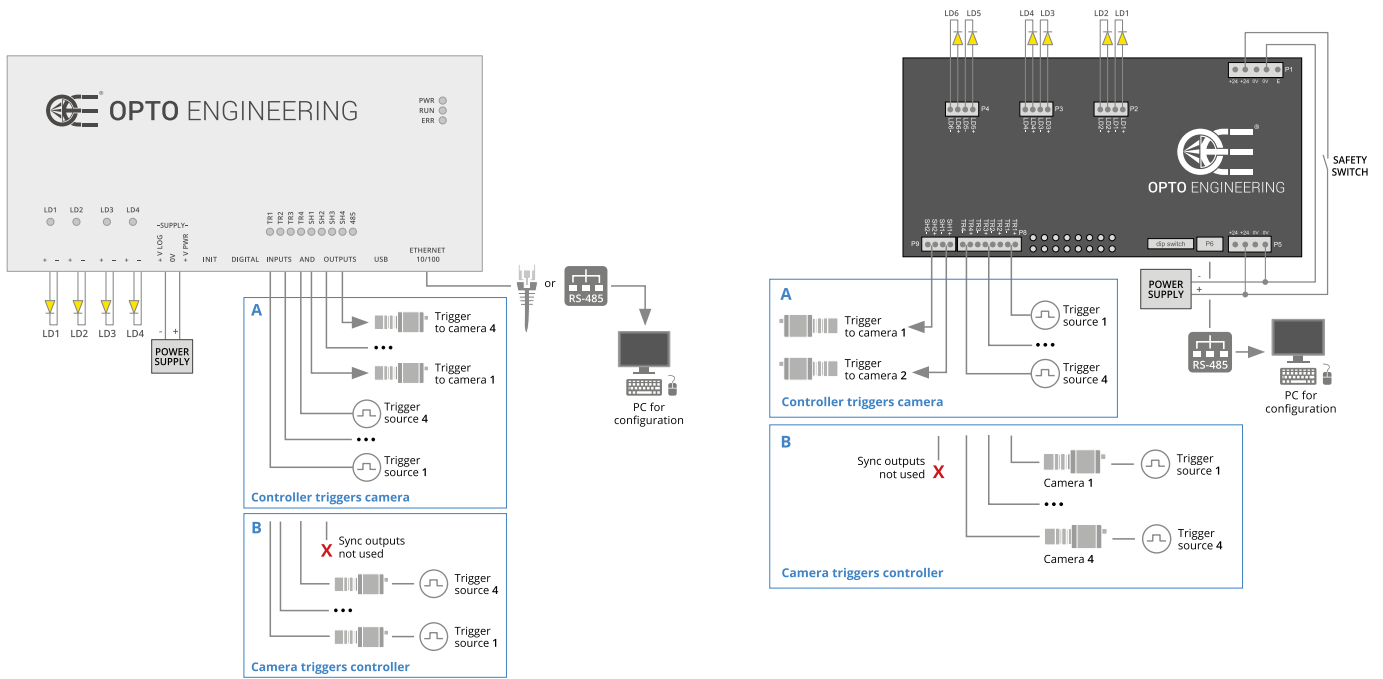


LTDVE2CH-20

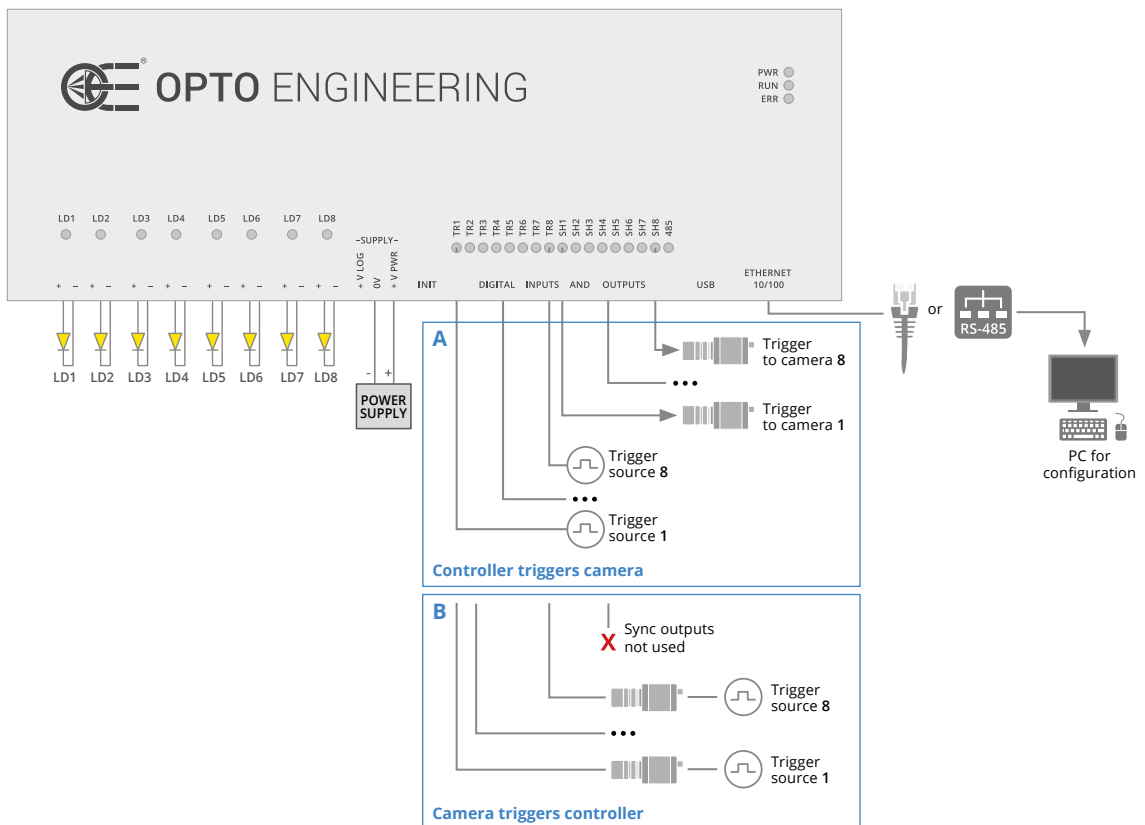


LTDVE4CH-20

LTDV6CH



LTDVE8CH-20











LTIC series

LED lighting controllers



Opto Engineering® offers light intensity controllers available as accessories to precisely adjust the light intensity of our wide range of lights.

Part number	Description	Light control type	Mode	Electrical specifications				
				Status LEDs	Input Supply voltage (V)	Power cord xx	Other	
DIN RAIL								
 LTIC1CH-A1-4	Analogue lighting controller unit, 4A, 24V	Analogue (via knob or 0-10V analogue signal)	Continuous and pulsed ⁴	Yes (for power on, enable and fault)	24-48	not included	Enable input (0-24V), Thermal sensor input ⁵	
 LTIC1CH-D1-4	Digital lighting controller unit, 4A, 24V	Analogue (via knob or 0-10V analogue signal) and Digital (Ethernet and RS485) ⁷	Continuous and pulsed ⁴	Yes (for power on, enable and fault)	24-48	not included	Enable input (0-24V), Thermal sensor input ⁵	
 LTICGR1000-D1	Analogue lighting controller unit, 1 channel, 24V, 2A, constant mode, power adaptor 24V plug	Analogue (via knob)	Continuous	No	24	not included	-	
 LTICGR1000-D1-PS-xx ³	Analogue lighting controller unit, 1 channel, 24V, 2A, constant mode, power cord, power adaptor 24V plug	Analogue (via knob)	Continuous	No	24	included (EU, UK or US)	-	
 LTICGR1000-D1-PS-xx-TB ³	Analogue lighting controller unit, 1 channel, 24V, 2A, constant mode, power cord, power adaptor 24V plug, Illumination cable side A SM 3 way male connector, side B terminal blocks connector, 24V - 3 m	Analogue (via knob)	Continuous	No	24	included (EU, UK or US)	-	
BENCHTOP								
 LTICOBUL1000CH1-24VxxTB ³	24VDC analogue lighting controller 1 channel, power cord, Illumination cable side A SM 3 way male connector, side B terminal blocks connector, 24V - 3 m	Analogue (via knob)	Continuous	No	100 - 240	included (EU, UK or US)	-	
 LTICOBUL2000CH2-24V-A1xxTB ³	24VDC analogue lighting controller 2 channels, power cord, Illumination cable side A SM 3 way male connector, side B terminal blocks connector, 24V - 3 m	Analogue (via knob)	Continuous	No	100 - 240	included (EU, UK or US)	-	
 RT-PSP-12122-LV-xx ³	12VDC analogue power supply for LVx-00614 LED spot light	Analogue	Continuous	No	100 - 240	included (EU, UK or US)	-	

¹ Do not exceed lighting maximum ratings specified in the product datasheet. Refer to specific product documentation for detailed instructions.

² Within each product series, only lights that require continuous driving current ≤ max output current of the light controller are considered compatible.

³ xx = UK (240VAC) / EU (220VAC) / US (110VAC).

⁴ Rising time is approx 400 μs. Falling time is approx 100 μs.

⁵ Thermal sensor input works with compatible LED lights (LTRNHP and LTLNE series).



Electrical specifications					Dimensions			Compatibility 1, 2		
Channels	Voltage (V, DC)	Output		Other	Length (mm)	Width (mm)	Height (mm)	LED illuminators 2	LED pattern projectors	LED sources/ modules
		Max current (A)	Power (W)							
1	24-48	4	100	Fault output (0-24V), cooling fans output (0-24V) ⁶	86	54	117	LED illuminators with continuous driving current ≤ 4A, LTRNOBHP, LTRNST, LTRNOB, LT2BC, LTLNC, LTLNE, LTDMC, LTLAIC, LTLADC, LTRNDC, LTBC, LTBFC, LT2BC, LTBDC, LTTNC, LTCXC		
1	24-48	4	100	Fault output (0-24V), cooling fans output (0-24V) ⁶	86	54	117	LED illuminators with continuous driving current ≤ 4A, LTRNOBHP, LTRNST, LTRNOB, LT2BC, LTLNC, LTLNE, LTDMC, LTLAIC, LTLADC, LTRNDC, LTBC, LTBFC, LT2BC, LTBDC, LTTNC, LTCXC		
1	24	2	48	-	55	24	90	LED illuminators with continuous driving current ≤ 2A, LTDMC, LTLAIC, LTLADC, LTRNDC, LTBC, LTBFC, LT2BC, LTBDC, LTTNC, LTCXC, LTLNC, LTLNE		
1	24	2	48	-	55	24	90	LED illuminators with continuous driving current ≤ 2A, LTDMC, LTLAIC, LTLADC, LTRNDC, LTBC, LTBFC, LT2BC, LTBDC, LTTNC, LTCXC, LTLNC, LTLNE	-	-
1	24	2	48	-	55	24	90	LTRNST, LTRNOB	-	-
1	24	5	120	-	330	93	123	LTCLHP, LTCLHP CORE, LTCLHP CORE PLUS, LTCL4K, TCCX, TCCXQ, TCBENCH, TCBENCH CORE, LTDMC, LTRNST, LTRNOB, LTLAIC, LTLADC, LTRNDC, LTBC, LTBFC, LTBDC, LTTNC, LTCXC	LTPRHP3W, LTPRSMHP3W, LTPRXP	LTSCHP
2	24	1	500 mA @ 12V	-	154	91	48	LED illuminators with continuous driving current <1 A	-	-
2	12	1	12	-	118	83	38	-	-	LDSC (RT-LVW-00614 RT-LVG-00614)

⁶ Cooling fans output works with compatible LED lights (LTLNE series).

⁷ Communication protocols: Web browser or Modbus/TCP or Modbus/UDP for Ethernet; Modbus/RTU for RS485.

LED sources & replacements

Opto Engineering® offers replacement LED modules for collimated lights, coaxial telecentric lenses and LED pattern projectors.

LTSCHP series

High-performance replacement LED modules



LTSCHP modules power several Opto Engineering® LED illuminators and feature excellent current stability. They are available in various colors and can be ordered as spare parts:

1W power sources:

- LTSCHP1W modules are compatible with LTCLHP, LTLCHP CORE (only red, green and white), LTCL4K, TCCXQ, TCCX, TCBENCH series, TCBENCH CORE, MZMT12X series and TCKIT case.
- The new LTSCCP1W-G green light source is compatible with the LTLHP CORE PLUS series.
- The new LTSCHP1W-GZ green light source is now also available: suitable for any kind of sample, it is specifically tailored for measuring reflective objects and objects with sharp edges. In fact, it reduces edge diffraction effects, also ensuring superior illumination uniformity (especially on large FOVs) and making the whole system less sensitive to alignment. It is compatible with LTCLHP, TCBENCH, LTCL4K, LTCLHP CORE, TCBENCH CORE series and TCKIT case.

3W power sources:

- LTSCHP3W modules are compatible with LTPRHP3W and LTPRSMHP3W pattern projectors.

Part number	Light color, Wavelength peak	Device power ratings				LED power ratings			Compatibility
		DC voltage ¹		Power consumption (W)	Max LED forward current (mA) ²	Forward voltage		Max pulse current (mA) ⁵	
		Minimum (V)	Maximum (V)			Typical (V) ³	Maximum (V) ⁴		
1W power sources ⁶									
LTSCHP 1W-R	red, 630 nm	12	24	< 2.5	350	2.4	3.00	2000	LTCLHP, TCBENCH, LTCL4K, TCCX, TCCXQ, LTCLHP CORE, TCBENCH CORE, TCKIT, MZMT12X 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	
LTSCCP 1W-G • NEW	green, 520 nm	12	24	< 2.5	350	3.3	4.00	2000	LTCLHP CORE PLUS
LTSCHP 1W-GZ • NEW	green, 520 nm	12	24	< 2.5	350	3.3	4.00	2000	LTCLHP, TCBENCH, LTCL4K, LTCLHP CORE, TCBENCH CORE, TCKIT
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 unassembled. 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.

LED sources & replacements

LDSC series

LED sources



* RT

Part number	Description	Compatibility
RT-LVW-00614	Light source for Optart telecentric lenses with built-in coaxial illumination, white	RT-PSP-12122-LV-xx
RT-LVG-00614	Light source for Optart telecentric lenses with built-in coaxial illumination, green	RT-PSP-12122-LV-xx

FULL RANGE OF COMPATIBLE PRODUCTS		
	TCCXHM series	p. 35
	TCCXLM series	p. 35
	TCCX2M series	p. 46

Motorised lenses and more in general multi-configuration optics, are **extremely powerful and versatile tools that guarantee high versatility of application**. However, precise control tools are a must if you want to exploit their possibilities to the most. Opto Engineering® offers a complete range of lens controllers specifically designed for this purpose.

MTDV series

Motion controller for bipolar stepper motors with additional encoder input _____



KEY ADVANTAGES

Plug and play

Both Ethernet and USB interface available.

Compact Industrial Design

Rigid and compact design for industrial use.

Wide product range

Available from 1 channel to 4 channels.



Designed for both open loop / close loop

Suitable for wide range of applications.

User-friendly web interface

No software installation is necessary with high configurability.

COMPATIBLE MOTORISED LENSES

	TCZRS series	p. 60
CABLE FOR CONNECTION WITH MZMT AND ENMT		
	CBMT001	p. 264

The **MTDV series** offers a compact robust designed motion controller for bipolar stepper motors with winding currents up to 1.2A working at 24V DC. MTDV has a wide product range which allows them to drive from 1 to 4 stepper motors in both open or close loop operations (by means of 1 to 4 encoders) to control different type of motorised optics and motion stages.

It features the Ethernet communication interface commonly employed in industrial applications, allowing plug and play operations (USB and RS485 are already implemented at the hardware level and can be developed on request). Together with a user-friendly Web interface, it is possible to operate the controller with high configurability without installing any software.

The controllers are compatible with TCZRS series for changing the magnification and MZMT12X, 12X continuous macro zoom lenses with motorised control. It is also compatible with encoder based XY linear motion stages, which are frequently used for metrology application.

MTDV can also be controlled from the customer application using the functions of the provided DLL library. DLL library and code examples can be downloaded from the Opto Engineering® website.

The MTDV controller lets you easily set specific F-number, focus and/ or zoom settings when used in combination with any compatible lens model (i.e. TCZRS and MZMT12X series) by downloading a specific configuration file from our website containing a lookup table of preset values.

Specific configurations can be saved in the controller's non-volatile memory.

In order to connect MTDV1CH-22A2 to TCZRS series and to connect MTDV2CH-22A2 to MZMT12X, a suitable cable indicated in the specification table must be ordered separately.

MTDV features a solid aluminium housing and can be easily mounted on a DIN rail for easy integration in any industrial automation environment.

Product combinations*



TCZRS lens + CBMT002 + MTDV1CH-22A2.



General linear stage + MTDV2CH-22A2 + MTDV3CH-22A2.

MTDV series

Motion controller for bipolar stepper motors with additional encoder input

Part number		MTDV1CH-22A2	MTDV2CH-22A2	MTDV3CH-22A3	MTDV4CH-22A4
Electrical specifications					
DC Voltage	(V)	24			
Power consumption max	(W)	38	71	96	96
Communication interfaces		Ethernet (TCP/IP), USB2.0 (custom serial), RS485 (custom serial)			
Connectors		1x RJ45, 1x USB Type A, 2x Terminal blocks, Nx DB15HD female ¹			
Visual indicators		Ethernet activity LED, RGB LED for each motor status			
Protections		ESD, polarity inversion, overvoltage, undervoltage, output overcurrent, shorted output, open output, overtemperature			
Functions					
Non volatile memory		Yes			
Automatic position saving		Yes			
Software		Integrated web interface (Ethernet), Ethernet DLL library (USB and RS485 to be developed on request)			
Control type		Closed-loop, open-loop			
Motion mode		Positioning mode (relative and absolute) with 2 stage velocity ramp			
Special features		Advanced motor drive with StealthChop™ and 256x SpreadCycle™, extremely silent operation, adjustable RUN and HOLD currents for optimised power consumption, advanced positioning control in closed-loop operation, motor homing based on encoder reference or limit switch, reduced EMI noise ²			
Motor parameters ³					
Number of motors		1	2	3	4
Type		Bipolar stepper			
RMS winding current	(mA)	20 to 1350 (adj)	20 to 1350 (adj)	20 to 1250 (adj)	20 to 935 (adj)
Peak winding voltage	(V)	24 (PWM)			
Encoder parameters ³					
Number of encoders		1	2	3	4
DC power supply	(V)	5			
Type		Linear / rotary, incremental			
Signal outputs		A, B, Z (index)			
Interface		RS422			
Environmental specifications					
Operating temperature	(°C)	10 to 40			
Storage temperature	(°C)	0 to 50			
Humidity	(%)	10-85 non condensing			
IP rating		-			
Installation		Indoor use only			
Mechanical specifications					
Length	(mm)	47	62.8	78.6	94.4
Height	(mm)	84			
Width (case only)	(mm)	80.2			
Width (total)	(mm)	102.6			
Material		Anodised aluminium			
Mounting		DIN rail			
Compatibility ⁴					
Lenses		TCZRS	TCZRS, ENMT, MZMT12x		
Cable ⁵		CBMT002, CBETH003	CBMT002, CBMT003, CBETH003		
Accessories		ADPT001			

¹ N represents the number of channels.
² StealthChop™ and SpreadCycle™ are property of their respective owners.
³ For a complete list of specifications please refer to the user manual.
⁴ All compatible products must be ordered separately.
⁵ CBMTxxx cables are required to connect MTDV to compatible lenses.
 See the lens product page for more information on what cable to order.

ELDV series

Controllers for liquid lens modules

NEW



COMPATIBLE HOLE INSPECTION OPTICS		
	PCHI023-AF	p. 100
COMPATIBLE TELECENTRIC OPTICS		
	TCEL series	p. 54

Opto Engineering® offers controllers available as accessories to precisely adjust the optical power of liquid lens modules integrated in the Opto Engineering products.

The lens drivers from the ELDV series offer a simple yet precise way to control the electrically tunable lenses integrated in the OE products. Communication with the driver follows an open simple serial protocol, which can be implemented in any programming language on Windows or Linux (C#, Labview and Python source code is available).

The driver comes with free software and can be used as a standalone solution or integrated into OEM designs.

KEY ADVANTAGES

Current control from -290 to +290 mA in 0.07 mA steps.

Drive frequencies from 0.25 to 2000 Hz
(rectangular, triangular or sinusoidal).

I2C sensor read-out e.g. for temperature compensation
("Focal Power Mode").

USB powered (5V).

UART control option available.









Driver software for Windows 7, 8 & 10.

