

# Lens





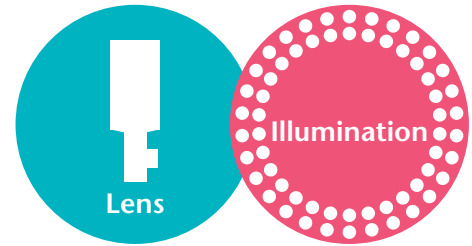
Striving for Quality and Vision technology ahead of market,  
we will keep on creating Moritex Value.

MORITEX is a leading international brand in the machine vision market. With abundant experience in optical technology, we excel in markets such as flat panel display, semiconductor, electronic component mounting, and other markets requiring factory automation. Our product portfolio comprises of a full range of illumination and optical components, modules and systems for machine vision.

# Markets & Locations

## One-Stop Optical Technology Company

MORITEX is a one-stop company which provides various optical technology solutions based on its broad knowledge in optical design and manufacturing. Not only do we offer the excellent combination of lenses and illumination, we can also provide custom, integrated solutions for modules and systems using our core lens and illumination technology.



## Global Network



### Asia

- MORITEX Corporation  
Saitama, Japan
- MORITEX Technologies  
(Shenzhen) Co., Ltd.  
Shenzhen, China

### Europe

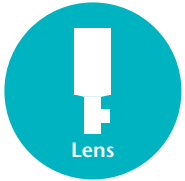
- Moritex Asia Pacific Pte Ltd.  
Singapore

- Europe Representative Office  
Seefeld, Germany

### North America

- MORITEX North America, Inc.  
San Jose, U.S.A.

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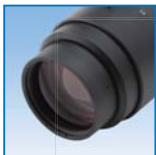
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## Guidance

Telecentric Lens

Non-Telecentric  
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# Basic Information for Lens

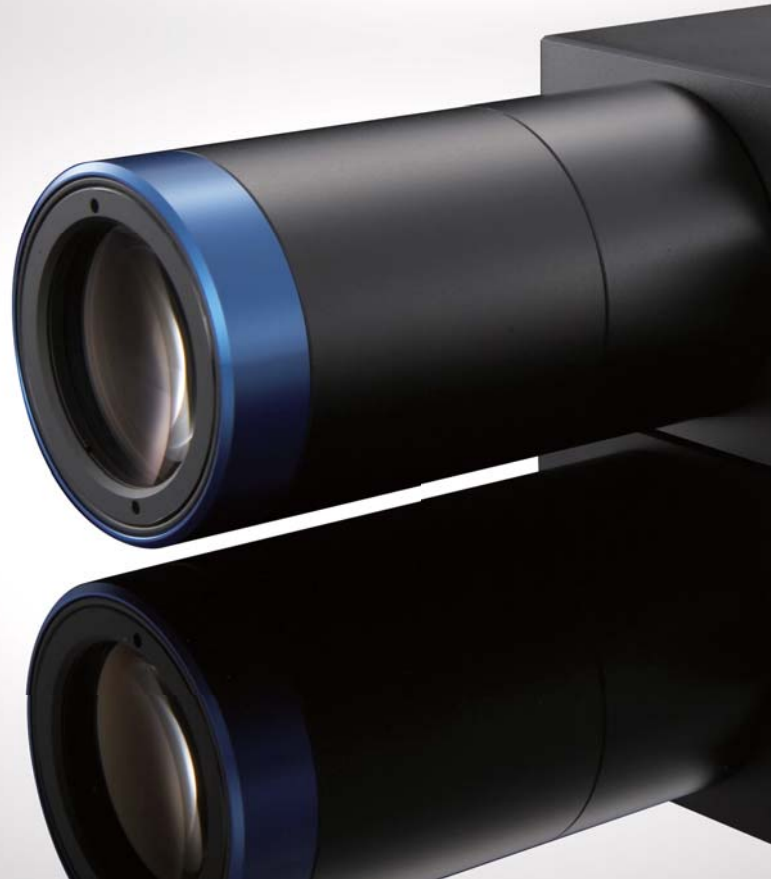
	Features	Advantage	Disadvantage	Applications
<b>Telecentric lens</b> 	<ul style="list-style-type: none"> <li>• High quality lens for machine vision application</li> <li>• The lens, chief rays are designed parallel to the optical axis enable to get precise image</li> </ul>	<ul style="list-style-type: none"> <li>• The best magnification range for machine vision application</li> <li>• High precise image in DOF and at image center to edge</li> <li>• Enable coaxial illumination to see reflective surface</li> </ul>	<ul style="list-style-type: none"> <li>• Low magnification needs big lens diameter</li> <li>• Expensive due to high precise lens</li> </ul>	<ul style="list-style-type: none"> <li>• Si Wafer &amp; LCD panel alignment</li> <li>• Pattern inspection and defect inspection</li> <li>• Electrical parts, connector inspection and measurement</li> </ul>
<b>Macro lens</b> 	<ul style="list-style-type: none"> <li>• Designed high performance at close distance suitable for machine vision</li> <li>• Compact body and high quality image</li> </ul>	<ul style="list-style-type: none"> <li>• Macro range magnification up to 1x</li> <li>• Reasonable price</li> <li>• Available vibration resistance model</li> </ul>	<ul style="list-style-type: none"> <li>• Magnification is changed when the object surface moves in the range of DOF</li> <li>• The image at corner has angle</li> <li>• Light is not homogeneous at image corner</li> </ul>	<ul style="list-style-type: none"> <li>• Electrical parts, connector and automotive parts inspection</li> <li>• IC chip parts alignment and inspection</li> <li>• Food and Pharma production line</li> </ul>
<b>CCTV</b> 	<ul style="list-style-type: none"> <li>• Enable to see wide FOV area</li> <li>• Adjustable functions and accessories support various applications</li> </ul>	<ul style="list-style-type: none"> <li>• Wide line-up by focal length 6mm to 75mm</li> <li>• FOV and DOF are adjustable by variable focus and iris</li> <li>• High cost performance</li> </ul>	<ul style="list-style-type: none"> <li>• Magnification is changed when the object surface moves in the range of DOF</li> <li>• Light is not homogeneous at image corner</li> <li>• Need adjustments focus and iris position</li> </ul>	<ul style="list-style-type: none"> <li>• Parts inspection</li> <li>• Food &amp; Beverage label, packaging inspection</li> <li>• Code reading, OCR</li> </ul>
<b>Line scan lens</b> 	<ul style="list-style-type: none"> <li>• Special designed for Line scan camera</li> <li>• High quality image from image center to edge</li> <li>• Enable to attach to Line scan camera by using Camera mount adapters</li> </ul>	<ul style="list-style-type: none"> <li>• High brightness optical design</li> <li>• Excellent lighting uniformity and lens resolution</li> <li>• Robustness mechanical design</li> </ul>	<ul style="list-style-type: none"> <li>• Heavy weight compared with SLR due to aluminum body</li> </ul>	<ul style="list-style-type: none"> <li>• FPD inspection (Glass, TFT and color filter)</li> <li>• PCB inspection (AOI, AVI)</li> <li>• WEB inspection</li> </ul>