Part number	Current range (mA)	Current steps (mA)	Drive frequency range (Hz)	Waveform	Power (V)	Housing	Compatibility
RT-EL-E-4i	-290 ... +290	0.07	0.25 ... 2000	Rectangular, triangular or sinusoidal	USB (5V)	Metal	PCHI023-AF

Opto Engineering® offers a variety of power supplies available as accessories to power our wide range of machine vision products.

PS series

Power supplies

Part number	Description	Electrical specifications						Dimensions		
		Input Supply voltage (V, AC)	Power cord	Channels	Output Voltage (V, DC)	Max current (A)	Power (W)	Length (mm)	Width (mm)	Height (mm)
 RT-SDR-120-24	24VDC DIN rail power supply	88 - 264	not included	1	24	5	120	113.5	40	125.2
 RT-SDR-240-48	48VDC DIN rail power supply	88 - 264	not included	1	48	5	240	113.5	63	125.2
 RT-DRP-240-24	DIN rail power supply 240VAC - 24VDC 240 W	85 - 264VAC 120 - 370VDC	not included	1	24	10	240	125.5	100	125.2
 RT-DRP-480-24	DIN rail power supply 240VAC - 24VDC 480 W	180 - 264VAC 250 - 370VDC	not included	1	24	20	480	227	100	125.2
 RT-DRT-240-24	DIN rail power supply 400V ac three phase - 24VDC 240 W	Three-Phase 340 - 550VAC (Dual phase operation possible) 480 - 780VDC	not included	1	24	10	240	125.5	100	125.2
 RT-DRT-480-24	DIN rail power supply 400V ac three phase - 24VDC 480 W	Three-Phase 340 - 550VAC 480 - 780VDC	not included	1	24	20	240	227	100	125.2
 RT-MV-DC1201-BCSXIO-REV2	Power Supply 12V with digital I/O on separate cable	100, 240	Included (EU)	1	12	2.5		100, 240	Included (EU)	
 COE-PS-UNIVERSAL	Power Supply for COE HR AS series and HR LS series	90 - 264	not included	1	12	5	60	151.90	107	47

- 1 Do not exceed the maximum ratings specified in each product datasheet. Refer to specific product documentation for detailed instructions.
- 2 Additional wires (not supplied) are required to connect the controllers with the power supply units.

- 3 Select a power supply with output voltage, maximum output current and maximum output power compatible with the controller and the lights used in the application. Refer to the datasheets of controllers and lights for data about power consumption, voltage and current.



*** RT**

Compatibility 1

Controllers 2		Optics	Lights			Cameras	AI vision units
Light controllers 3	Motion controllers		LED illuminators	LED pattern projectors	LED sources/modules		
LTDVE8CH-20, LTDVE4CH-20, LTDV6CH, LTDV1CH-17V, LTIC1CH-A1-4, LTICGR1000-D1	MTDVxCH-22A2	AOL0223A, AOL0223B	LTCLHP, LTCLHP CORE, LTCLHP CORE PLUS, LTCL4K, TCCX, TCCXQ, TCBENCH, TCBENCH CORE, LTDMC, LTRNST, LTRNOB, LTLAIC, LTLADC, LTRNDC, LTBC, LTBFC, LTBRC, LTTNC, LTCXC, LTLNC, LTLNM, LTLNE, LT2BC	LTPRHP3W, LTPRSMHP3W, LTPRXP	LTSCHP		
LTDVE8CH-20, LTDVE4CH-20, LTIC1CH-A1-4			-	-	-		
LTDVE8CH-20, LTDVE4CH-20, LTIC1CH-A1-4, LTICGR1000-D1							PENSO, ALBERT-01
LTDVE8CH-20, LTDVE4CH-20, LTIC1CH-A1-4, LTICGR1000-D1							ALBERT-01
							PENSO, ALBERT-01
							ALBERT-01
							mvBlueCOUGAR-X, mvBlueCOUGAR-XD
							COE series

Opto Engineering® offers a variety of power supplies available as accessories to power our wide range of machine vision products.

CB series

Cables

* RT

Part number	Description	Compatibility
Power cables		
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, LTBP240180-B/W, LTBP288180-B/W, LTBP240216-B/W, LTBP288216-B/W
CBLT002	Illumination cable, side 1 M12 connector right angled, side 2 cable end - 5 m - for single stage systems	LTDMB2-x, LTDMCX-x, LTLAB2-x, LTLACx-x, LTPRUP-x, LTBP240180-B/W, LTBP288180-B/W, LTBP240216-B/W, LTBP288216-B/W
CBLT003	Illumination cable, side 1 M8 connector straight, side 2 cable end - 5 m - for single stage systems	LTDMA1-x, LT2BC series, LTBP series 1, LTLNCxxx-x
CBLT004	Illumination cable, side 1 M8 connector right angled, side 2 cable end - 5 m - for single stage systems	LTDMA1-x, LT2BC series, LTBP series 1, LTLNCxxx-x
CBLT005	Illumination cable, side 1 M12 connector straight, side 2 cable end - 5 m - for double stage systems	LTDMLAB2-WW, LTDMACx-WW, LTBP240180-R/G, LTBP288180-R/G, LTBP240216-R/G, LTBP288216-R/G
CBLT006	Illumination cable, side 1 M12 connector right angled, side 2 cable end - 5 m - for double stage systems	LTDMLAB2-WW, LTDMACx-WW, LTBP240180-R/G, LTBP288180-R/G, LTBP240216-R/G, LTBP288216-R/G
CBLT007	Illumination cable PVC grey, side 1 industrial circular connector straight, side 2 cable end - 5 m	LTLNE series
CBLT008	Illumination cable, side 1 industrial circular connector straight, side 2 cable end - 5 m - power supply	LTLNM series
CBLT009	Illumination cable, side 1 industrial circular connector straight, side 2 cable end - 5 m - I/O signals	LTLNM series
CBLT010	Illumination cable, side 1 industrial circular connector straight, side 2 cable end - 5 m	LTRNOBHP series
CBLT014	Illumination cable PVC black, side 1 M12 female connector straight, side 2 cable end, 5-way, 5m length	LTBRZ3 series
CBLT015	Illumination cable PVC black, side 1 M12 female connector right angled, side 2 cable end, 5-way, 5m length	LTBRZ3 series
CBLT016	Illumination jumper cable PVC, side 1 M12 male connector straight, side 2 M12 female connector straight, 5-way, 0.5m length	LTBRZ3-x-y-w-p-DC
CBLT017	Illumination jumper cable PVC, side 1 M12 male connector straight, side 2 M12 female connector straight, 5-way, 1m length	LTBRZ3-x-y-w-p-DC
CBLT018	Illumination jumper cable PVC, side 1 M12 male connector straight, side 2 M12 female connector straight, 5-way, 2m length	LTBRZ3-x-y-w-p-DC
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	LTCLHP series, LTCLHP CORE series, LTCL4K series, TCCX series, LTPR series, LTPRHP3W series, LTPRSMHP3W series, LTSCHP series
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	LTPRXP series, TCCAGExx096
CBSLH-24V-F-3M-TB	Illumination cable, side A flying leads, side B terminal blocks connector, 24V - 3m	LTRNST series, LTRNOB series, RT-ANGX1000CH1-24V-xx-TB, RT-ANG2000CH2-24VA1-xx-TB
CBSLH-24V-F-3M	Illumination cable, side A flying leads, side B SM 3 way female connector, 24V - 3m	RT-SD-1000-D1-PS-xx, LTDMC series, LTLAIC series, LTLADC series, LTRNDC series, LTBFC series, LTBRDC series, LTTNC series, LTCXC series
CBPWALB01	ALBERT power cable, 5 m, IP65	ALBERT-01
RT-70261132	Power cord with schuko plug - open end cable, 3 m 10A 250V, single-phase	RT-SDR-120-24, RT-SDR-120-48, RT-DRP-240-24, RT-DRP-480-24, RT-DRT-240-24, RT-DRT-480-24
CBMT002	15 wires cable, DB15HD Male to DB15HD Female connector, 2 m	MTDVxCH-22Ax, TCZRS series
CBMT003	8 wires cable, 2x DB15HD Male to DIN EN 60529 12 Pin Female connector, 2 m	MTDVxCH-22Ax, MZMT12X series, ENMT series
USB cables		
CBUSB20ACT01	Active USB 2.0 cable, industrial level, screw locking, 10 m	STLTCM01
CBUSB3001	Passive USB 3.0 cable, industrial level, horizontal screw locking, 3m	COE HR AS-X series, COE-U series, mvBlueFOX3-2
Ethernet cables		
CBETH001	Ethernet cable for Panel PC, 5 m, IP65	ALBERT-01, RT-KWP5170
CBETH002	Ethernet cable, general purpose, 5 m, IP65	ALBERT-01
CBETH003	Ethernet cable, CAT6, industrial level, high flexible cable with screw, 5 m	COE-G series, COE HR AS-X series, mvBlueCOUGAR-X, mvHR mvBlueCOUGAR-XD, MTDVxCH-22Ax

1 Except LTBP240180-z, LTBP288180-z, LTBP240216-z, LTBP288216-z

Part number	Description	Compatibility
Cables for control and I/O		
CBGPI06PMF-3M	6 Pin Hirose Male - Female moulded connector cable, 3 m	PCHI023-AF, RT-EL-E-4i
CBGPO001	Output cable, 5 m, IP65	ALBERT-01
CBGPI0001	I/O cable, side 1 HIROSE 12 pin, side 2 cable end, 3 m	mvBlueFOX3-2, mvBlueCOUGAR-X, mvBlueCOUGAR-XD, mvHR
CBPH001	Photoelectric sensor cable with M12 connector, 5 m, IP65	RT-WTB9-3P2461, ALBERT-01
CBPH002	Photoelectric sensor cable with flying leads, 5 m, IP65	ALBERT-01
CBTL001	Tower light cable with M12 connector, 5 m, IP68	RT-69942075, ALBERT-01
CBTL002	Tower light cable with flying leads, 5 m, IP68	ALBERT-01
COE I/O cables		
COE-6P-FEMALE	HIROSE 6-pin/Female connector cable for COE HR LS series, 2 meters	COE HR LS series, COE-PS-UNIVERSAL
COE-6P-MALE	HIROSE 6-pin/Male connector cable for COE HR AS series, 2 meters	COE HR AS series, COE-PS-UNIVERSAL
COE-6P-OPEN1-005	HIROSE 6-pin/Open end cable, 0,5 meters	COE-G series, COE-U series, COE HR AS-X series
COE-6P-OPEN1-030	HIROSE 6-pin/Open end cable, 3 meters	COE-G series, COE-U series, COE HR AS-X series
COE-6P-OPEN1-050	HIROSE 6-pin/Open end cable, 5 meters	COE-G series, COE-U series, COE HR AS-X series
COE-6P-OPEN1-100	HIROSE 6-pin/Open end cable, 10 meters	COE-G series, COE-U series, COE HR AS-X series
COE-6P-OPEN1-150	HIROSE 6-pin/Open end cable, 15 meters	COE-G series, COE-U series, COE HR AS-X series
COE-6P-OPEN1-300	HIROSE 6-pin/Open end cable, 30 meters	COE-G series, COE-U series, COE HR AS-X series
COE-6P-OPEN2-030	HIROSE 6-pin/Open end super flexible cable, 3 meters	COE-G series, COE-U series, COE HR AS-X series
COE-6P-OPEN2-050	HIROSE 6-pin/Open end super flexible cable, 5 meters	COE-G series, COE-U series, COE HR AS-X series
COE-6P-OPEN2-100	HIROSE 6-pin/Open end super flexible cable, 10 meters	COE-G series, COE-U series, COE HR AS-X series
COE-6P-OPEN2-150	HIROSE 6-pin/Open end super flexible cable, 15 meters	COE-G series, COE-U series, COE HR AS-X series
COE-6P-OPEN2-300	HIROSE 6-pin/Open end super flexible cable, 30 meters	COE-G series, COE-U series, COE HR AS-X series
COE-12P-OPEN1-030	HIROSE 12-pin/Open end cable, 3 meters	COE HR AS-X series
COE-12P-OPEN1-050	HIROSE 12-pin/Open end cable, 5 meters	COE HR AS-X series
COE-12P-OPEN2-030	HIROSE 12-pin/Open end super flexible cable, 3 meters	COE HR AS-X series

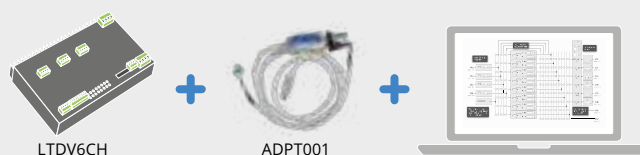
Cables

ADPT001

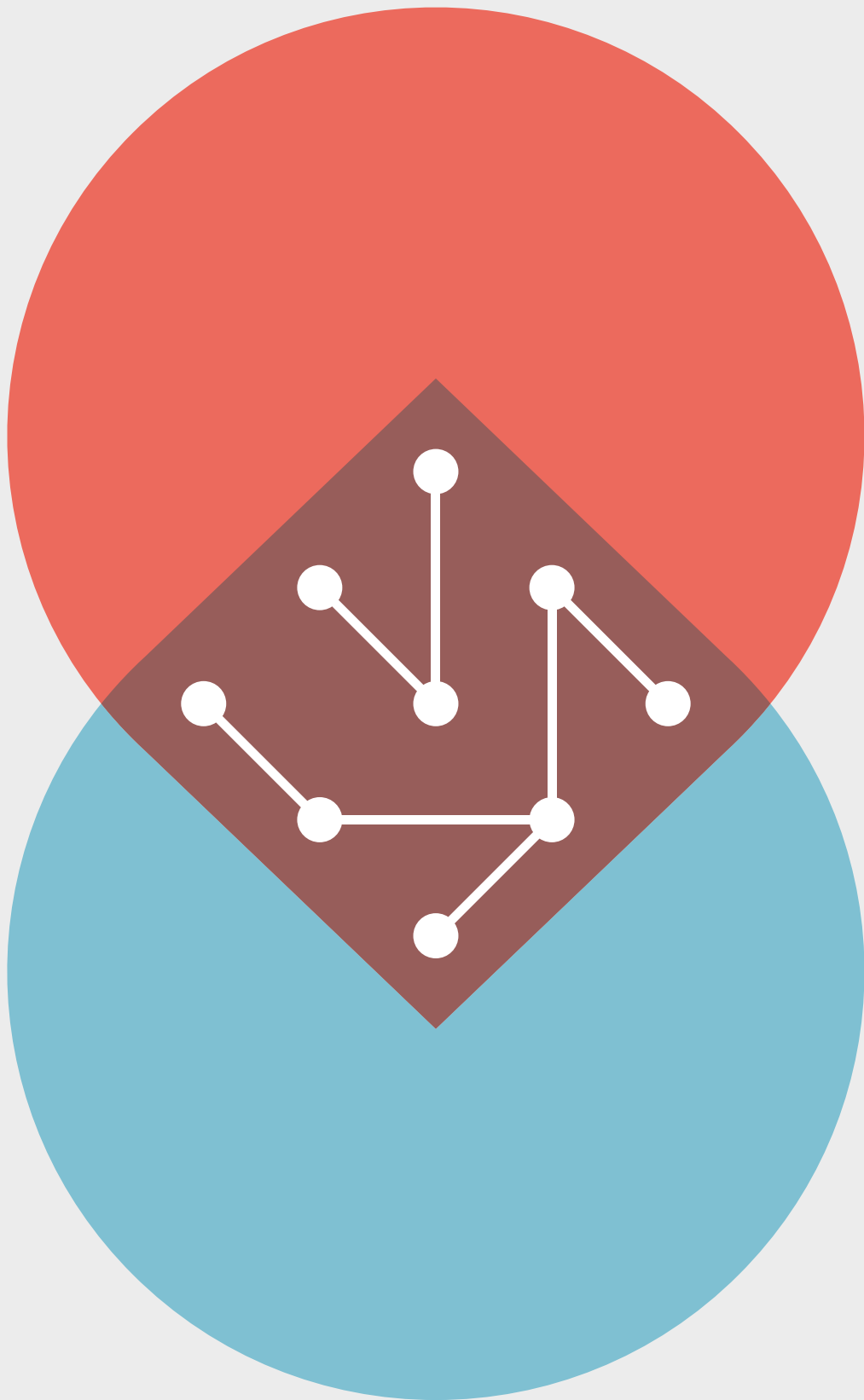
Adapter RS485-USB + cable with 3 elements for LTDV6CH connection



Product combination




Part number	Description	Compatibility
ADPT001	Adapter RS485-USB + cable with 3 elements for LTDV6CH connection	LTDV6CH, MTDV3CH-00A1



Refer to specific datasheets available at www.opto-e.com

for product compliancy with regulations, certifications and safety labels.

AI VISION UNITS



Nowadays vision systems come in all shapes and sizes in order to suit the largest number of applications. At their core, all vision systems share the same building blocks: cameras and optics to capture images of the object under inspection, lighting devices to optimally illuminate the part, specific imaging software and a processing unit. Through the years, and thanks to its long time experience in manufacturing and marketing high quality imaging components, Opto Engineering® has identified very specific needs concerning machine vision systems: as a general tendency, many industries require new vision systems to be adaptive, so that they can be quickly repurposed to inspect new products.

They also have to be easy to use, so that an experienced engineer is not necessarily needed for programming and maintenance. One of the most recent tools in Machine Vision that helps us accomplish these goals is Artificial Intelligence. Opto Engineering® has been a pioneer in introducing AI to the Machine Vision industry, first with ALBERT - a self learning, turnkey vision system dedicated to the needs of the food industry - then with PENSO®, an AI-based computational unit which can be interfaced to endless combinations of cameras, lenses and illuminators. Artificial intelligence and statistical inference are the keywords for an easy, fast and reliable approach to the most recent challenges of the Machine Vision world - always keeping in mind the same principle that drives the development of all our products: “simple works better”.

PENSO®

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ALBERT

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PENSO®

The artificial intelligence-based vision unit



KEY ADVANTAGES

Works where all the others fail

PENSO® is designed to work on unpredictable variations and defects, as well as on objects difficult to model or without a golden reference.

Fast configuration, even faster prototyping

PENSO® full configuration requires hours, not weeks and produce feasibility studies in minutes, not days, without any programming required.

Adapts easily to the real working conditions

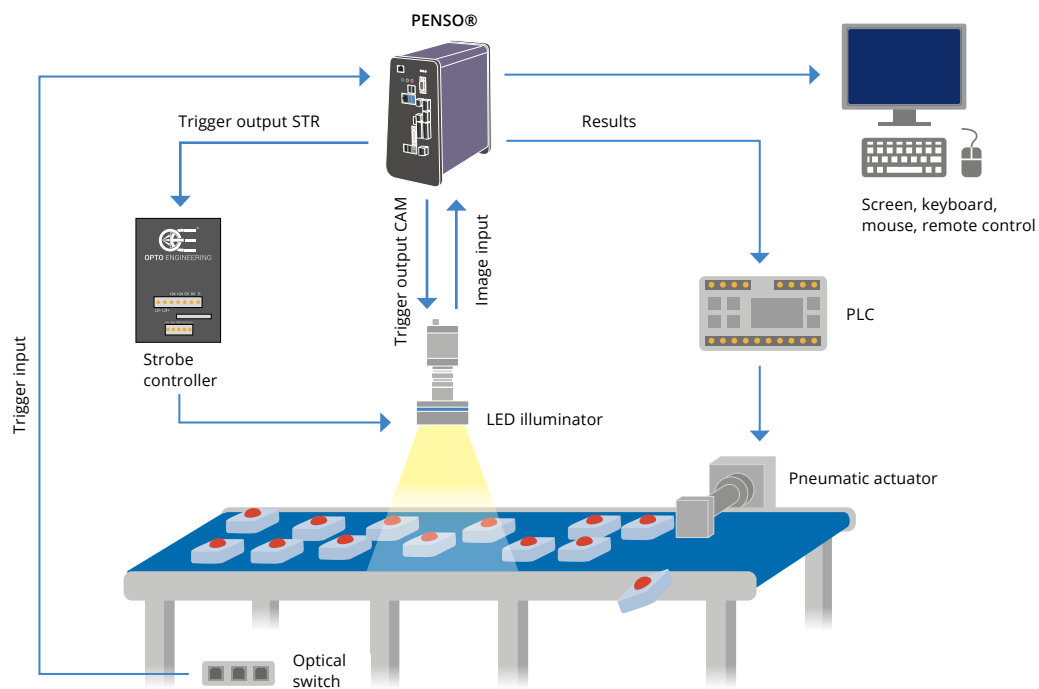
PENSO® helps the consistency of the inspection process by autoadjusting to changes on working conditions, self-learning from the ongoing process.