# Chart for Sensor Size

	Product name	Lens type	Mount	Pix.	Sensor Size (mm)																			
					1/3"	1/2"	2/3"	1"	1.2"	12M	25M	29M/12K3.5	8K7	12K5/16K3.5	16K5	6mm	8mm	11mm	12.8mm	14mm	16.5mm	22.5mm	28mm	32mm
Telecentric	<b>SOD-10X</b>	Telecentric	C	5µm	[Bar chart showing sensor size range for SOD-10X]																			
	<b>SOD-20X</b>	Telecentric	C	5µm	[Bar chart showing sensor size range for SOD-20X]																			
	<b>MML-HR5M</b>	Telecentric	C	3.5µm	[Bar chart showing sensor size range for MML-HR5M]																			
	<b>MML-HR</b>	Telecentric	C	5µm	[Bar chart showing sensor size range for MML-HR]																			
	<b>MML-ST</b>	Telecentric	C	7µm	[Bar chart showing sensor size range for MML-ST]																			
	<b>ML-Z07545HR</b> <b>ML-Z07545</b>	Telecentric Zoom Telecentric Zoom	C C	5µm 7µm	[Bar chart showing sensor size range for ML-Z07545HR and ML-Z07545]																			
Macro	<b>ML-MCHR</b>	Macro	C	5µm	[Bar chart showing sensor size range for ML-MCHR]																			
	<b>ML-N</b>	Macro	C	7µm	[Bar chart showing sensor size range for ML-N]																			
	<b>ML-Z0108</b>	Macro Zoom	C	7µm	[Bar chart showing sensor size range for ML-Z0108]																			
	<b>MLH-10X</b>	Macro Varifocal	C	7µm	[Bar chart showing sensor size range for MLH-10X]																			
	<b>MLH-3XMP</b>	Macro Zoom	C	7µm	[Bar chart showing sensor size range for MLH-3XMP]																			
CCTV	<b>MTE-55</b>	CCTV	C	7µm	[Bar chart showing sensor size range for MTE-55]																			
	<b>ML-MP5</b>	CCTV	C	3.5µm	[Bar chart showing sensor size range for ML-MP5]																			
	<b>ML-MP</b>	CCTV	C	5µm	[Bar chart showing sensor size range for ML-MP]																			
	<b>ML</b>	CCTV	C	7µm	[Bar chart showing sensor size range for ML]																			
LineScan	<b>ML-F90C</b>	Macro	M72	3.5µm	[Bar chart showing sensor size range for ML-F90C]																			
	<b>ML-F80C</b>	Macro	M72,M84.5,M95,F	5~10µm	[Bar chart showing sensor size range for ML-F80C]																			
	<b>ML-12K5A</b>	Macro	M72. F	5µm	[Bar chart showing sensor size range for ML-12K5A]																			

\*Camera mount of line scan is optional.

# Telecentric Lens



MORITEX high quality telecentric lenses have become the industry standard for semiconductor, FPD, and other electronics manufacturing applications that require machine vision for recognition, mounting, alignment, or inspection. Our lenses enable high contrast, high resolution and low distortion imaging with optional integrated coaxial illumination that utilizes our proprietary hot spot reduction techniques.

Catalog specifications alone cannot convey the high level of MORITEX lens quality.



## SOD-X

The cutting-edge SOD-X Series consists of a unique set of multifunctional telecentric lenses designed with high NA, high magnification, and integrated coaxial illumination while providing a long working distance. They allow for high resolution imaging never seen before in a machine vision lens.

High Magnification  
Machine Micro Lens  
**SOD-10X / 20X-VI**





## MML

Essential in alignment, gauging, and inspection applications, the Machine Micro Lens (MML) Series are the highest quality fixed magnification, compact telecentric lenses available. The Standard (ST), High Resolution (HR), and 5 Megapixel (HR 5M) Series offer solutions for a wide-range of machine vision systems including the NIR light range.

Fixed Magnification Telecentric Lens  
**MML High Resolution 5M Series**  
**MML High Resolution Series**  
**MML Standard Series**  
**MML Series**

For Use  
 with Near-Infrared  
**MML-NIR Series**

## MML-Zoom Lens

This telecentric zoom lens series is used for high performance inspection and object recognition when a wide range of FOV and long WD are required. The ML-Z and ML-Z HR Series offer integrated coaxial illumination, adapter lenses, and motorized zoom function options.

High Resolution  
 Zoom Lens  
**ML-Z07545HR Series**  
 Standard Zoom Lens  
**ML-Z07545 Series**

# High Magnification Machine Micro Lens

## Super Optical Device-SOD-10X

The SOD-10X is the first telecentric machine vision lens that we introduced with the resolution to rival microscope objectives. The long WD and high NA have made it indispensable for high magnification alignment & inspection applications of 10x or greater.

High performance rear converters allow for magnifications of 15x & 20x to be achieved without changing the working distance allowing microscope type performance in a relatively compact package.