PENSO® is an artificial intelligence computational unit for imaging applications.

PENSO® self-learns the expected features of an object by simply looking at a small series of samples, regardless of the possible presence of defective product in the midst. Once trained, PENSO® will start operating autonomously and warning you if something unwanted happens.

Object modeling, often very difficult or even impossible is therefore no longer needed; moreover, you are not asked to define possible object variations or defects from the beginning, usually impossible.

Instead, as a human operator would do after observing some samples, PENSO® understands what will be considered normal and acceptable from now on. Since neither modeling or programming is needed, with just some elementary configuration tools you can immediately understand if an application is feasible or not and really save a lot of time. Then, with minimum additional effort, you can fine tune the application and make it fully working.



Installation

PENSO® is extremely easy to install: you simply need to connect the input (camera, keyboard/mouse etc.) and output (synchronization signal, OK/NOK signal, etc.) and provide 24V DC. The basic settings are extremely simple and fast: image brightness, color correction, focusing and segmentation (i.e. is the process

of separating the product to be inspected from the background) are assisted by convenient software tools. The interaction with PENSO® is possible at all time through standard physical interfaces (keyboard, mouse and screen) or remotely, integrating PENSO® within the local network.

Learning

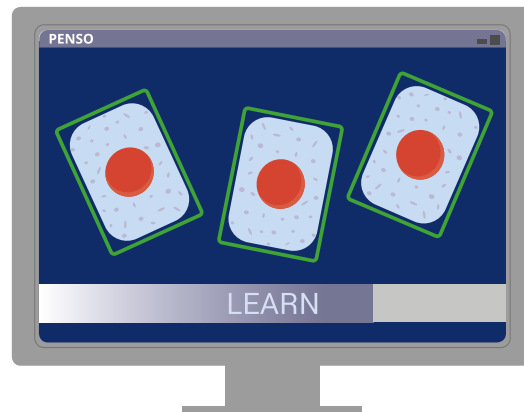
The **learning** process is easily performed by presenting some products on the production line and activating PENSO® in "LEARN" mode during normal operation.

Unlike traditional vision units, PENSO® autonomously learns the characteristics of your production in a few minutes: it is normally sufficient to present a few tens or a few hundreds of products during production to allow PENSO® to learn their characteristics without complicated settings.

PENSO® can tolerate up to 20% defective products during the learning phase, without affecting its ability to sort products correctly. PENSO® will be ready to check your production once the status bar is full.

Moreover, whenever the goods on your production line change or anytime you want to adjust your quality control process to new production parameters, you can just press the "LEARN" button and PENSO® will adjust itself accordingly.

Even during the learning phase, PENSO® continues to monitor production, quickly adapting to the new inspection criteria without having to stop the line: no other vision system is so flexible and easy to configure.



PENSO® in "LEARN" mode.

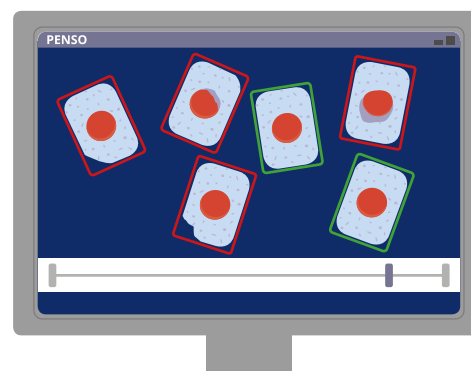
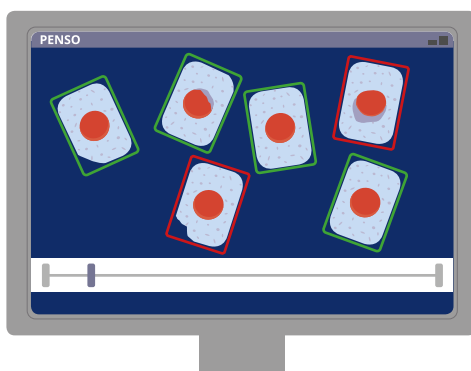
Sorting

Once the learning process is complete, PENSO® is ready for the sorting phase or "CHECK" phase: the products deemed inconsistent with the desired level of quality are reported and can be rejected from the line by interfacing PENSO® with most common ejection systems thanks to the preinstalled opto-isolated outputs.

PENSO® can store images of defective products, also keeping track of the reasons for rejection: this data can then be analyzed to improve the production process.

You can also adjust the "severity" level of the control parameters without having to stop the line. A dedicated slider bar allows the user to loosen or tighten the sorting criteria, quickly and easily adjusting PENSO® to new quality parameters.

PENSO® also allows a higher level of control: we can decide which features describing the object color and shape are taken into consideration by PENSO®, and how much PENSO® will consider them critical for the final decision (weight), all done in real time.



PENSO® set to low (left) or high (right) severity level.

PENSO® is successfully applied in many imaging applications. Here are some of the many cases where AI-driven imaging is the key to success.

Color/Mono imaging: Dishwasher tablets



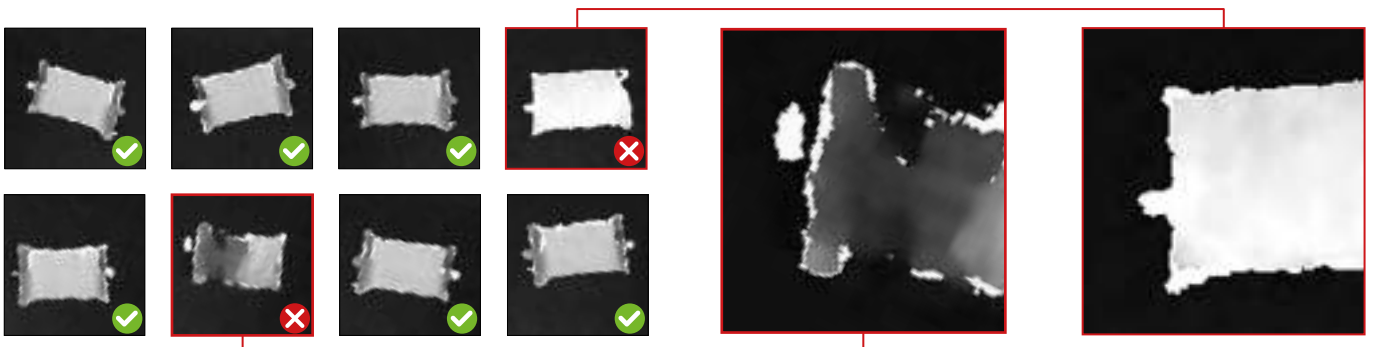
Dishwasher tablets come with natural variations: the density of blue over white soap, the roundness of the red core, etc. Nevertheless, PENSO® sees the defects as deviation from the average product shape or color distribution, exactly the way a human operator would.

Color/Mono imaging: Tealight candles



Inspecting candles is not an easy task: surface features and texture are always slightly different, making it hard to work within the usual deterministic imaging approach. An AI-driven inspection, on the other hand, skips the unimportant details and shows us only what matters!

3D imaging



The typical output of a 3D camera is a monochrome picture of the object, where dark regions are lower and bright regions are higher (height map). In this example, a package with broken or irregular crackers is first detected by PENSO® because of its unusual dark spots, corresponding to the missing chunks. Too many crackers in the package, instead, appear as a uniform brighter-than-average tint, corresponding to the increased height.

Thermal imaging / IR / X-Ray*

PENSO® works with array images, looking at change of shape and color. For this reason, the source of the image does not matter

- from IR application to X-ray vision, if the camera output is a 2D image, PENSO® can process it!

*might require hardware/software customization



SOFTWARE FEATURES

System calibration



When setting up the image for PENSO®, we want to make sure it represents the product as accurately as possible. Therefore, our first step is system calibration: an intuitive tool guides the user through the optimization of focusing, color calibration and light intensity.

Image segmentation



In our second step, we need to tell PENSO® how to separate the object from the surface underneath (segmentation). This goal is also achieved using a simple software tool, which lets us play with intensity thresholding and color differences to quickly and easily get the best result.

Feature extraction management



Once we set our best image and the LEARN process is completed, we can start fine-tuning the sorting process, selecting from a growing number of features the ones that best relate to our specific sorting process. PENSO® will show us in real time how a single feature and its relative importance (weight) contributes to the overall choice between OK and NOK sample.

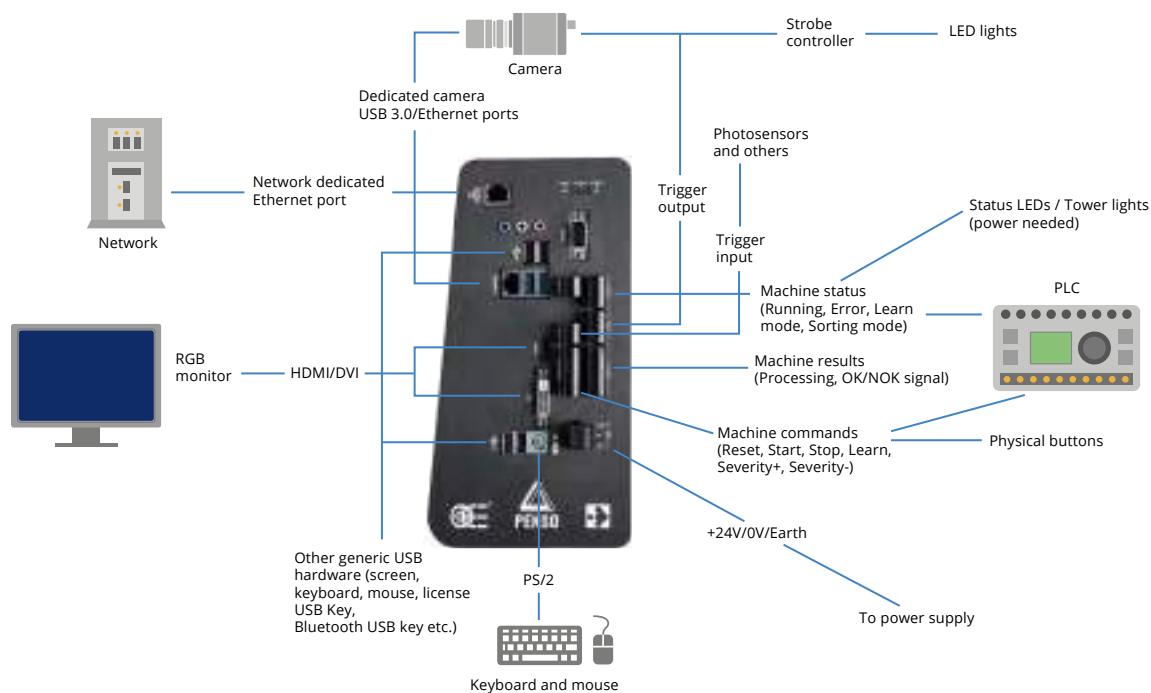
*Do you need a non-standard feature? We'll create it for you!
Contact us to know about customized filters in PENSO®.*

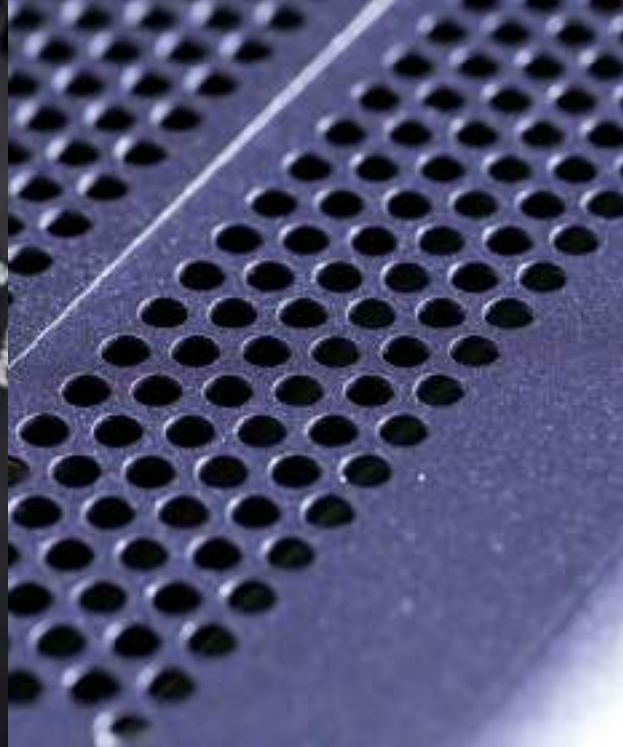
TECHNICAL SPECIFICATIONS

Model		PENSO-01
Description	Artificial Intelligence-based Vision Unit	
Application	In-line inspection	
Camera ¹	Matrix Vision up to 5 MPx , 3D cameras (see Accessories)	
Number of parts per second ²	20	
LED indicators	Power, Status and Error	
N° of storable images ³	≈ 800K	
Ports		
Input		
Synchronization input	2, opto isolated, common reference	
Commands	6, opto isolated, common reference	
Output		
Status	4, opto isolated, common reference	
Synchronization output	2 strobe trigger, opto isolated, common reference, 1 camera trigger, opto isolated	
Results	6, opto isolated, common reference	
Elaborated	1, opto isolated	
Communication		
USB 3.0	2 (dedicated camera)	
Ethernet	1 (dedicated camera) + 1	
RS232	1	
RS485	1	
USB 2.0	4	
1 PS/2	1 (keyboard and mouse)	
HDMI	1	
DVI	1	
Power Requirements		
Voltage	V, DC	24 ± 5%
Maximum power consumption	W	100
Mechanical specifications		
Width W	mm	128
Length L	mm	230
Height H	mm	226
Weight	Kg	2.5
Material	Aluminium	
Mounting	DIN mount	
Environment		
Operating temperature	°C	10-40
Storage temperature	°C	0-50
Humidity	20-85% (with no condensation)	
IP class	no IP class	
Installation	indoor use only	

- ¹ Non-standard cameras available upon request (customization).
² Estimated value. The number of inspected parts per second may vary depending on image resolution, line speed and number of activated features.

- ³ Estimated value based on 250 Kbytes images stored in 200 GB SSD memory.





ACCESSORIES AND COMPATIBLE PRODUCTS

Power supply

RT-DRT-240-24	DIN rail power supply 400V AC three-phase - 24V DC 240 W
RT-DRP-240-24	DIN rail power supply 240V AC - 24V DC 240 W
RT-70261132	Power cord with schuko plug - open end cable, 3 m 10A 250V, single-phase

Cameras

RT-mvBC-X102eC	CMOS camera GIGE, 1280 x 1024 color, 1/1.8", 60 Hz, IR cut, C-mount, I/O
RT-mvBF3-2032aC-1112	CMOS camera USB3, 2064 x 1544 color, 1/1.8", 55 Hz, IR cut, C-mount, with I/O
RT-mvBC-X104iC	CMOS camera GIGE, 2064 x 1544 color, 1/1.8", 37 Hz, IR cut, C-mount, I/O
RT-mvBF3-2051aC-1112	CMOS camera USB3, 2464 x 2056 color 2/3", 35.6 Hz, IR cut, C-mount, with I/O
RT-mvBC-X105bC	CMOS camera GIGE, 2464 x 2056 color sensor, 2/3", 23.5 Hz, IR cut, C-mount, I/O
STLTCM01	3D Structured-light Camera, 0.6-8.0 m range, USB 2.0

Optics

EN2MP0814	Megapixel lens, focal length 8 mm, f# 1.4-C, C-mount
EN2MP1214	Megapixel lens, focal length 12 mm, f# 1.4-C, C-mount
EN2MP1614	Megapixel lens, focal length 16 mm, f# 1.4-C, C-mount
EN2MP2514	Megapixel lens, focal length 25 mm, f# 1.4-C, C-mount
EN2MP3514	Megapixel lens, focal length 35 mm, f# 1.4-C, C-mount
EN2MP5018	Megapixel lens, focal length 50 mm, f# 1.8-C, C-mount

Lighting components - Strobe

LTLAB2-W	Diffusive strobed low angle ring light illuminator - medium size high power white
LTBP048216-W	High power strobed LED backlight, 48 x 216 mm lighting area, white
LTDMB2-W	Diffusive strobed dome illuminator - medium size high power white
LTDV1CH-17V	Strobe controller 1 channel variable current 5 mA - 17A
LTDV6CH	Strobe controller 6 channels

Lighting components - Continuous

LTZGK090-00-4-W-24V	LED ring light, 4 LED rows, outer diameter 92 mm, 0°, white, 24V
LTZPFL200-00-6-W-24V	LED bar light, 6 LED rows, 200X26.3 illumination area, white, 24V
LT4WRG150-00-1-W-24V	LED dome light, 185 mm outer diameter, white, 24V
LTCGR1000-D1	Analogue lighting controller unit, 1 channel, 24V, 2A, constant mode, power adaptor 24V plug
DFLTZGK090-00-4	Diffuser for LED ring light, 4 LED rows, outer diameter 92 mm, 0°
DFLTZPFL200-00-6	Diffuser for LED bar light, 6 LED rows, 200X26.3 illumination area
CBSLH-24V-F-3M	Illumination cable, side A flying leads, side B SM 3 way female connector, 24V - 3 m

Cables

CBUSB3001	Passive USB 3.0 cable, industrial level, horizontal screw locking, 3 m
CBGPI0001	I/O cable, side 1 HIROSE 12 pin, side 2 cable end, 3 m
CBETH003	Ethernet cable, CAT6, industrial level, high flexible cable with screw, 5 m
CBUSB20ACT01	Active USB 2.0 cable, industrial level, screw locking, 10 m

Other

RT-WTB9-3P246	Background suppression sick photoelectric sensor 20 - 350 mm detection range, PNP output, block style
RT-10060911	Set of 2 8" x 10" white balance/exposure cards - 18% grey and 90% white for color calibration

ALBERT

Self-learning vision system based on artificial intelligence



ALBERT

KEY ADVANTAGES

Simple

Learns and assesses the quality of your products directly from the production line without complicated settings.

Intelligent

Independently decides whether a product can be accepted and can control it in a more strict or tolerant way according to different production requirements.

Self-learning

Quickly learns the characteristics of a new product under inspection.

Suitable to identify complex defects

Is capable to understand the quality of products even with complex features and high variability.

IP65 Rated

APPLICATIONS

Ideal to quality check a variety of baked goods such as croissants and cookies but also frozen products, chocolates and various other foods, even when presented in a disorderly manner and with different orientations.

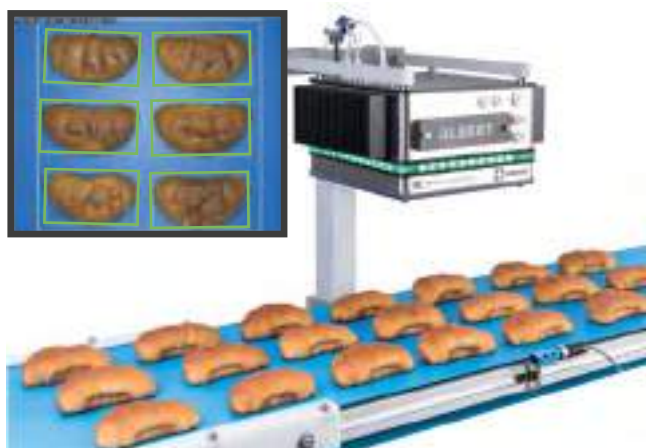
ALBERT is a complete and independent unit for visual inspection, based on the most advanced artificial intelligence techniques.

ALBERT learns the characteristics of a product directly from the production line and **autonomously** assesses its quality. ALBERT is very simple to use and does not require complicated programming procedures by experienced users, so it is quickly ready to control new products with different characteristics.

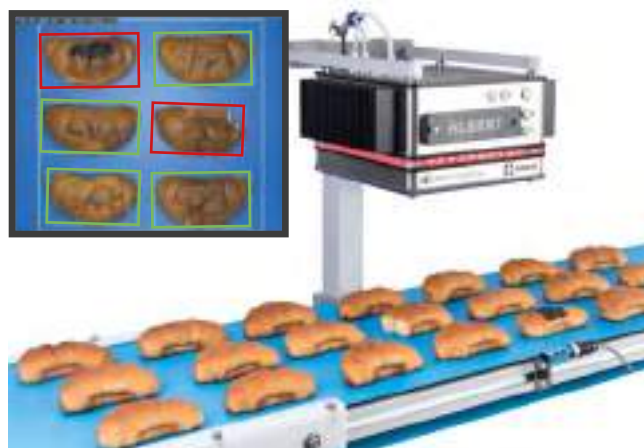
No traditional machine vision system is able to analyze complex objects or products with high variability as **simply** as a human

operator would: ALBERT, on the other hand, interprets the concept of "quality" just like the fastest and most trained of your quality control operators. ALBERT is able to adapt to the production requirements of the moment since its "severity" level can be increased or decreased at the touch of a button, thus loosening or tightening the product acceptance criteria.

Each time, ALBERT chooses autonomously which will be the features to monitor that best describe the quality of your products. At any time and with a simple click, ALBERT can learn how to sort a new product or adapt to changing production conditions.



Inspection of croissants.



Installation

ALBERT is extremely easy to install: just attach it to any mechanical fixture by means of the four threaded holes on top of the unit, making sure to respect the correct working distance from the conveyor belt. Once connected to a 24V power supply, simply press the “ON” button and wait less than a minute for ALBERT to be ready for use.

The basic settings are extremely simple and fast: the process of adjusting the focus and identifying the product to be inspected is assisted by convenient software tools. The interaction with ALBERT is possible both through the physical interfaces on the product or by connecting the unit to a tablet or industrial PC.



There are four M6 holes to mount ALBERT on the production line at the correct working distance. ALBERT can be configured using the buttons on the product or by tablet/PC.

Learning

The learning process is easily performed by presenting some products on your production line and activating ALBERT in “LEARN” mode during normal operation.

Unlike traditional vision systems, ALBERT autonomously learns the characteristics of your production in a few minutes: it is normally sufficient to present a few tens or a few hundreds of products during production to allow ALBERT to learn their characteristics without complicated settings.

ALBERT is able to tolerate up to 10% defective products during the learning phase, without affecting its ability to sort products correctly. ALBERT will be ready to check your production once the status bar is full.

Moreover, whenever the goods on your production line change or anytime you want to adjust your quality control process to new production parameters, you can just press the “LEARN” button and ALBERT will adjust itself accordingly.

Even during the learning phase, ALBERT continues to monitor production, quickly adapting to the new inspection criteria without having to stop the line: no other vision system is so flexible and easy to configure.



ALBERT in “LEARN” mode.



Sorting

Once the learning process is complete, ALBERT is ready for the sorting phase or "CHECK" phase: the products deemed inconsistent with the desired level of quality are reported via an integrated light bar and can be rejected from the line by interfacing ALBERT with the most common ejection systems thanks to the preinstalled opto-isolated outputs.

ALBERT is able to store images of defective products also keeping track of the reasons for rejection: this data can then be analyzed to improve the production process.

You can also adjust the "severity" level of the control parameters without having to stop the line: a dedicated slider bar allows the user to loosen or tighten the sorting criteria, quickly and easily adjusting ALBERT to new quality parameters.



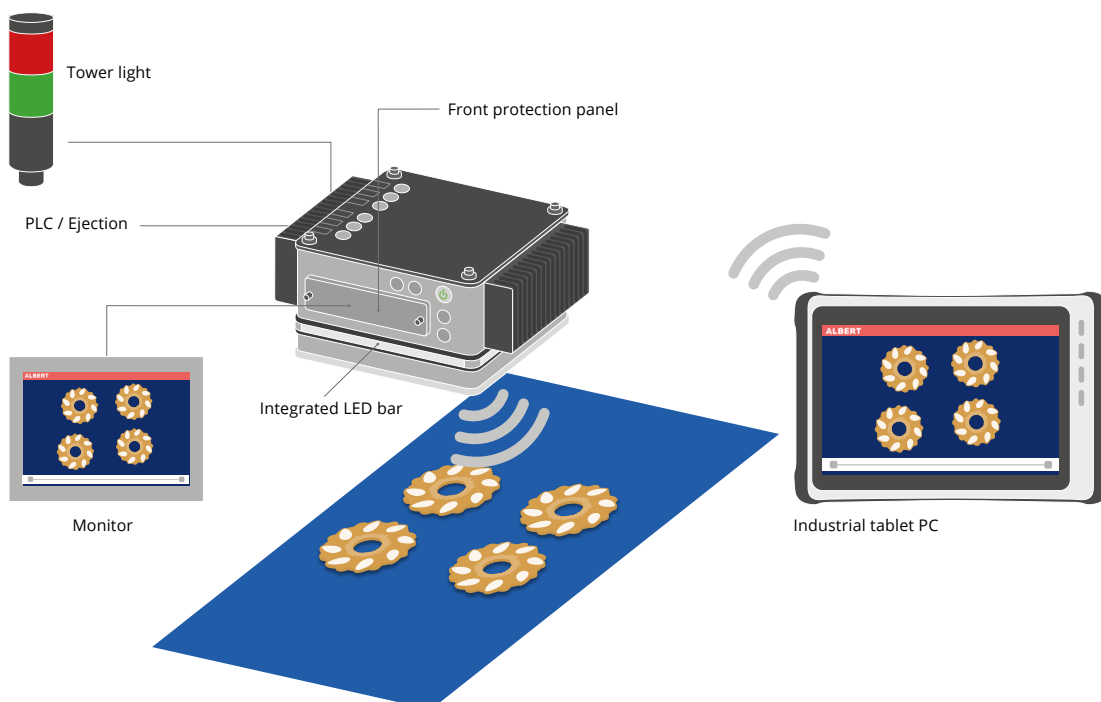
ALBERT set to low (left) or high (right) severity level.

Interface

ALBERT communicates its status through a LED bar that turns red when defective products are detected.

ALBERT is also preset to be interfaced with an industrial tower light already installed on your production line and reports defective products through appropriate output signals that can trigger up to six eject stations.

If you wish to view the images that ALBERT is acquiring, you can do so wirelessly through an industrial tablet PC without losing IP65 rating or by connecting ALBERT to a monitor after removing the front protection panel. Connecting ALBERT to a monitor / tablet PC is also required to adjust the basic settings and to monitor rejection statistics on an external screen.



ALBERT interfaces.

ALBERT is designed to also control products characterized by a high degree of variability and impossible to parameterize through a traditional vision system, specifically in the food industry, but not exclusively. The most typical areas of use are the inspection of baked goods, frozen products, sweets, fish or meat. ALBERT is also ideal for products that are presented in a disorderly manner or with different orientations (provided there's some spacing between them), or whose packaging cannot be represented by a predetermined pattern. In all of these cases, ALBERT makes it possible to control the products avoiding excess scrap or continued assistance by operators experienced in programming.

ALBERT is suitable for use on food lines thanks to the IP65 protection, the adoption of materials compatible with the food industry and the engineering solutions adopted.

Bakery products with variations in color, shape or other attributes

ALBERT is the ideal inspection solution for production lines of bakery products, such as biscuits, where traditional vision systems fail because product acceptance is not determined by a single

parameter but is rather a combination of multiple subjective variables.



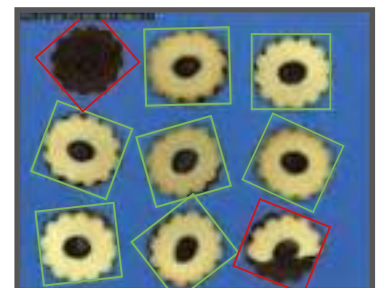
Works with a variety of conveyor belts including mesh or white.

Inspection of cookies.

ALBERT learns to know your production

Due to continuous and genuine changes in products such as chocolate or shortcrust pastry, no traditional on-line vision system is able to quickly learn and properly inspect this type of products like ALBERT does.

In fact, ALBERT can learn the natural change in color of the ingredients of a new batch in less than 5 minutes without the need to adjust complicated parameters each time.



Zoomed in image.

Inspection of shortcrust pastry.

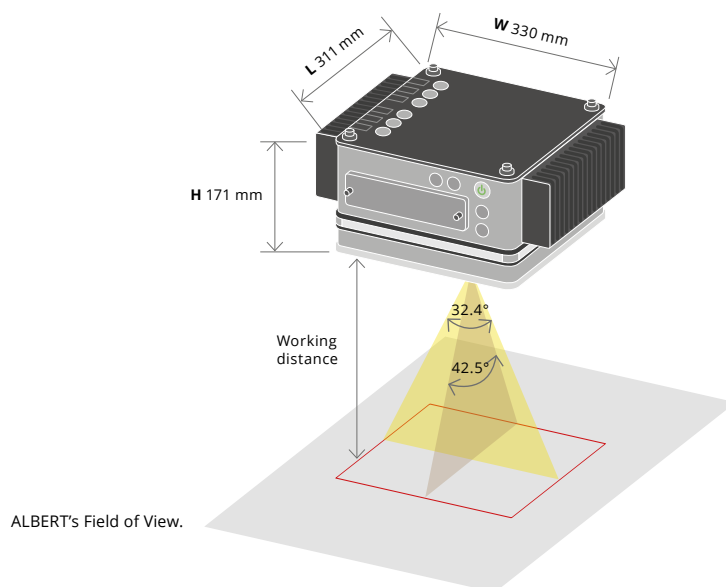
Frozen products with variations in color, shape or ingredients

The acceptance criterion for frozen products is often a complex combination of many parameters. Unlike traditional vision systems, ALBERT is flexible and quickly learns the characteristics of products

such as frozen pizzas, semi-finished meat or fish products, allowing you to loosen or tighten the sorting parameters by simply adjusting a dedicated slider bar on the main interface.



TECHNICAL SPECIFICATIONS



Model

ALBERT-01

Description		Self-Learning Vision system based on artificial intelligence		
Application		In-line inspection		
		Working distance (mm) 1		
		460	900	1350
Field of View	mm x mm	400 x 295	800 x 590	1200 x 890
Minimum Working Distance	mm		100	
Optics		8 mm f1.4-f16 with manual focus adjustment		
Lighting system		LED diffuse strobe illuminator, 5700 K white		
Line speed 2	m/s		≈ 1	
Number of parts per second 3			20	
LED indicators		Yes (STATUS and SEVERITY LEVEL)		
N° of storable images 4			≈ 800K	
Ports				
Input				
Synchronization input		1, opto-isolated (on top of the unit)		
Output				
for tower light		2 lights, 1 siren (on top)		
for ejector (s)		6, opto-isolated (on top)		
Synchronization output		1, opto-isolated (on top)		
Communication				
Ethernet		2 (on top)		
Wireless		Wi-Fi (802.11n)		
USB 3.0		4 (front of the unit)		
HDMI		1 (front)		
DVI		1 (front)		
Power Requirements				
Voltage	V, DC	24 ± 5%		
Maximum power consumption	W	150		
Cable		CBPWALB01 length 5 m IP68 (included)		
Mechanical specifications				
Width W 5	mm	330		
Length L	mm	311		
Height H	mm	171		
Weight	kg	10		
Material		AISI304 stainless steel, anodized aluminum, scratch resistant polycarbonate (Lexan Margard®)		
Mounting		4X M6 holes (optional mounting accessories available)		
Environment				
Operating temperature	°C	10-40		
Storage temperature	°C	0-50		
Humidity		20-85% (with no condensation)		
IP class		65		
Installation		indoor use only		

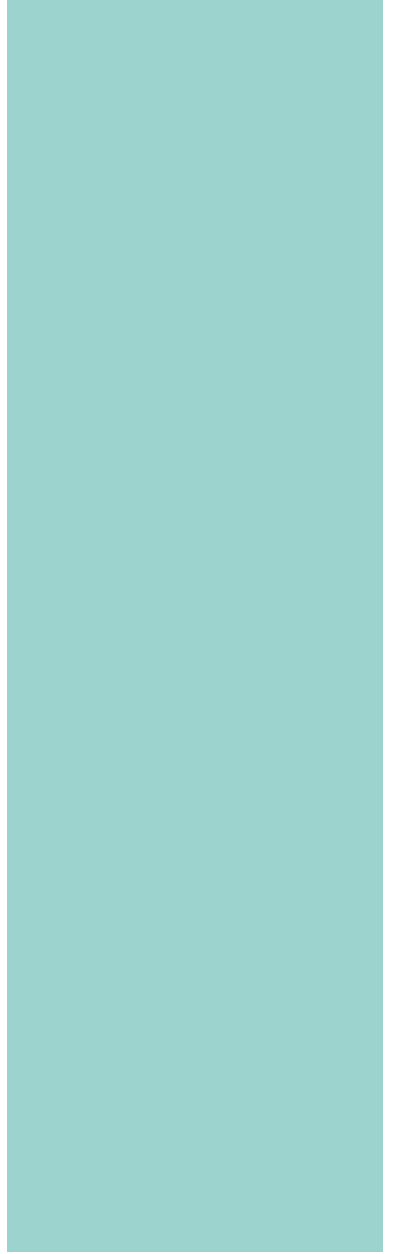
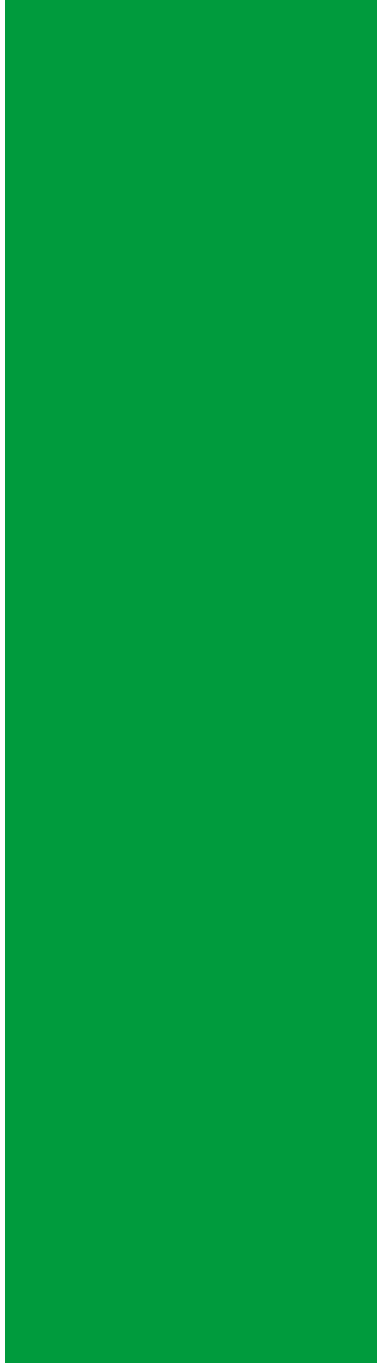
1 Example values. Working distance must be set based on: size of the area to be imaged, size and number of pieces to be imaged and **type of control required**.

2 Approximate value. Higher speeds are possible. Please contact us to check compatibility with your production line.

3 Estimated value. The number of inspected parts per second may vary depending on their size and the speed of the line.

4 Estimated value based on 250 Kbytes images stored in 200 GB SSD memory.

5 Wireless antenna included.



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

KITS

Every machine vision lab needs a wide variety of high quality lenses, lights, cameras and accessories to perform feasibility tests.

Our kits include a selection of our best-selling products available at a special price: you should seriously consider to buy these kits for your laboratory to accurately perform feasibility tests with different types of machine vision components.

Opto Engineering® kits are the best solution for everyone frequently dealing with new machine vision applications requiring different type of products.

OEMV STARTER KIT

Machine vision starter kit for beginners

NEW

The OEMV Machine Vision Starter Kit is ideal for users who are fairly new to machine vision and would like to learn how to solve simple vision tasks. It is also suitable for university labs that need a basic set of machine vision products for experimental use.

The Starter Kit includes all the essential components needed to solve different vision tasks: an intuitive but powerful machine vision software, 5 MP industrial camera, 5 MP fixed focal length lenses, 4 different LED illuminators and all of the relevant accessories.

Together with the kit, you will also gain free access to a one-day Machine Vision Training Class held by our Tech Specialists in one of our local labs. The class will allow you to learn the fundamentals of machine vision technology and make the the most out of your newly purchased kit!

KEY ADVANTAGES

Learn from the Opto Engineering's Experts

1 day of training with our Tech Specialists to learn the fundamentals of Machine Vision.

Smart Investment

This attractively priced kit will serve you for years to come!

Intuitive image processing software

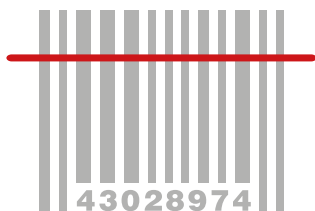
Data-flow based system with no low-level programming knowledge required.

Complete Package

With all the essential components available at hand, you can start develop applications in no time.

This **OEMV Starter Kit** can help you solve many different types of vision tasks, such as defect detection, shape recognition, barcode reading, OCR, color check, counting, presence / absence detection... etc.

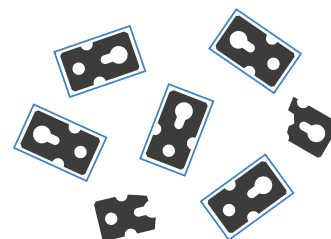
Application examples



Barcode recognition.



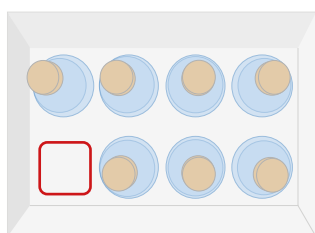
Color sorting.



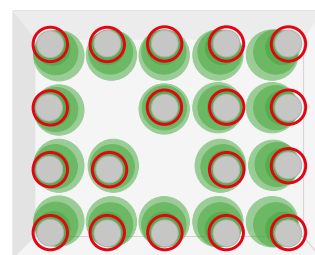
Object identification.



Liquid level inspection.



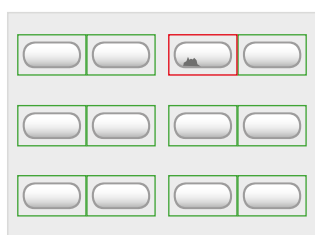
Presence/Absence.



Counting.



OCR - OCV



Defect Detection.



Packaging / labeling inspection.

Part number	Product type	Kit content	Description
MVKIT-STR	SOFTWARE	FIS-PRO	FabImage® software
		USB-DONGLE-FI	USB Dongle for software
	CAMERAS	COE-050-M-USB-050-IR-C	Area Scan camera, 2/3", 5 Mpix USB, B/W
	LENS	EN5MP1616 1	Fixed focal length lens for 5 MP camera, focal length 16 mm
		EN5MP2514 1	Fixed focal length lens for 5 MP camera, focal length 25 mm
	ILLUMINATORS	LTZGK100-15-5-W-24V 2	LED ring light, 5 LED rows, outer diameter 103 mm, 15°, white, 24V
		LTZZO130-75-3-R-24V 2	LED low angle ring light, 3 LED rows, outer diameter 131 mm, 75°, red, 24V
		LT5WRG200-00-1-W-24V 2	LED dome light, 232 mm outer diameter, white, 24V
		LTPVR100-00-1-R-24V 2	Flat side-emitting LED backlight, 100x100 mm illumination area, red, 24V
	ACCESSORIES	CMLT5WRG200-00-X	Bracket for LED dome light, 232 mm outer diameter
		DFLTZZO130-75-3	Illumination diffusers for LTZZO130-75-3-R-24V
		DFLTZGK100-15-5	Illumination diffusers for LTZGK100-15-5-W-24V
		LTICGR1000-D1-PS-XX 3	Lighting Controller
		CBSLH-24V-F-3M	Illuminator cable
CBUSB3001		Camera USB cable	

1 Can be replaced with EN5MP1216, EN5MP3514, EN5MP5018.

2 Can be replaced with White, Red, Blue, Green light.

3 Available with -EU, -UK or -US plug.

OEMV LAB KIT

Machine vision advanced kit for experts

NEW



The **OEMV Machine Vision Lab Kit** is suitable for experienced machine vision users that would like to better equip their vision labs and perform advanced feasibility studies in house prior to designing a machine vision system.

The OEMV LAB KIT includes an extremely powerful and intuitive machine vision software, a 12 MP industrial camera, 5 high resolution fixed focal length lenses and a 50 mm FoV Telecentric lens, in addition to 5 different LED illuminators and a 4-channel ethernet controller to tackle the most challenging vision applications.

Together with the kit, you will also gain free access to a one-day Machine Vision Advanced Training Class held by our Tech Specialists in one of our local labs. This class will allow you to deepen your knowledge of machine vision techniques and to discuss how to solve advanced applications directly with our Experts.

KEY ADVANTAGES

Learn from the Opto Engineering's Experts

1 day of advanced training with our Tech Specialists to deepen your knowledge of Machine Vision.

Complete bundle for high resolution applications

Includes 12 MP camera, 5 high resolution lenses and 1 high resolution 50 mm FOV Telecentric lenses.

Intuitive image processing software

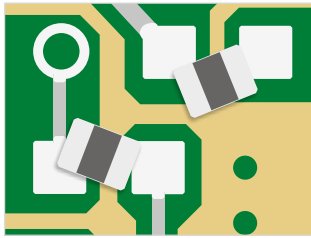
Data-flow based system, no low-level programming knowledge required.

Smart Investment

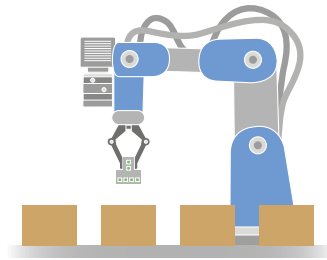
Solve advanced applications in a breeze and your investment will be repaid in no time.

The **OEMV Lab Kit** is ideal for more complex vision tasks including inspection of highly reflective samples, robotic pick and place, detection of minute defects, high accuracy gauging, 3D measurement... etc.

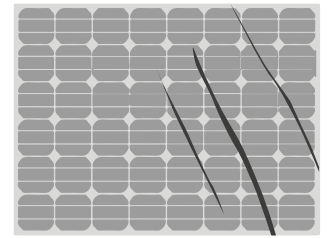
Application examples



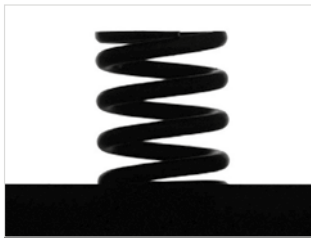
PCB parts inspection.



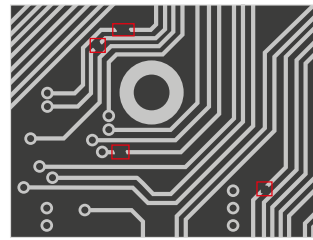
Robot guidance for fast pick and place.



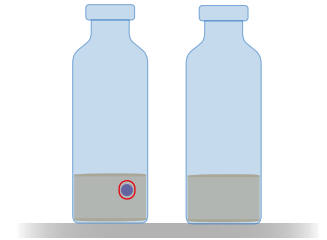
Surface inspection.



High accuracy measurement with Telecentric lens.



Defect detection.



Particle Detection.

Part number	Product type	Kit content	Description
MVKIT-LAB	SOFTWARE	FIS-PRO	FabImage® software
		USB-DONGLE-FI	USB Dongle for softwarez
	CAMERAS	COE-123-M-POE-080-IR-C	Area Scan camera, 1.1", 12 Mpixel, GigE, B/W
	LENS	EN10MPL1220	Fixed focal length lens for 12 MP camera, focal length 12 mm
		EN10MPL1620	Fixed focal length lens for 12 MP camera, focal length 16 mm
		EN10MPL2520	Fixed focal length lens for 12 MP camera, focal length 25 mm
		EN10MPL3520	Fixed focal length lens for 12 MP camera, focal length 35 mm
		EN10MPL5020	Fixed focal length lens for 12 MP camera, focal length 50 mm
		TC3MHR048-C	High resolution telecentric lens for 1.1" detectors, magnification 0.303x, C-mount
	ILLUMINATORS	LTRN048NW 1	Ring LED illuminator, inner diameter 75 mm, straight type, white
		LTZZO130-75-3-R-24V 1	LED low angle ring light, 3 LED rows, outer diameter 131 mm, 75°, red, 24V
		LT5WRG200-00-1-W-24V 1	LED dome light, 232 mm outer diameter, white, 24V
		LT2QOG070-00-X-W-24V 1	LED coaxial light, 70x70 mm light emitting area, white, 24V
		LT2BC096072-G 1	High uniformity continuous LED backlights, 96 x 72 mm x mm, green, 525 nm
	ACCESSORIES	FTBP470M40.5	Blue (470 nm) bandpass filter with M40.5 mount for fixed focal length lenses.
		FTBP525M40.5	Green (525 nm) bandpass filter with M40.5 mount for fixed focal length lenses.
		FTBP635M40.5	Red (635 nm) bandpass filter with M40.5 mount for fixed focal length lenses.
		RT-PR032-40.5	Linear polarizer filter. Mount Thread M40.5 x P 0.5
		CMHO048	Clamping mechanics for TCxx048 lenses and LTCLHP048-X illuminators
		CMLT5WRG200-00-X	Bracket for LED dome light, 232 mm outer diameter
		RT-POE21U-1AF	56V Power Over Ethernet (POE) 1 mid-range Injector Port 10/100/1000 Mbps Data Rate
		RT-SDR-75-12	DIN Rail Power Supplies 75.6W 12V 6.3A DinRail Power Supply
		CBETH003	Ethernet cable, CAT6, industrial level, high flexible cable with screw, 5 m
		COE-6P-OPEN1-030	HIROSE 6-pin/Open end cable, 3 meters
		LTDVE4CH-20	Strobe controller 4 channels
		RT-70261132 2	Power cord
		RT-SDR-120-24	Power supply
		CBSLH-24V-F-3M	Illumination cable, side A flying leads, side B SM 3 way female connector, 24V - 3 m
CBSLH-24V-F-3M-TB		Illumination cable, side A SM 3 way male connector, side B terminal blocks connector, 24V - 3 m	

1 Can be replaced with White, Red, Blue, Green light.
 2 Different part number available for -UK, -US or -CN plug.

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 centres that are frequently dealing with new machine vision applications.

The TCKIT case also benefits from our special educational price: you should seriously consider buying 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

FULL RANGE OF COMPATIBLE ACCESSORIES

	CMHO series clamping mechanics	p. 248
	LTDV1CH-17V strobe controller	p. 252

FULL RANGE OF COMPATIBLE CAMERAS

	Area scan cameras	p. 188-203
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DID YOU KNOW?

TCKIT case is now also available with new LTSCHP1W-GZ **green** light source, suitable for any kind of sample and specifically tailored for measuring reflective objects and objects with sharp edges.

KEY FEATURES

- **Reduction of edge diffraction effects**
- Enhanced **illumination uniformity**, especially on large FOVs
- Less sensitive to **alignment**



Ordering information

To order the version with the new green LED module use p/n **TCKIT-0-GZ**.

LTPKIT-A

Starter high power LED lighting kit, A version

NEW



Opto Engineering® **LTPKIT-A** LED lighting KIT includes a selection of some of our best-selling LED illuminators and a high-performance LED controller. Specifically:

- A LED backlight ideal for shape inspection and measurement applications
- A LED illuminator that combines a dome light and a low angle ring light. The dome light homogeneously illuminates complex shapes with curved and shiny surfaces while the diffused ring light provides darkfield lighting that can be used to cast shadows, greatly emphasizing surface irregularities or scratches of the workpiece
- A LED line light that provides both a powerful and uniform beam of light that is sharply focused onto the object being inspected, by means of a condenser lens.
- A high-performance LED strobe controller ideal for high precision machine vision applications. The controller features 2 independent channels, 2 trigger inputs and 2 synchronization outputs, output currents up to 40A in strobe mode and up to 4A in continuous mode*, Ethernet/RS485 interfaces and easy configuration via Web browser.

This LED lighting kit is a very helpful tool for system integrators that are frequently dealing with new machine vision applications requiring different type of lights and high precision control of the timing.

The LTPKIT-A also benefits from a special price: you should seriously consider to buy this kit for your laboratory to accurately perform feasibility tests with different types of lights.

Part number	Products included	Description
LTPKIT-A	LT2BC096072-W	LED backlight, 96 x 72 mm lighting area, white
	LTLC100-W	LED line light 100 mm, white
	LTDMLAB2-WW	Dome + low angle illumination system - medium size high power white
	LTDVE2CH-20F	LED Strobe controller 2 channels, 20A/40A pulsed - 2A/4A continuous, fast version

*When used in "Special current sharing mode". See LTDVE2CH-20F manual for further details.








LTPKIT

High power lighting kit



The **LTPKIT** is a selection of some of the Opto Engineering® high-power LED lighting solutions, including three different strobe illuminators and an ultra-bright strobe LED pattern projector. The case also includes a 6 channel strobe controller, designed to precisely control the lights and easily manage the trigger signals, in addition to a DIN rail industrial power supply.

This versatile and portable light kit is ideal for system integrators dealing with machine vision applications that require high power strobe illumination. The LTPKIT also benefits from our special educational price: you should seriously consider buying one for your laboratory to discover the advantages of our strobe lights!

Part number	Products included	Quantity	Description
LTPKIT	 LTLAB2-W	1	Diffuse strobe low angle ring light illuminator - medium size high power white
	 LTDMLAB2-W	1	Diffuse strobe dome + low angle illumination system - medium size high power white
	 LTBP096072-W	1	High power strobe LED backlight, 96 x 72 mm lighting area, white
	 LTPRUP-W	1	90W strobe LED pattern projector white
	 LTDV6CH	1	Strobe controller 6 channels
	 RT-SDR-120-24	1	24VDC DIN rail power supply
	 ADPT001	1	Adapter RS485-USB + cable with 3 elements for LTDV6CH connection

LTKITRY-FH-OR-V1

Continuous lighting kit



Opto Engineering® **LTKITRY-FH-OR-V1** case includes a selection of some of our commonly used LED illuminators working in continuous mode, including two lighting controllers for dimming, brackets and diffusers.

The continuous lighting kit case is a very helpful tool for system integrators that are frequently dealing with new machine vision applications requiring different type of lights.

The LTKITRY-FH-OR-V1 case also benefits from our special educational price: you should seriously consider to buy this kit for your laboratory in order to be able to perform feasibility tests with many different types of lights!

Part number	Products included	Quantity	Description
LTKITRY-FH-OR-V1	 LTICGR1000-D1-PS-EU	2	Analogue lighting controller unit, 1 channel, 24V, 2A, constant mode, EU power cord, power adaptor 24V plug
	 LT4WRG100-00-1-W-24V	1	LED dome light, 118 mm outer diameter, white, 24V
	 LT2QOG040-00-X-W-24V	1	LED coaxial light, 48 x 48 mm light emitting area, white, 24V
	 LTZPFL160-00-6-W-24V	1	LED bar light, 6 LED rows, 160x26.3 illumination area, white, 24V
	 LTZGK070-15-3-W-24V	1	LED ring light, 3 LED rows, outer diameter 70 mm, 15°, white, 24V
	 LTZGK070-45-3-W-24V	1	LED ring light, 3 LED rows, outer diameter 70 mm, 45°, white, 24V
	 LTZZO130-75-3-W-24V	1	LED low angle ring light, 3 LED rows, outer diameter 131 mm, 75°, white, 24V
	 LTPVR070-00-1-W-24V	1	Flat side-emitting LED backlight, thin borders, 70 x 70 mm illumination area, white, 24V
	 LTPVR070-00-1-W-24V	1	Flat side-emitting LED backlight, 70 x 70 mm illumination area, white, 24V
	 LT2RZF100-60-2-W-24V	1	LED ring light, 2 LED rows, 100 mm outer diameter, 60°, white, 24V
	Diffusers	-	Diffuser for LTZGK070-15-3, LTZGK070-45-3, LTZZO170-75-3
	Brackets	-	Brackets for LT4WRG100-00-1, LT2QOG040-00-X, LTZPFL160-00-6
	Polarizer	1	Polarizer for LTZPFL160-00-6

PENSO® KIT case

Artificial Intelligence for machine vision - starter kit



PENSO® KIT case includes a selection of Opto Engineering® components that will easily allow you to bring Artificial Intelligence into your applications.

This versatile kit is ideal for system integrators that are frequently dealing with new, challenging inspection processes. Artificial Intelligence can be an extremely powerful resource; therefore, it is extremely important to have quick access to it for testing, feasibility studies and demonstrations.

The kit contains PENSO®, our innovative artificial intelligence-based vision unit, together with all necessary hardware to set it up: power supply, proximity sensor, color camera, 3D camera, lens, illuminator, strobe controller, cables and mounting mechanics. Saving time from choosing all the necessary individual components, a kit offers an ideal development tool at a bundle pricing.

Get the PENSO-KIT now, and start discovering the advantages of Artificial Intelligence!

Part number	Products included	Description
PENSO-KIT	PENSO-01	Artificial Intelligence-based Vision Unit
	RT-DRP-240-24	DIN rail power supply 240V AC - 24V DC 240 W
	RT-70261132	Power cord with schuko plug - open end cable, 3m 10A 250V, single-phase
	RT-mvBF3-1013C-1112	CMOS camera USB3, 1280 x 1024 gray, 1/1.8", 60 Hz, IR cut, C-mount, with I/O
	CBUSB3001	Passive USB 3.0 cable, industrial level, horizontal screw locking, 3 m
	CBGPI0001	I/O cable, side 1 HIROSE 12 pin, side 2 cable end, 3 m
	STLTCM01	3D Structured-light Camera, 0.6-8.0 m range, USB 2.0
	CBUSB20ACT01	Active USB 2.0 cable, industrial level, screw locking, 10 m
	EN2MP1214	Megapixel lens, focal length 12 mm, f# 1.4-C, C-mount
	LTZGK090-00-4-W-24V	LED ring light, 4 LED rows, outer diameter 92 mm, 0°, white, 24V
	DFLTZGK090-00-4	Diffuser for LED ring light, 4 LED rows, outer diameter 92 mm, 0°
	LTDV1CH-17V	Strobe controller 1 channel variable current 5 mA - 17A
	LTICGR1000-D1	Analogue lighting controller unit, 1 channel, 24V, 2A, constant mode, power adaptor 24V plug
	CBSLH-24V-F-3M	Illumination cable, side A flying leads, side B SM 3 way female connector, 24V - 3 m
	CBPH003	Photoelectric sensor cable, M12 connector to flying leads, length 5 m
	RT-WTB9-3P246	Background suppression sick photoelectric sensor 20 - 350 mm detection range, PNP output, block style
	RT-10060911	Set of 2 8" x 10 " white balance/exposure cards - 18% grey and 90% white for color calibration

SELECTION CHARTS

“Simple works better” is one of our guiding principles and it is the reason why we have organized our optics and lights in easy-to-use selection charts.

Use these charts to quickly identify and select the best Opto Engineering® products that fit your next machine vision application. Our selection charts are also available online at www.opto-e.com to be printed as posters.

Telecentric lenses selection chart	292
Macro lenses selection chart	296
Fixed focal length lenses selection chart	298
LED illuminators selection chart	300
LED line lights selection chart	302

TELECENTRIC LENSES SELECTION CHART

SENSORS	MT9M021 CMOS 1/3" 1280x960 3.75pix 1.2Mpix		MT9M034 CMOS 1/3" 1280x960 3.75pix 1.2Mpix		IMX287 CMOS 1/2.9" 728x544 6.9pix 0.3Mpix	MT9P031 CMOS 1/2.5" 2592x1944 2.2pix 5Mpix	Python480 CMOS 1/4" 808x608 4.8pix 0.4Mpix	MT9V034 CMOS 1/3" 752x480 6pix 0.3Mpix	MT9M031 CMOS 1/3" 1280x960 3.75pix 1.2Mpix	IMX273 CMOS 1/2.9" 1456x1088 3.45pix 1.5Mpix	AR0521 CMOS 1/2.5" 2592x1944 2.2pix 5Mpix	Python1300 CMOS 1/2" 1280x1024 4.8pix 1.3Mpix
	Python 480 CMOS 1/4" 808x608 4.8pix 0.4Mpix	MT9V034 CMOS 1/3" 752x480 6pix 0.3Mpix	MT9M031 CMOS 1/3" 1280x960 3.75pix 1.2Mpix	IMX287 CMOS 1/2.9" 728x544 6.9pix 0.3Mpix	MT9P031 CMOS 1/2.5" 2592x1944 2.2pix 5Mpix							
FOV												
1 to 1.5 mm			RT-TV-3M-150, RT-TV-3M-220, RT-TV-3M-290									RT-HR-6M-110, RT-HR-6M-71, RT-HR-6F-110, RT-HR-6F-71
1.5 to 2 mm			RT-TV-2M-150, RT-TV-2M-220, RT-TV-2M-290		RT-TV-3M-150, RT-TV-3M-220, RT-TV-3M-290		RT-TV-3M-150, RT-TV-3M-220, RT-TV-3M-290					RT-HR-4M-110, RT-HR-4M-71, TCLWD350, TCCX350-Y, RT-HR-4F-110, RT-HR-4F-71, TCEL350
2 to 3 mm					RT-TV-2M-150, RT-TV-2M-220, RT-TV-2M-290		RT-TV-2M-150, RT-TV-2M-220, RT-TV-2M-290, RT-TV-2M-400					TCLWD250, RT-TV-3M-150, RT-TV-3M-220, RT-TV-3M-290, TCCX250-Y, TCEL250
3 to 4 mm			RT-TV-1M-150, RT-TV-1M-220, RT-TV-1M-290									TC23004, RT-HR-2M-110, RT-HR-2M-71, RT-TV-2M-150, RT-TV-2M-220, RT-TV-2M-290, RT-TV-2M-400, RT-HR-2F-110, RT-HR-2F-71
4 to 6 mm					RT-TV-1M-150, RT-TV-1M-220, RT-TV-1M-290		RT-TV-1M-150, RT-TV-1M-220, RT-TV-1M-290, RT-TV-1M-400, RT-TV-1M-800					TC23007, TCLWD150, TCCX150-Y, TCCXQ011-Y, TCEL150
6 to 8 mm			RT-TV-05M-400									TC23009, RT-HR-1M-110, RT-HR-1M-71, TCLWD100, RT-TV-1M-150, RT-TV-1M-220, RT-TV-1M-290, RT-TV-1M-400, RT-TV-1M-800, TCCX100-Y, RT-HR-1F-110, RT-HR-1F-71, TCCXQ014-Y, TCEL100
8 to 11 mm			TC12016		RT-TV-05M-400							TC23012, TCLWD066, TCLWD075, TCCX066-Y, TCCX075-Y, TCCXQ016-Y, TCCXQ018-Y, TCEL066, TCEL075
11 to 15 mm	TC13016		TC13016, TC12024		TC12016		TC12016, RT-TV-05M-400, RT-TV-05M-800					TC23016, TCLWD050, RT-TV-05M-400, RT-TV-05M-800, TCCX050-Y, TCCXQ024-Y, TCEL050
15 to 20 mm		TC13016	TC13024, TC12036		TC12024							TC12016, TC23024, RT-TCL0400-F
20 to 30 mm	TC13024, TC13036	TC13024	TC13036, TC12048, TCCR12048		TC12036		TC12024					TC12024, TC23036, RT-TCL0300-F, TCCXQ050-Y, TCEL23036
30 to 40 mm	TC13048	TC13036	TC13048, TC12056, TC12064, TCCR12056, TCCR12064		TC12048, TCCR12048		TC12036					TC12036, TC23048, TC23056, TCCR23048, TCCR23056, RT-TCL0200-F, TCCXQ066-Y, TCCXQ075-Y
40 to 50 mm	TC13056	TC13048	TC13056, TC13064, TC12080, TCCR12080		TC12056, TCCR12056		TC12048, TC12056, TCCR12048, TCCR12056					TC12048, TC23064, TCCR12048, TCCR23064, TCCXQ100-Y
50 to 70 mm	TC13064, TC13080	TC13056, TC13064	TC13080, TC13096, TC12096, TC13120, TCCR12096, TCCR12120		TC12064, TC12080, TCCR12064, TCCR12080		TC12056, TC12064, TCCR12056, TCCR12064					TC12056, TC12064, TC23072, TC23080, TC23085, TC23096, TCCR12056, TCCR12064, TCCR23080, TCCR23096, TCCXQ150-Y
70 to 100 mm	TC13096	TC13080, TC13096	TC12120, TC13144, TC12144, TC12192		TC12096, TC13120, TCCR12096, TCCR12120		TC12080, TC12096, TCCR12080, TCCR12096					TC12080, TC12096, TC23110, TC23120, TC23130, TCCR12080, TCCR12096
100 to 150 mm	TC12120, TC13144	TC12120, TC13144	TC13192		TC12144		TC13120, TC12144, TCCR12120, TCCP12144					TC13120, TC12144, TC23144, TC23172, TC23192, TC23200, TCCR12120, TCCP12144
150 to 200 mm	TC13192	TC13192			TC12192		TC12192, TCCP12192					TC12192, TC23240, TCCP12192
200 to 300 mm							TCCP12260					TCCP12260

-Y refers to the optics mount type

		IMX265 CMOS 1/1.8" 2064x1544 3.45pix 3.1Mpix			
MT9J003 CMOS 1/2.35" 3856x2764 1.67pix 10.6Mpix	MT9M001 CMOS 1/2" 1280x1024 5.2pix 1.3Mpix	IMX252 CMOS 1/1.8" 2064x1544 3.45pix 3.1Mpix	IMX178 CMOS 1/1.8" 3096x2080 2.4pix 6.4Mpix	IMX226 CMOS 1/1.7" 4024x3036 1.85pix 12.2Mpix	PYTHON 2000 CMOS 2/3" 1920x1200 4.8pix 2.3Mpix
RT-HR-6M-110, RT-HR-6M-71, RT-HR-6F-110, RT-HR-6F-71	RT-HR-6M-110, RT-HR-6M-71, RT-HR-6F-110, RT-HR-6F-71	RT-HR-6M-110, RT-HR-6M-71, RT-HR-6F-110, RT-HR-6F-71	RT-HR-6M-110, RT-HR-6M-71, RT-HR-6F-110, RT-HR-6F-71	RT-HR-6M-110, RT-HR-6M-71, RT-HR-6F-110, RT-HR-6F-71	
RT-HR-4M-110, RT-HR-4M-71, TCLWD350, TCCX350-Y, RT-HR-4F-110, RT-HR-4F-71, TCEL350	RT-HR-4M-110, RT-HR-4M-71, TCLWD350, TCCX350-Y, RT-HR-4F-110, RT-HR-4F-71, TCEL350	RT-HR-4M-110, RT-HR-4M-71, RT-HR-4F-110, RT-HR-4F-71	RT-HR-4M-110, RT-HR-4M-71, RT-HR-4F-110, RT-HR-4F-71	RT-HR-4M-110, RT-HR-4M-71, RT-HR-4F-110, RT-HR-4F-71	RT-HR-6M-110, RT-HR-6M-71, RT-HR-6F-110, RT-HR-6F-71
TCLWD250, RT-TV-3M-150, RT-TV-3M-220, RT-TV-3M-290, TCCX250-Y, TCEL250	TCLWD250, TCCX250-Y, TCEL250	TCLWD250, TCLWD350, TCCX250-Y, TCCX350-Y, TCEL250, TCEL350	TCLWD250, TCLWD350, TCCX250-Y, TCCX350-Y, TCEL250, TCEL350	TCLWD250, TCLWD350, TCCX250-Y, TCCX350-Y, TCEL250, TCEL350	RT-HR-4M-110, RT-HR-4M-71, TCLWD350, TCCX350-Y, RT-HR-4F-110, RT-HR-4F-71, TCEL350
TC23004, RT-HR-2M-110, RT-HR-2M-71, RT-TV-2M-150, RT-TV-2M-220, RT-TV-2M-290, RT-TV-2M-400, RT-HR-2F-110, RT-HR-2F-71	TC23004, RT-HR-2M-110, RT-HR-2M-71, RT-TV-2M-400, RT-HR-2F-110, RT-HR-2F-71	TC23004, RT-HR-2M-110, RT-HR-2M-71, RT-TV-2M-400, RT-HR-2F-110, RT-HR-2F-71	TC23004, RT-HR-2M-110, RT-HR-2M-71, RT-TV-2M-400, RT-HR-2F-110, RT-HR-2F-71	TC23004, RT-HR-2M-110, RT-HR-2M-71, RT-TV-2F-110, RT-HR-2F-71	TCLWD250, TCCX250-Y
TC23007, TCLWD150, TCCX150-Y, TCCXQ011-Y, TCEL150	TC23007, TCLWD150, TCCX150-Y, TCCXQ011-Y, TCEL150	TC23007, TCLWD150, TCCX150-Y, TCCXQ011-Y, TCEL150	TC23007, TCLWD150, TCCX150-Y, TCCXQ011-Y, TCEL150	TC23007, TCLWD150, TCCX150-Y, TCCXQ011-Y, TCEL150	TC23004, RT-HR-2M-110, RT-HR-2M-71, RT-HR-2F-110, RT-HR-2F-71
TC23009, RT-HR-1M-110, RT-HR-1M-71, TCLWD100, RT-TV-1M-150, RT-TV-1M-220, RT-TV-1M-290, RT-TV-1M-400, RT-TV-1M-800, TCCX100-Y, RT-HR-1F-110, RT-HR-1F-71, TCCXQ014-Y, TCEL100	TC23009, RT-HR-1M-110, RT-HR-1M-71, TCLWD100, RT-TV-1M-400, RT-TV-1M-800, TCCX100-Y, RT-HR-1F-110, RT-HR-1F-71, TCCXQ014-Y, TCEL100	TC23009, RT-HR-1M-110, RT-HR-1M-71, TCLWD100, RT-TV-1M-400, RT-TV-1M-800, TCCX100-Y, RT-HR-1F-110, RT-HR-1F-71, TCCXQ014-Y, TCEL100	TC23009, RT-HR-1M-110, RT-HR-1M-71, TCLWD100, RT-TV-1M-400, RT-TV-1M-800, TCCX100-Y, RT-HR-1F-110, RT-HR-1F-71, TCCXQ014-Y, TCEL100	TC23009, RT-HR-1M-110, RT-HR-1M-71, TCLWD100, TCCX100-Y, RT-HR-1F-110, RT-HR-1F-71, TCCXQ014-Y, TCEL100	TC23007, TCLWD150, TCCX150-Y, TCCXQ011-Y, TCEL150
TC23012, TCLWD066, TCLWD075, TCCX066-Y, TCCX075-Y, TCCXQ016-Y, TCCXQ018-Y, TCEL066, TCEL075	TC23012, TCLWD066, TCLWD075, TCCX066-Y, TCCX075-Y, TCCXQ016-Y, TCCXQ018-Y, TCEL066, TCEL075	TC23012, TCLWD066, TCLWD075, TCCX066-Y, TCCX075-Y, TCCXQ016-Y, TC- CXQ018-Y, TCEL066, TCEL075	TC23012, TCLWD075, TCCX075-Y, TCCXQ016-Y, TCEL075	TC23012, TCLWD075, TCCX075-Y, TCCXQ016-Y, TCEL075	TC23009, RT-HR-1M-110, RT-HR-1M-71, TCLWD100, TCCX100-Y, RT-HR-1F-110, RT-HR-1F-71, TCCXQ014-Y, TCEL100
TC23016, TCLWD050, RT-TV-05M-400, RT-TV-05M-800, TCCX050-Y, TCCXQ024-Y, TCEL050	TC23016, TCLWD050, RT-TV-05M-800, TCCX050-Y, TCCXQ024-Y, TCEL050	TC23016, TCLWD050, RT-TV-05M-800, TCCX050-Y, TCCXQ024-Y, TCEL050	TC23016, TCLWD050, TCLWD066, RT-TV-05M-800, TCCX050-Y, TCCX066-Y, TCCXQ018-Y, TC- CXQ024-Y, TCEL050, TCEL066	TC23016, TCLWD050, TCLWD066, TCCX050-Y, TCCX066-Y, TCCXQ018-Y, TCCXQ024-Y, TCEL050, TCEL066	TC23012, TCLWD066, TCLWD075, TCCX066-Y, TCCX075-Y, TCCXQ016-Y, TCCXQ018-Y, TC1MHR016-C, TCEL066, TCEL075
TC12016, TC23024, RT-TCL0400-F	TC23024, RT-TCL0400-F	RT-TCL0400-F	RT-TCL0400-F	RT-TCL0400-F	TC23016, TCLWD050, TCCX050-Y, TCCXQ024-Y, TCEL050
TC12024, TC23036, RT-TCL0300-F, TCCXQ050-Y, TCEL23036	TC23036, RT-TCL0300-F, TCCXQ050-Y, TCEL23036	TC23024, TC23036, RT-TCL0300-F, TCCXQ050-Y, TCEL23036	TC23024, RT-TCL0300-F	TC23024, RT-TCL0300-F	TC23024, RT-TCL0400-F, TC1MHR024-C
TC12036, TC23048, TCCR23048, RT-TCL0200-F, TCCXQ066-Y, TCCXQ066-Y	TC23048, TCCR23048, RT-TCL0200-F, TCCXQ066-Y	TC23048, TCCR23048, RT-TCL0200-F, TCCXQ066-Y	TC23036, RT-TCL0200-F, TCCXQ050-Y, TCEL23036	TC23036, RT-TCL0200-F, TCCXQ050-Y, TCEL23036	TC23036, RT-TCL0300-F, TCCXQ050-Y, TC1MHR036-C, TCEL23036
TC12048, TC23056, TC23064, TCCR12048, TCCR23056, TCCR23064, TCCXQ075-Y, TCCXQ100-Y	TC23056, TC23064, TCCR12048, TCCR23056, TCCR23064, TCCXQ075-Y, TCCXQ100-Y	TC23056, TCCR23056, TCCXQ075-Y	TC23048, TC23056, TCCR23048, TCCR23056, TCCXQ066-Y, TCCXQ075-Y	TC23048, TC23056, TCCR23048, TCCR23056, TCCXQ066-Y, TCCXQ075-Y	RT-TCL0200-F, TC1MHR048-C, TC1MHR056-C, TCCR1M048-C, TCCR1M056-C
TC12056, TC12064, TC23072, TC23080, TC23085, TC23096, TCCR12056, TCCR12064, TCCR23080, TCCR23096, TCCXQ150-Y	TC23072, TC23080, TC23085, TCCR12056, TCCR12064, TCCR23080, TCCXQ150-Y	TC23064, TC23072, TC23080, TC23085, TCCR23064, TCCR23080, TCCXQ100-Y, TCCXQ150-Y	TC23064, TC23072, TC23080, TCCR23064, TCCR23080, TCCXQ100-Y, TCCXQ150-Y	TC23064, TC23072, TC23080, TCCR23064, TCCR23080, TCCXQ100-Y, TCCXQ150-Y	TC23048, TC23056, TC23064, TCCR23048, TCCR23056, TCCR23064, TCCXQ066-Y, TCCXQ075-Y, TCCXQ100-Y, TC1MHR064-C, TC1MHR080-C, TCCR1M064-C, TCCR1M080-C
TC12080, TC12096, TC23110, TC23120, TC23130, TCCR12080, TCCR12096, TCCR23120	TC23096, TC23110, TC23120, TC23130, TCCR12080, TCCR12096, TCCR23096, TCCR23120	TC23096, TC23110, TC23120, TCCR23096, TCCR23120	TC23085, TC23096, TC23110, TCCR23096	TC23085, TC23096, TC23110, TCCR23096	TC23072, TC23080, TC23085, TC23096, TCCR23080, TCCR23096, TCCXQ150-Y, TC1MHR096-C, TCCR1M096-C
TC13120, TC12144, TC23144, TC23172, TC23192, TC23200, TCCR12120, TCCP12144	TC23144, TC23172, TC23192, TCCR12120, TCCP23144	TC23130, TC23144, TC23172, TCCP23144	TC23120, TC23130, TC23144, TC23172, TCCR23120	TC23120, TC23130, TC23144, TC23172, TCCR23120, TCCP23144	TC23110, TC23120, TC23130, TCCR23120, TC1MHR120-C, TC1MHR144-C, TCCR1M120-C
TC12192, TC23240, TCCP12192	TC23200, TC23240, TCCP12144, TCCP23192, TCCP23260	TC23192, TC23200, TC23240, TCCP12144, TCCP23192, TCCP23260	TC23192, TC23200, TCCP12144	TC23192, TC23200, TCCP12144, TCCP23192	TC23144, TC23172, TC1MHR192-C
TCCP12260	TCCP12192, TCCP12260	TCCP12192, TCCP12260	TC23240, TCCP12192, TCCP12260	TC23240, TCCP12192, TCCP12260, TCCP23260	TC23192, TC23200, TC23240, TC1MHR240-C

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TELECENTRIC LENSES SELECTION CHART

SENSORS	IMX264 CMOS 2/3" 2464x2056 3.45pix 5Mpix	IMX249 CMOS 1/1.2" 1936x1216 5.86pix 2.3Mpix			IMX267 CMOS 1" 4112x2176 3.45pix 8.9Mpix	IMX432 CMOS 1.1" 1600x1104 9pix 1.7Mpix
	IMX250 CMOS 2/3" 2464x2056 3.45pix 5Mpix	IMX174 CMOS 1/1.2" 1936x1216 5.86pix 2.3Mpix	Python5000 CMOS 1" 2592x2048 4.8pix 5.3Mpix	IMX183 CMOS 1" 5544x3692 2.4pix 20.4Mpix	IMX255 CMOS 1" 4112x2176 3.45pix 8.9Mpix	IMX425 CMOS 1.1" 1600x1104 9pix 1.7Mpix
FOV						
1 to 1.5 mm	RT-HR-6M-110, RT-HR-6M-71, RT-HR-6F-110, RT-HR-6F-71					
1.5 to 2 mm						
2 to 3 mm	RT-HR-4M-110, RT-HR-4M-71, TCLWD350, TCCX350-Y, RT-HR-4F-110, RT-HR-4F-71, TCEL350	RT-MP-4F-65				
3 to 4 mm	TCLWD250, TCCX250-Y		TC4M004-Y, RT-MP-4F-65	TC4M004-Y, RT-MP-4F-65	TC4M004-Y, RT-MP-4F-65	TC4M004-Y
4 to 6 mm	TC23004, RT-HR-2M-110, RT-HR-2M-71, TCLWD150, TCCX150-Y, RT-HR-2F-110, RT-HR-2F-71, TCCXQ011-Y, TCEL150	RT-MP-2F-65	TC4M007-Y	TC4M007-Y	TC4M007-Y	TC4M007-Y
6 to 8 mm	TC23007	RT-MP-1.5F-65	TC4M009-Y, RT-MP-2F-65	TC4M009-Y, RT-MP-2F-65	TC4M009-Y, RT-MP-2F-65	TC4M009-Y
8 to 11 mm	TC23009, RT-HR-1M-110, RT-HR-1M-71, TCLWD100, TCCX100-Y, RT-HR-1F-110, RT-HR-1F-71, TCCXQ014-Y, TCEL100		RT-MP-1.5F-65	RT-MP-1.5F-65	RT-MP-1.5F-65	
11 to 15 mm	TC23012, TCLWD066, TCL- WD075, TCCX066-Y, TCCX075-Y, TCCXQ016-Y, TCCXQ018-Y, TC1MHR016-C, TCEL066, TCEL075	TC3MHR016-C, TC2MHR016-Y, RT-MP-1F-65	TC3MHR016-C, TC4MHR016-Y, RT-MP-1F-65	TC4MHR016-Y, RT-MP-1F-65	TC4MHR016-Y, RT-MP-1F-65	TC4MHR016-Y
15 to 20 mm	TC23016, TCLWD050, TCCX050-Y, TCCXQ024-Y, TCEL050	TC1MHR016-C, RT-TCL0600-FU, RT-TCL0750-FU	TC4MHR024-Y, TC2MHR016-Y, RT-TCL0750-FU	TC3MHR016-C, TC4MHR024-Y, TC2MHR016-Y, RT-TCL0750-FU	TC3MHR016-C, TC2MHR016-Y, RT-TCL0750-FU	TC3MHR016-C
20 to 30 mm	TC23024, RT-TCL0300-F, RT-TCL0400-F, TC1MHR024-C, TC1MHR036-C	TC3MHR024-C, TC3MHR036-C, TC1MHR024-C, TC2MHR024-Y, RT-TCL0450-FU	TC3MHR024-C, TC4MHR036-Y, TC2MHR024-Y, RT-TCL0450-FU, RT-TCL0600-FU	TC3MHR024-C, TC4MHR036-Y, TC2MHR024-Y, RT-TCL0450-FU, RT-TCL0600-FU	TC3MHR024-C, TC4MHR024-Y, TC4MHR036-Y, TC2MHR024-Y, RT-TCL0600-FU	TC3MHR024-C, TC4MHR024-Y, TC4MHR036-Y
30 to 40 mm	TC23036, TCCXQ050-Y, TC1MHR048-C, TCCR1M048-C, TCEL23036	TC3MHR048-C, TC1MHR036-C, TC2MHR036-Y, TCCR3M048-C, RT-TCL0300-FU	TC3MHR036-C, TC4MHR048-Y, TC4MHR056-Y, TC2MHR036-Y, TCCR4M048-Y, TCCR4M056-Y	TC3MHR036-C, TC4MHR048-Y, TC2MHR036-Y, TCCR4M048-Y	TC3MHR036-C, TC4MHR048-Y, TCCR4M048-Y, RT-TCL0450-FU	TC3MHR036-C, TC4MHR048-Y, TCCR4M048-Y
40 to 50 mm	TC23048, TCCR23048, RT- TCL0200-F, TCCXQ066-Y, TC1MHR056-C, TCCR1M056-C	TC3MHR056-C, TC3MHR064-C, TC2MHR048-Y, TC2MHR056-Y, TCCR3M056-C, TCCR3M064-C, TCCR2M048-Y, TCCR2M056-Y	TC3MHR048-C, TC3MHR056-C, TC4MHR064-Y, TC2MHR048-Y, TCCR3M048-C, TCCR3M056-C, TCCR2M048-Y, RT-TCL0300-FU	TC3MHR048-C, TC4MHR056-Y, TC4MHR064-Y, TC2MHR048-Y, TCCR3M048-C, TCCR2M048-Y, TCCR4M056-Y, TCCR4M064-Y, RT-TCL0300-FU	TC3MHR048-C, TC4MHR056-Y, TC2MHR036-Y, TCCR3M048-C, TCCR4M056-Y, RT-TCL0300-FU	TC3MHR048-C, TC4MHR056-Y, TCCR3M048-C, TCCR4M056-Y
50 to 70 mm	TC23056, TC23064, TC23072, TCCR23056, TCCR23064, TCCXQ075-Y, TCCXQ100-Y, TC1MHR064-C, TC1MHR080-C, TCCR1M064-C, TCCR1M080-C	TC3MHR080-C, TC1MHR048-C, TC1MHR056-C, TC1MHR064-C, TC2MHR064-Y, TCCR1M048-C, TCCR1M056-C, TCCR1M064-C, TCCR3M080-C, TCCR2M064-Y	TC3MHR064-C, TC3MHR080-C, TC4MHR080-Y, TC4MHR096-Y, TC2MHR056-Y, TC2MHR064-Y, TCCR3M064-C, TCCR3M080-C, TCCR2M056-Y, TCCR2M064-Y, TCCR4M080-Y, TCCR4M096-Y	TC3MHR056-C, TC3MHR064-C, TC4MHR080-Y, TC2MHR056-Y, TC2MHR064-Y, TCCR3M056-C, TCCR3M064-C, TCCR2M056-Y, TCCR2M064-Y, TCCR4M080-Y	TC3MHR056-C, TC3MHR064-C, TC4MHR064-Y, TC4MHR080-Y, TC2MHR064-Y, TC2MHR080-Y, TCCR3M080-C, TCCR3M096-C, TCCR2M064-Y, TCCR2M080-Y, TCCR4M096-Y, TCCR4M120-Y	TC3MHR056-C, TC3MHR064-C, TC4MHR064-Y, TC4MHR080-Y, TC4MHR096-Y, TCCR3M064-C, TCCR3M080-C, TCCR3M096-C, TCCR4M064-Y, TCCR4M080-Y
70 to 100 mm	TC23080, TC23085, TC23096, TCCR23080, TCCR23096, TCCXQ150-Y, TC1MHR096-C, TC1MHR120-C, TCCR1M096-C, TCCR1M120-C	TC3MHR096-C, TC3MHR120-C, TC1MHR080-C, TC1MHR096-C, TC2MHR080-Y, TC2MHR096-Y, TCCR1M080-C, TCCR1M096-C, TCCR3M096-C, TCCR3M120-C, TCCR2M080-Y, TCCR2M096-Y	TC3MHR096-C, TC4MHR120-Y, TC2MHR080-Y, TC2MHR096-Y, TCCR3M096-C, TCCR2M080-Y, TCCR2M096-Y, TCCR4M120-Y	TC3MHR080-C, TC3MHR096-C, TC4MHR096-Y, TC4MHR120-Y, TC2MHR080-Y, TC2MHR096-Y, TCCR3M080-C, TCCR3M096-C, TCCR2M080-Y, TCCR2M096-Y, TCCR4M096-Y, TCCR4M120-Y	TC3MHR080-C, TC3MHR096-C, TC4MHR096-Y, TC4MHR120-Y, TC2MHR064-Y, TC2MHR080-Y, TCCR3M080-C, TCCR3M096-C, TCCR2M064-Y, TCCR2M080-Y, TCCR4M096-Y, TCCR4M120-Y	TC3MHR080-C, TC3MHR096-C, TC4MHR096-Y, TCCR3M080-C, TCCR3M096-C, TCCR4M096-Y
100 to 150 mm	TC23110, TC23120, TC23130, TC23144, TCCR23120, TCCP23144, TC1MHR144-C	TC3MHR144-C, TC1MHR120-C, TC2MHR120-Y, TC2MHR144-Y, TCCR1M120-C, TCCR2M120-Y	TC3MHR120-C, TC3MHR144-C, TC4MHR144-Y, TC4MHR192-Y, TC2MHR120-Y, TC2MHR144-Y, TCCR3M120-C, TCCR2M120-Y, TCCP3MHR144-C	TC3MHR120-C, TC3MHR144-C, TC4MHR144-Y, TC4MHR192-Y, TC2MHR120-Y, TC2MHR144-Y, TCCR3M120-C, TCCR2M120-Y	TC3MHR120-C, TC3MHR144-C, TC4MHR144-Y, TC2MHR096-Y, TC2MHR120-Y, TCCR3M120-C, TCCR2M096-Y, TCCR2M120-Y	TC3MHR120-C, TC3MHR144-C, TC4MHR120-Y, TC4MHR144-Y, TCCR3M120-C, TCCR4M120-Y
150 to 200 mm	TC23172, TC23192, TC23200, TCCP23192, TC1MHR192-C, TC1MHR240-C	TC3MHR192-C, TC3MHR240-C, TC1MHR144-C, TC2MHR192-Y	TC3MHR192-C, TC4MHR240-Y, TC2MHR192-Y, TCCP3MHR192-C	TC3MHR192-C, TC4MHR240-Y, TC2MHR192-Y, TCCP3MHR144-C	TC3MHR192-C, TC4MHR192-Y, TC4MHR240-Y, TC2MHR144-Y	TC3MHR192-C, TC4MHR192-Y, TC4MHR240-Y,
200 to 300 mm	TC23240, TCCP23260	TC1MHR192-C, TC1MHR240-C, TC2MHR240-Y	TC3MHR240-C, TC2MHR240-Y, TCCP3MHR260-C	TC3MHR240-C, TC2MHR240-Y, TCCP3MHR192-C, TCCP3M- HR260-C	TC3MHR240-C, TC2MHR192-Y, TC2MHR240-Y	TC3MHR240-C, TCCP3MHR192-C, TCCP3MHR260-C

-Y refers to the optics mount type

IMX304 CMOS 1.1" 4112x3008 3.45pix 12.3Mpix	IMX428 CMOS 1.1" 3216x2208 4.5pix 7.1Mpix	IMX367 CMOS 4/3" 4432x4432 3.45pix 19.6Mpix			
IMX253 CMOS 1.1" 4112x3008 3.45pix 12.3Mpix	IMX420 CMOS 1.1" 3216x2208 4.5pix 7.1Mpix	IMX387 CMOS 4/3" 5472x3080 3.45pix 16.8Mpix	IMX342 CMOS APS-C 6480x4856 3.45pix 31.4Mpix	Python 25K CMOS APS-H 5120x5120 4.5pix 26.2Mpix	CMV50000 CMOS 35 mm 7920x6004 4.6pix 47.5Mpix
TC4M004-Y	TC4M004-Y				
TC4M007-Y	TC4M007-Y	TC4M004-Y		TC16M009-Y	
TC4M009-Y	TC4M009-Y	TC4M007-Y		TC16M012-Y	
		TC4M009-Y			
TC4MHR016-Y	TC4MHR016-Y		TC12M016-F	TC12M016-F, TC16M018-Y	
TC3MHR016-C	TC3MHR016-C		TC12M024-F		
TC3MHR024-C, TC4MHR024-Y, TC4MHR036-Y	TC3MHR024-C, TC4MHR024-Y, TC4MHR036-Y	TC4MHR024-Y	TC12M036-F	TC12M024-F, TC12M036-F, TC16M036-Y	
TC3MHR036-C, TC4MHR048-Y, TCCR4M048-Y	TC3MHR036-C, TC4MHR048-Y, TCCR4M048-Y		TC12M048-F	TC12M048-F, TC16M048-Y, TC16M056-Y	TC12K064
TC3MHR048-C, TC4MHR056-Y, TCCR3M048-C, TCCR4M056-Y	TC3MHR048-C, TC4MHR056-Y, TCCR3M048-C, TCCR4M056-Y		TC12M056-F, TC12M064-F	TC12M048-F, TC12M056-F, TC12M064-F, TC16M064-Y, TC16M080-Y	
TC3MHR056-C, TC3MHR064-C, TC4MHR064-Y, TC4MHR080-Y, TCCR3M056-C, TCCR3M064-C, TCCR4M064-Y, TCCR4M080-Y	TC3MHR056-C, TC3MHR064-C, TC4MHR064-Y, TC4MHR080-Y, TCCR3M056-C, TCCR3M064-C, TCCR4M064-Y, TCCR4M080-Y	TC4MHR048-Y, TC4MHR056-Y, TC4MHR064-Y, TCCR4M048-Y, TCCR4M056-Y, TCCR4M064-Y	TC12M080-F	TC12M080-F, TC16M096-Y	TC12K080, TC12K120
TC3MHR080-C, TC3MHR096-C, TC4MHR096-Y, TC4MHR120-Y, TCCR3M080-C, TCCR3M096-C, TCCR4M096-Y, TCCR4M120-Y	TC3MHR080-C, TC3MHR096-C, TC4MHR096-Y, TCCR3M080-C, TCCR3M096-C, TCCR4M096-Y	TC4MHR080-Y, TCCR4M080-Y	TC12M096-F, TC12M120-F	TC12M096-F, TC12M120-F, TC16M120-Y, TC16M144-Y	TC12K144
TC3MHR120-C, TC3MHR144-C, TC4MHR144-Y, TCCR3M120-C	TC3MHR120-C, TC3MHR144-C, TC4MHR120-Y, TC4MHR144-Y, TCCR3M120-C, TCCR4M120-Y	TC4MHR096-Y, TCCR4M096-Y, TCCR4M120-Y	TC12M144-F	TC12M144-F, TC16M192-Y	TC12K192, TC12K240
TC3MHR192-C, TC4MHR192-Y, TC4MHR240-Y, TCCP3MHR144-C	TC3MHR192-C, TC4MHR192-Y, TC4MHR240-Y, TCCP3MHR144-C	TC4MHR144-Y, TCCP5MHR144-F	TC12M196-F, TC12M240-F	TC12M196-F, TC16M240-Y	
TC3MHR240-C, TCCP3MHR192-C, TCCP3MHR260-C	TC3MHR240-C, TCCP3MHR192-C, TCCP3MHR260-C	TC4MHR192-Y, TCCP5MHR192-F, TCCP5MHR260-F		TC12M240-F	

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MACRO LENSES SELECTION CHART

SENSORS				IMX287 CMOS 1/2.9" 720x540 6.9pix 0.4Mpix		
				IMX273 CMOS 1/2.9" 1456x1088 3.45pix 1.5Mpix	IMX265 CMOS 1/1.8" 2064x1544 3.45pix 3.1Mpix	
		AR0331 CMOS 1/2.3" 2048x1536 2.2pix 3.1Mpix		MT9P031 CMOS 1/2.5" 2592x1944 2.2pix 5Mpix	IMX252 CMOS 1/1.8" 2064x1544 3.45pix 3.1Mpix	
		MT9V034 CMOS 1/3" 752x480 6pix 0.3Mpix		AR0521 CMOS 1/2.5" 2592x1944 2.2pix 5Mpix	IMX178 CMOS 1/1.8" 3096x2080 2.4pix 6.4Mpix	IMX264 CMOS 2/3" 2464x2056 3.45pix 5Mpix
		Python 300 CMOS 1/4" 640x480 4.8pix 0.3Mpix	MT9M031 CMOS 1/3" 1280x960 3.75pix 1.2Mpix	Python1300 CMOS 1/2" 1280x1024 4.8pix 1.3Mpix	IMX226 CMOS 1/1.7" 4024x3036 1.85pix 12.2Mpix	IMX250 CMOS 2/3" 2464x2056 3.45pix 5Mpix
	FOV					
1 to 2.5 mm	MC150X, MC200X MC300X	MC200X MC300X	MC300X	MC300X		
2.5 to 5 mm	MC075X MC100X	MC100X MC150X	MC150X MC200X	MC150X, MC200X, MC4K150X-Y MC4K175X-Y MC4K200X-Y	MC200X, MC300X, MC4K175X-Y MC4K200X-Y	
5 to 10 mm	MC033X MC050X	MC050X MC075X	MC075X MC100X	MC075X, MC100X, MC4K075X-Y MC4K100X-Y, MC4K125X-Y	MC100X, MC150X, MC4K100X-Y MC4K125X-Y, MC4K150X-Y	
10 to 20 mm		MC033X	MC033X MC050X	MC050X MC4K050X-Y	MC050X, MC075X, MC4K050X-Y MC4K075X-Y	
20 to 30 mm				MC033X MC4K025X-Y	MC033X	
30 to 40 mm					MC4K025X-Y	
40 to 60 mm						
60 to 80 mm						
80 to 100 mm						
100 to 150 mm						
150 to 200 mm						
200 to 250 mm						
250 to 300 mm						
300 to 350 mm						
350 to 400 mm						
400 to 500 mm						

-Y refers to the optics mount type

		IMX183 CMOS 1" 5544x3692 2.4pix 20.4Mpix				
		IMX267 CMOS 1" 4112x2176 3.45pix 8.9Mpix				
		IMX255 CMOS 1" 4112x2176 3.45pix 8.9Mpix				
		IMX304 CMOS 1.1" 4112x3008 3.45pix 12.3Mpix				
	CMV2000 CMOS 2/3" 2048x1088 5.5pix 2.2Mpix	IMX253 CMOS 1.1" 4112x3008 3.45pix 12.3Mpix				
	CMV4000 CMOS 1" 2048x2048 5.5pix 4.1Mpix	IMX432 CMOS 1.1" 1600x1104 9pix 1.7Mpix				
	IMX249 CMOS 1/1.2" 1936x1216 5.86pix 2.3Mpix	IMX425 CMOS 1.1" 1600x1104 9pix 1.7Mpix				
	IMX174 CMOS 1/1.2" 1936x1216 5.86pix 2.3Mpix	IMX428 CMOS 1.1" 3216x2208 4.5pix 7.1Mpix				
PYTHON 2000 CMOS 2/3" 1920x1200 4.8pix 2.3Mpix	Python5000 CMOS 1" 2592x2048 4.8pix 5.3Mpix	IMX420 CMOS 1.1" 3216x2208 4.5pix 7.1Mpix	IMX342 CMOS APS-C 6480x4856 3.45pix 31.4Mpix	Python 25K CMOS APS-H 5120x5120 4.5pix 26.2Mpix	CHR70M CMOS 35 mm 10000x7094 3.1pix 70.9Mpix	CMV50000 CMOS 35 mm 7920x6004 4.6pix 47.5Mpix

MC200X, MC300X MC4K200X-Y						
MC100X, MC150X, MC4K100X-Y MC4K125X-Y, MC4K150X-Y MC4K175X-Y	MC4K125X-Y MC4K150X-Y MC4K175X-Y MC4K200X-Y	MC4K150X-Y MC4K175X-Y MC4K200X-Y	RT-OPKE16-300M95	RT-OPKE16-300M95		
MC050X, MC075X MC4K050X-Y MC4K075X-Y	MC4K075X-Y MC4K100X-Y	MC4K075X-Y MC4K100X-Y MC4K125X-Y	MC4K125X-Y, MC4K150X-Y MC4K175X-Y, MC4K200X-Y MC12K150X-Y, MC12K200X-Y RT-OPKE16-150M95 RT-OPKE16-200M95	MC12K150X-Y MC12K200X-Y RT-OPKE16-150M95 RT-OPKE16-200M95	MC12K200X-Y RT-OPKE16-200M95 RT-OPKE16-300M95	MC12K200X-Y RT-OPKE16-200M95 RT-OPKE16-300M95
MC033X	MC4K050X-Y	MC4K050X-Y	MC4K075X-Y, MC4K100X-Y MC12K100X-Y RT-OPKE16-100M95	MC12K100X-Y RT-OPKE16-100M95		MC12K150X-Y RT-OPKE16-150M95
MC4K025X-Y			MC12K067X-Y RT-OPKE16-070M95	MC12K067X-Y RT-OPKE16-070M95	MC12K100X-Y RT-OPKE16-100M95	MC12K100X-Y RT-OPKE16-100M95
	MC4K025X-Y	MC4K025X-Y	MC4K050X-Y, MC12K050X-Y RT-OPKE16-050M95	MC12K050X-Y RT-OPKE16-050M95	MC12K067X-Y RT-OPKE16-070M95	MC12K067X-Y RT-OPKE16-070M95
					MC12K050X-Y RT-OPKE16-050M95	MC12K050X-Y RT-OPKE16-050M95
			MC4K025X-Y, MC12K025X-Y	MC12K025X-Y		
					MC12K025X-Y	MC12K025X-Y
			MC12K012X-Y	MC12K012X-Y		
			MC12K008X-Y	MC12K008X-Y	MC12K012X-Y	
						MC12K012X-Y
					MC12K008X-Y	
						MC12K008X-Y

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FIXED FOCAL LENGTH LENSES SELECTION CHART

SENSORS	IMX287 CMOS 1/2.9" 728x544 3.45mpix 0.3Mpix	MT9P031 CMOS 1/2.5" 2592x1944 2.2pix 5Mpix				IMX265 CMOS 1/1.8" 2064x1544 3.45mpix 3.1Mpix		IMX264 CMOS 2/3" 2464x2056 3.45mpix 5Mpix	IMX249 CMOS 1/1.2" 1936x1216 5.86mpix 2.3Mpix	
	IMX273 CMOS 1/2.9" 1456x1088 3.45mpix 1.5Mpix	AR0521 CMOS 1/2.5" 2592x1944 2.2pix 5Mpix	Python1300 CMOS 1/2" 1280x1024 4.8pix 1.3Mpix	MT9J003 CMOS 1/2.35" 3856x2764 1.67pix 10.6Mpix	MT9M001 CMOS 1/2" 1280x1024 5.2pix 1.3Mpix	IMX252 CMOS 1/1.8" 2064x1544 3.45mpix 3.1Mpix	PYTHON 2000 CMOS 2/3" 1920x1200 4.8pix 2.3Mpix	IMX250 CMOS 2/3" 2464x2056 3.45mpix 5Mpix	IMX174 CMOS 1/1.2" 1936x1216 5.86mpix 2.3Mpix	Python5000 CMOS 1" 2592x2048 4.8pix 5.3Mpix
ANGLE OF VIEW										
2 to 5 °	EN2MP7528 EN5MP7520	EN2MP7528 EN5MP7520	EN2MP7528 EN5MP7520	EN2MP7528 EN5MP7520						
5 to 7.5 °	EN2MP5018 EN5MP5018	EN2MP5018 EN5MP5018	EN2MP5018 EN5MP5018	EN2MP5018 EN5MP5018	EN2MP7528 EN5MP7520	EN2MP7528 EN5MP7520	EN2MP7528 EN5MP7520	EN2MP7528 EN5MP7520		
7.5 to 10 °	EN2MP3514 EN5MP3514	EN2MP3514 EN5MP3514	EN2MP3514 EN5MP3514		EN2MP5018 EN5MP5018 EN8MPL5020	EN2MP5018 EN5MP5018 EN8MPL5020		EN2MP5018 EN5MP5018 EN8MPL5020		
10 to 12.5 °	EN2MP2514 EN5MP2514		EN2MP3514 EN5MP3514	EN2MP3514 EN5MP3514	EN2MP3514 EN5MP3514 EN8MPL3520	EN2MP3514 EN5MP3514 EN8MPL3520	EN2MP5018 EN5MP5018 EN8MPL5020			
12.5 to 15 °		EN2MP2514 EN5MP2514	EN2MP2514 EN5MP2514	EN2MP2514 EN5MP2514	EN2MP2514 EN5MP2514 EN8MPL2518		EN2MP3514 EN5MP3514 EN8MPL3520	EN2MP3514 EN5MP3514 EN8MPL3520	EN8MPL5020 EN10MPL5020	EN8MPL5020 EN10MPL5020
15 to 17.5 °	EN2MP1614 EN5MP1616					EN2MP2514 EN5MP2514 EN8MPL2518				
17.5 to 20 °		EN2MP1614 EN5MP1616						EN2MP2514 EN5MP2514 EN8MPL2518	EN8MPL3520 EN10MPL3520	EN8MPL3520 EN10MPL3520
20 to 25 °	EN2MP1214 EN5MP1216		EN2MP1614 EN5MP1616	EN2MP1614 EN5MP1616	EN2MP1614 EN5MP1616 EN8MPL1620	EN2MP1614 EN5MP1616 EN8MPL1620	EN2MP2514 EN5MP2514 EN8MPL2518		EN8MPL2518 EN10MPL2520	
25 to 30 °		EN2MP1214 EN5MP1216	EN2MP1214 EN5MP1216	EN2MP1214 EN5MP1216	EN2MP1214 EN5MP1216 EN8MPL1220		EN2MP1614 EN5MP1616 EN8MPL1620	EN2MP1614 EN5MP1616 EN8MPL1620		EN8MPL2518 EN10MPL2520
30 to 35 °	EN5MP0816					EN2MP1214 EN5MP1216 EN8MPL1220				
35 to 40 °		EN5MP0816	EN5MP0816	EN5MP0816	EN5MP0816 EN8MPL0818		EN2MP1214 EN5MP1216 EN8MPL1220	EN2MP1214 EN5MP1216 EN8MPL1220	EN8MPL1620	EN8MPL1620
40 to 45 °						EN5MP0816 EN8MPL0818			EN8MPL1220	
45 to 50 °							EN5MP0816 EN8MPL0818	EN5MP0816 EN8MPL0818		EN8MPL1220
50 to 55 °									EN8MPL0818	
55 to 60 °										EN8MPL0818
60 to 65 °										

LEGEND

	IMX267 CMOS 1" 4112x2176 3.45pix 8.9Mpix	IMX304 CMOS 1.1" 4112x3008 3.45pix 12.3Mpix	IMX428 CMOS 1.1" 3216x2208 4.5pix 7.1Mpix
IMX183 CMOS 1" 5544x3692 2.4pix 20.4Mpix	IMX255 CMOS 1" 4112x2176 3.45pix 8.9Mpix	IMX253 CMOS 1.1" 4112x3008 3.45pix 12.3Mpix	IMX420 CMOS 1.1" 3216x2208 4.5pix 7.1Mpix
EN8MPL5020 EN10MPL5020			
	EN8MPL5020 EN10MPL5020	EN10MPL5020	EN10MPL5020
EN8MPL3520 EN10MPL3520	EN8MPL3520 EN10MPL3520	EN10MPL3520	EN10MPL3520
EN8MPL2518 EN10MPL2520	EN8MPL2518 EN10MPL2520	EN10MPL2520	
			EN10MPL2520
EN8MPL1620			
	EN8MPL1620		
EN8MPL1220	EN8MPL1220		
EN8MPL0818			
	EN8MPL0818		

Sensor description	Part number OPTO ENGINEERING®	Part number MATRIX VISION
Python 300 CMOS 1/4" 640x480 4.8pix 0.3Mpix	COE-003-x-USB-010-IR-C COE-004-x-POE-010-IR-C	
MT9V034 CMOS 1/3" 752x480 6pix 0.3Mpix		RT-mvBC-X100w
RJ33B4AD0DT CCD 1/3" 640x480 7.4pix 0.3Mpix	COE-003-x-POE-020-IR-C	
RJ33J4CA3DE CCD 1/3" 1280x960 3.75pix 1.2Mpix	COE-012-x-POE-020-IR-C	
IMX287 CMOS 1/2.9" 720x540 6.9pix 0.4Mpix	COE-004-x-POE-021-IR-C	RT-mvBC-X100f RT-mvBF3-2004
IMX273 CMOS 1/2.9" 1456x1088 3.45pix 1.5Mpix	COE-016-x-POE-021-IR-C COE-016-x-USB-021-IR-C	RT-mvBC-X102f RT-mvBC-XD102f RT-mvBF3-2016
MT9P031 CMOS 1/2.5" 2592x1944 2.2pix 5Mpix	COE-050-x-POE-023-IR-C	RT-mvBC-X105
AR0521 CMOS 1/2.5" 2592x1944 2.2pix 5Mpix	COE-050-x-USB-023-yy-C	
Python1300 CMOS 1/2" 1280x1024 4.8pix 1.3Mpix	COE-013-x-POE-030-IR-C COE-013-x-USB-030-IR-C	
IMX265 CMOS 1/1.8" 2064x1544 3.45pix 3.1Mpix	COE-032-x-POE-040-IR-C	RT-mvBC-X104i RT-mvBF3-2032a
IMX252 CMOS 1/1.8" 2064x1544 3.45pix 3.1Mpix		RT-mvBC-XD104h RT-mvBF3-2032
IMX178 CMOS 1/1.8" 3096x2080 2.4pix 6.4Mpix	COE-063-M-POE-040-IR-C-B COE-063-C-POE-040-IR-C COE-063-x-USB-040-IR-C	RT-mvBF3-2064
IMX226 CMOS 1/1.7" 4024x3036 1.85pix 12.2Mpix	COE-122-x-POE-041-IR-C	
PYTHON 2000 CMOS 2/3" 1920x1200 4.8pix 2.3Mpix	COE-023-x-POE-050-IR-C	
IMX264 CMOS 2/3" 2464x2056 3.45pix 5Mpix	COE-050-x-POE-050-IR-C COE-050-x-USB-050-IR-C	RT-mvBC-X105b RT-mvBF3-2051a
IMX250 CMOS 2/3" 2464x2056 3.45pix 5Mpix	COE-050-x-USB-050-IR-C-A	RT-mvBC-XD105a RT-mvBF3-2051
IMX249 CMOS 1/1.2" 1936x1216 5.86pix 2.3Mpix	COE-023-x-POE-060-IR-C COE-023-x-USB-060-IR-C	RT-mvBC-X104f RT-mvBF3-2024a
IMX174 CMOS 1/1.2" 1936x1216 5.86pix 2.3Mpix		RT-mvBC-XD104d RT-mvBF3-2024
Python5000 CMOS 1" 2592x2048 4.8pix 5.3Mpix	COE-053-x-POE-070-IR-C COE-053-x-USB-070-IR-C	
IMX183 CMOS 1" 5544x3692 2.4pix 20.4Mpix	COE-200-x-POE-070-IR-C COE-200-x-USB-070-IR-C	
IMX267 CMOS 1" 4112x2176 3.45pix 8.9Mpix	COE-089-x-POE-070-IR-C COE-089-x-USB-070-IR-C	RT-mvBC-X109b RT-mvBC-XD109b RT-mvBF3-2089a
IMX255 CMOS 1" 4112x2176 3.45pix 8.9Mpix		RT-mvBF3-2089
IMX304 CMOS 1.1" 4112x3008 3.45pix 12.3Mpix	COE-123-x-POE-080-IR-C COE-123-x-USB-080-IR-C	RT-mvBC-X1012b RT-mvBC-XD1012b RT-mvBF3-2124a
IMX253 CMOS 1.1" 4112x3008 3.45pix 12.3Mpix		RT-mvBF3-2124
IMX420 CMOS 1.1" 3216x2208 4.5pix 7.1Mpix		RT-mvBC-XD107
IMX387 CMOS 4/3" 5472x3080 3.45pix 16.8Mpix		RT-BF3-4-0169Zx-y
IMX342 CMOS APS-C 6480x4856 3.45pix 31.4Mpix		RT-mvBC-XD1031x-y RT-BF3-4-0315Zx-y
Python 25K CMOS APS-H 5120x5120 4.5pix 26.2Mpix	COE-260-x-10GIGE-100-IR-z	
CMV50000 CMOS 35 mm 7920x6004 4.6pix 47.5Mpix	COE50xCLyy-z COE50xUSB3yy-z	

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LED ILLUMINATORS SELECTION CHART

α	RINGLIGHT							BAR LIGHT
	Normal Angle ($\alpha < 45^\circ$)		30°	45°	Low Angle ($\alpha \geq 45^\circ$)		-	Direct /Diffused
	0°	15°	Direct/Diffused	Direct/Diffused	60°	75°	Diffused	
Light Structure	Direct/Diffused	Direct/Diffused	Direct/Diffused	Direct/Diffused	Diffused	Direct/Diffused	Diffused	Direct /Diffused
LONGEST SIDE OF ILLUMINATED OBJECT								
1 to 8 mm	LTRN023XX(C,SV) LTZGK040-00-2-X-24V(C,SV)	LTZGK050-15-2-X-24V(C,SV)	LTZGK040-30-2-X-24V(C,SV)		LT3RF050-60-2-X-24V(C,SV) LTLAB2-X(SI)			LTPZFL040-00-6-X-24V(C,SV) LTBP048036-X(SI) LT2BC048036-X(C,SI)
8 to 11 mm	LTRN016XX(C,SV) LTZGK050-00-2-X-24V(C,SV)	LTZGK050-15-2-X-24V(C,SV)	LTZGK040-30-2-X-24V(C,SV)	LTZGK070-45-3-X-24V(C,SV)	LT3RF050-60-2-X-24V(C,SV) LTLAB2-X(SI)			LTPZFL040-00-6-X-24V(C,SV) LTBP048036-X(SI) LT2BC048036-X(C,SI)
11 to 15 mm	LTRN016XX(C,SV) LTZGK050-00-2-X-24V(C,SV)	LTZGK050-15-2-X-24V(C,SV)	LTZGK050-30-2-X-24V(C,SV)	LTZGK070-45-3-X-24V(C,SV)	LT3RF050-60-2-X-24V(C,SV) LTLAB2-X(SI)			LTPZFL040-00-6-X-24V(C,SV) LTBP048036-X(SI) LT2BC048036-X(C,SI)
15 to 20 mm	LTRN024XX(C,SV)	LTZGK050-15-2-X-24V(C,SV)	LTZGK050-30-2-X-24V(C,SV)	LTZGK070-45-3-X-24V(C,SV)	LT3RF050-60-2-X-24V(C,SV) LTLAB2-X(SI)		LTRN050X45(C,SV) LTRN075X45(C,SV) LTRNHP075X45(C,SI)	LTPZFL040-00-6-X-24V(C,SV) LTBP048036-X(SI) LT2BC048036-X(C,SI)
20 to 30 mm	LTRN036XX(C,SV) LTZGK070-00-3-X-24V(C,SV)	LTZGK050-15-2-X-24V(C,SV)	LTZGK070-30-3-X-24V(C,SV)	LTZGK070-45-3-X-24V(C,SV)	LT3RF050-60-2-X-24V(C,SV) LTLAB2-X(SI)		LTRN050X45(C,SV)	LTPZFL040-00-6-X-24V(C,SV) LTBP048036-X(SI) LT2BC048036-X(C,SI)
30 to 40 mm	LTRN036XX(C,SV) LTRN048XX(C,SV) LTZGK090-00-4-X-24V(C,SV)	LTZGK050-15-2-X-24V(C,SV)	LTZGK090-30-4-X-24V(C,SV)	LTZGK070-45-3-X-24V(C,SV)	LT3RF050-60-2-X-24V(C,SV) LTLAB2-X(SI)		LTRN075X45(C,SV)	LTPZFL040-00-6-X-24V(C,SV) LTBP048036-X(SI) LT2BC048036-X(C,SI) LTBRZ3 series (C)
40 to 50 mm	LTRN048XX(C,SV) LTRN056XX(C,SV)	LTZGK050-15-2-X-24V(C,SV) LTZGK070-15-3-X-24V(C,SV)		LTZGK070-45-3-X-24V(C,SV)	LT3RF070-60-2-X-24V(C,SV) LTLAB2-X(SI)		LTRN165X45(C,SV) LTRNHP165X45(C,SI) LTRN165X20(C,SV)	LTPZFL080-00-6-X-24V(C,SV) LTBP096036-X(SI) LT2BC096036-X(C,SI) LTBRZ3 series (C)
50 to 70 mm	LTRN064XX(C,SV) LTRN080XX(C,SV)	LTZGK070-15-3-X-24V(C,SV) LTZGK100-15-5-X-24V(C,SV)		LTZGK070-45-3-X-24V(C,SV) LTZGK100-45-5-X-24V(C,SV)	LT3RF070-60-2-X-24V(C,SV) LT3RF100-60-2-X-24V(C,SV) LTLACX-X(C,SV)		LTRN165X45(C,SV) LTRN210X20(C,SV) LTRNHP210X20(C,SI) LTRN245X35(C,SV) LTRN245X45(C,SV)	LTPZFL080-00-6-X-24V(C,SV) LTBP096036-X(SI) LT2BC096036-X(C,SI) LTBRZ3 series (C)
70 to 100 mm	LTRN096XX(C,SV) LTRN120XX(C,SV)	LTZGK100-15-5-X-24V(C,SV)		LTZGK100-45-5-X-24V(C,SV)	LT3RF100-60-2-X-24V(C,SV) LT3RF100-60-2-X-24V(C,SV) LTLACX-X(C,SV)	LTTZO130-75-3-X-24V(C,SV)	LTRN210X20(C,SV) LTRNHP210X20(C,SI) LTRN245X25(C,SV)	LTPZFL080-00-6-X-24V(C,SV) LTPZFL120-00-6-X-24V(C,SV) LTBP144036-X(SI) LT2BC144036-X(C,SI) LTBRZ3 series (C)
100 to 150 mm	LTRN120XX(C,SV) LTRN144XX(C,SV)				LT3RF120-60-2-X-24V(C,SV)	LTTZO130-75-3-X-24V(C,SV) LTTZO170-75-3-X-24V(C,SV)		LTPZFL120-00-6-X-24V(C,SV) LTPZFL160-00-6-X-24V(C,SV) LTBP192036-X(SI) LT2BC192036-X(C,SI) LTBRZ3 series (C)
150 to 200 mm						LTTZO170-75-3-X-24V(C,SV)		LTPZFL160-00-6-X-24V(C,SV) LTBP240036-X(SI) LT2BC240036-X(C,SI) LTBRZ3 series (C)
200 to 300 mm								LTBP288036-X(SI) LT2BC288036-X(C,SI) LTBRZ3 series (C)
< 300 mm								LTBRZ3 series (C)

-X refers to the light color

(C) = Continuous mode

(SI) = Strobed mode (constant current I driving)

(SV) = Strobed mode (constant voltage V driving)

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For detailed specifications about the models listed in this chart, enter the specific part number inside the search bar on www.opto-e.com

ACCESSORIES




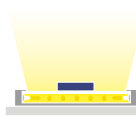




LED LIGHT CONTROLLERS





LTDV series
Strobe controllers



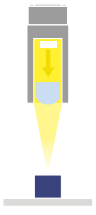


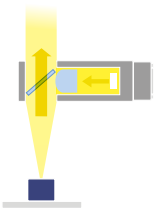
LTIC series
Light intensity controller



COLLIMATED LIGHT		FLAT LIGHT		COAXIAL	DOME	TUNNEL	COMBINED
Circular Beam	Linear Beam	Back-Emitting	Side-Emitting				(DOME + LOW ANGLE RINGLIGHT)
							
LTCLHP2300-X(C,SI)		LTBP048036-X(SI) LT2BC048036-X(C,SI)	LTPVRG25X36-00-1-X-24V(C,SV)	LT2QOG025-00-X-X-24V(C,SV)	LTDMA1-X(SI)		
LTCLHP2300-X(C,SI)		LTBP048036-X(SI) LT2BC048036-X(C,SI)	LTPVRG25X36-00-1-X-24V(C,SV)	LT2QOG025-00-X-X-24V(C,SV)	LTDMA1-X(SI)	LT3WRH150-00-1-X-24V(C,SV)	LTDLAB2-WW(SI)
LTCLHP016-X(C,SI)		LTBP048036-X(SI) LT2BC048036-X(C,SI)	LTPVRG25X36-00-1-X-24V(C,SV)	LT2QOG025-00-X-X-24V(C,SV)	LTDMA1-X(SI)	LT3WRH150-00-1-X-24V(C,SV)	LTDLAB2-WW(SI)
LTCLHP024-X(C,SI)		LTBP048036-X(SI) LT2BC048036-X(C,SI)	LTPVRG25X36-00-1-X-24V(C,SV)	LT2QOG025-00-X-X-24V(C,SV)	LTDMA1-X(SI)	LT3WRH150-00-1-X-24V(C,SV)	LTDLAB2-WW(SI)
LTCLHP036-X(C,SI) LTCLCR036-X(C,SI)		LTBC054054-X(C,SV) LTBP048036-X(SI) LT2BC048036-X(C,SI)	LTPVRG25X36-00-1-X-24V(C,SV)	LT2QOG025-00-X-X-24V(C,SV)	LTDMA1-X(SI)	LT3WRH150-00-1-X-24V(C,SV)	LTDLAB2-WW(SI)
LTCLHP036-X(C,SI) LTCLCR036-X(C,SI)		LTBC054054-X(C,SV) LTBP048036-X(SI) LT2BC048036-X(C,SI)	LTPVRG31X58-00-1-X-24V(C,SV)	LT2QOG040-00-X-X-24V(C,SV)	LTDMA1-X(SI)	LT3WRH150-00-1-X-24V(C,SV)	LTDLAB2-WW(SI)
LTCLHP048-X(C,SI) LTCLCR048-X(C,SI)		LTBC054054-X(C,SV) LTBP096072-X(SI) LT2BC096072-X(C,SI)	LTPVRG31X58-00-1-X-24V(C,SV)	LT2QOG040-00-X-X-24V(C,SV)	LTDMB2-X(SI) LT5WRG070-00-1-X-24V(C,SV)	LT3WRH150-00-1-X-24V(C,SV)	LTDLAB2-WW(SI)
LTCLHP056-X(C,SI) LTCLCR056-X(C,SI) LTCLHP064-X(C,SI) LTCLCR064-X(C,SI)	LTCL4K060-X(C,SI)	LTBC114114-X(C,SV) LTBP096072-X(SI) LT2BC096072-X(C,SI)	LTPVR070-00-1-X-24V(C,SV) LTPVRG070-00-1-X-24V(C,SV)	LT2QOG070-00-X-X-24V(C,SV)	LTDMB2-X(SI) LTDMCX-X(SI) LT5WRG070-00-1-X-24V(C,SV) LT5WRG100-00-1-X-24V(C,SV)	LT3WRH150-00-1-X-24V(C,SV)	LTDLAB2-WW(SI) LTDLACX-WW(SI)
LTCLHP080-X(C,SI) LTCLCR080-X(C,SI) LTCLHP096-X(C,SI) LTCLCR096-X(C,SI)	LTCL4K090-X(C,SI)	LTBC114114-X(C,SV) LTBP144108-X(SI) LT2BC144108-X(C,SI)	LTPVR100-00-1-X-24V(C,SV)	LT2QOG100-00-X-X-24V(C,SV)	LTDMCX-X(SI) LT5WRG100-00-1-X-24V(C,SV) LT5WRG150-00-1-X-24V(C,SV)	LT3WRH150-00-1-X-24V(C,SV)	LTDLACX-WW(SI)
LTCLHP120-X(C,SI) LTCLCR120-X(C,SI) LTCLHP144-X(C,SI) LTCLCP144-G	LTCL4K120-X(C,SI) LTCL4K180-X(C,SI)	LTBC114114-X(C,SV) LTBC174174-X(C,SV) LTBP192180-X(SI) LT2BC192180-X(C,SI)			LT5WRG150-00-1-X-24V(C,SV) LT5WRG200-00-1-X-24V(C,SV)	LT3WRH200-00-1-X-24V(C,SV)	
LTCLHP192-X(C,SI) LTCLCP192-G	LTCL4K180-X(C,SI)	LTBC174174-X(C,SV) LTBC234234-X(C,SV) LTBP240216-X(SI) LT2BC240216-X(C,SI)			LT5WRG200-00-1-X-24V(C,SV) LT5WRG250-00-1-X-24V(C,SV)		
LTCLHP240-X(C,SI)		LTBC234234-X(C,SV) LTBP288216-X(SI) LT2BC288216-X(C,SI)			LT5WRG250-00-1-X-24V(C,SV) LT4WRG360-00-1-X-24V(C,SV)		

POWER SUPPLIES PS series 	DIFFUSION PLATES DFLT series 	POLARIZING PLATES PLLT series 	CLAMPING MECHANICS CMLT series 
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LED LINE LIGHTS SELECTION CHART

LIGHT STRUCTURE	STRAIGHT			COAXIAL
	CONVERGENT		COLLIMATED	CONVERGENT
	Near Field Focusing (N)	Far Field Focusing (F)		Near Field Focusing (N)
				
LONGEST SIDE OF ILLUMINATED OBJECT				
1 to 100 mm	LTLNC100-X(C)			
100 to 150 mm	LTLNC150-X(C)			
150 to 200 mm	LTLNM-0200-N-c-FC-W(C) LTLNC200-X(C)	LTLNM-0200-F-c-FC-W(C)	LTLNM-0200-C-c-FC-W(C)	
200 to 300 mm	LTLNE-300-N-PC-W(C) LTLNE-300-N-FC-W(C) LTLNE-300-N-D-PC-W(C) LTLNE-300-N-D-FC-W(C) LTLNC300-X(C)	LTLNE-300-F-PC-W(C) LTLNE-300-F-FC-W(C) LTLNE-300-F-D-PC-W(C) LTLNE-300-F-D-FC-W(C)	LTLNE-300-C-PC-W(C) LTLNE-300-C-FC-W(C) LTLNE-300-C-D-PC-W(C) LTLNE-300-C-D-FC-W(C)	LTLNE-300-CX-N-PC-W(C) LTLNE-300-CX-N-FC-W(C) LTLNE-300-CX-N-D-PC-W(C) LTLNE-300-CX-N-D-FC-W(C)
300 to 400 mm	LTLNM-0400-N-c-FC-W(C)	LTLNM-0400-F-c-FC-W(C)	LTLNM-0400-C-c-FC-W(C)	
400 to 500 mm				
500 to 1000 mm	LTLNM-0600-N-c-FC-W(C) LTLNM-0800-N-c-FC-W(C) LTLNM-1000-N-c-FC-W(C)	LTLNM-0600-F-c-FC-W(C) LTLNM-0800-F-c-FC-W(C) LTLNM-1000-F-c-FC-W(C)	LTLNM-0600-C-c-FC-W(C) LTLNM-0800-C-c-FC-W(C) LTLNM-1000-C-c-FC-W(C)	
1000 to 1500 mm	LTLNM-1200-N-c-FC-W(C) LTLNM-1400-N-c-FC-W(C)	LTLNM-1200-F-c-FC-W(C) LTLNM-1400-F-c-FC-W(C)	LTLNM-1200-C-c-FC-W(C) LTLNM-1400-C-c-FC-W(C)	
1500 to 2000 mm	LTLNM-1600-N-c-FC-W(C) LTLNM-1800-N-c-FC-W(C) LTLNM-2000-N-c-FC-W(C)	LTLNM-1600-F-c-FC-W(C) LTLNM-1800-F-c-FC-W(C) LTLNM-2000-F-c-FC-W(C)	LTLNM-1600-C-c-FC-W(C) LTLNM-1800-C-c-FC-W(C) LTLNM-2000-C-c-FC-W(C)	

-X refers to the light color

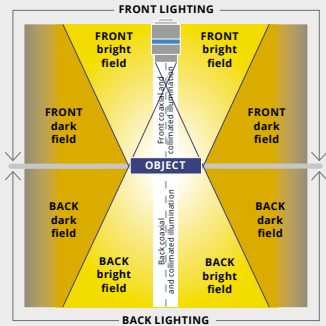
(C) = Continuous mode

(SI) = Strobed mode (constant current I driving)

(SV) = Strobed mode (constant voltage V driving)

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LIGHTING BASICS



Illumination and directionality: the 'W rule'

COAXIAL		45° MIRROR		
CONVERGENT Far Field Focusing (F)	COLLIMATED	CONVERGENT Near Field Focusing (N)	CONVERGENT Far Field Focusing (F)	COLLIMATED
LTLNE-300-CX-F-PC-W(C) LTLNE-300-CX-F-FC-W(C) LTLNE-300-CX-F-D-PC-W(C) LTLNE-300-CX-F-D-FC-W(C)	LTLNE-300-CX-C-PC-W(C) LTLNE-300-CX-C-FC-W(C) LTLNE-300-CX-C-D-PC-W(C) LTLNE-300-CX-C-D-FC-W(C)	LTLNE-300-MR-N-PC-W(C) LTLNE-300-MR-N-FC-W(C) LTLNE-300-MR-N-D-PC-W(C) LTLNE-300-MR-N-D-FC-W(C)	LTLNE-300-MR-F-PC-W(C) LTLNE-300-MR-F-FC-W(C) LTLNE-300-MR-F-D-PC-W(C) LTLNE-300-MR-F-D-FC-W(C)	LTLNE-300-MR-C-PC-W(C) LTLNE-300-MR-C-FC-W(C) LTLNE-300-MR-C-D-PC-W(C) LTLNE-300-MR-C-D-FC-W(C)

Relationship between object color and light color

One way to maximize contrast is to select the light color that is on the opposite side of the wheel of the feature color. In such case, features will appear dark on the image sensor

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