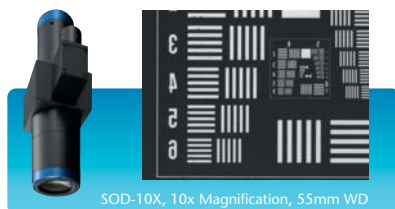
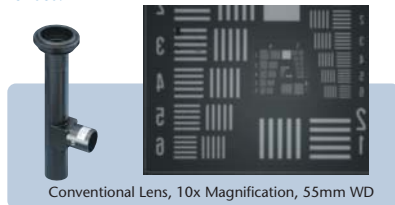
- 10× optical magnification
- Capable of 15× and 20× with rear converter lenses
- High NA of 0.23
- High resolution, 1.5 $\mu$ m
- Compact, integrated design



### 1 Even Better Images

#### High Resolution and NA

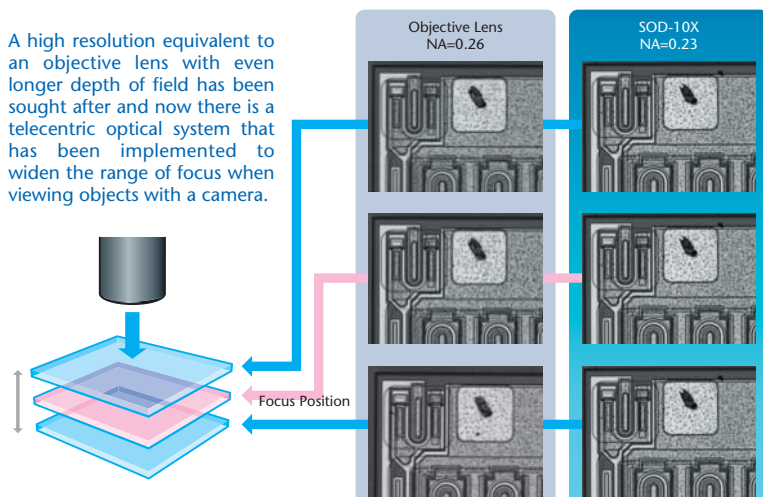
Achievement of high resolution that is beyond comparison with conventional machine vision lenses.



### 2 Wide Focus Range

#### Deep Depth of Field Telecentric Optical System

A high resolution equivalent to an objective lens with even longer depth of field has been sought after and now there is a telecentric optical system that has been implemented to widen the range of focus when viewing objects with a camera.



# High Magnification Machine Micro Lens

## Super Optical Device-SOD-20X-VI

This revolutionary 20× magnification SOD series model has a high NA & resolution that put it in the microscope objective lens class.

In addition, it boasts a long WD of 37.5 mm that provides you with additional space to install Illumination and motion, handling, & transfer systems.

The all-in-one machine vision lens has a compact body with an integrated coaxial epi-illumination also saving space & improving on-axis light quality.

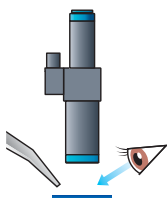
- 20× optical magnification
- Capable of 30× and 40× with rear converter lenses
- High NA of 0.35
- High resolution, 1μm
- Variable iris



### 3 Ease of Use **Long WD**

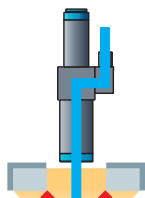
Improved ease of use through longer WD (working distance) while maintaining high resolution.

Sufficient space for tooling and pick-up tools has been provided allowing the performance of operations thought to be impossible with conventional lenses. Operating position and work status can be confirmed by eye resulting in a reduction of operating errors.



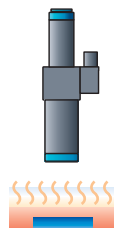
Establishment of operating space  
Confirmation of operation status and position possible by eye

Opens the possibility of using not only coaxial but ring and various other types of illumination. This increase in lighting options allows for the imaging of objects previously difficult to view and resolve.



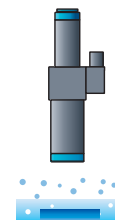
Oblique illumination is possible

Recognition is possible at a location with necessary separation from heat sources. Alignment and inspection are also possible during thermo compression bonding.



Separation from heat source

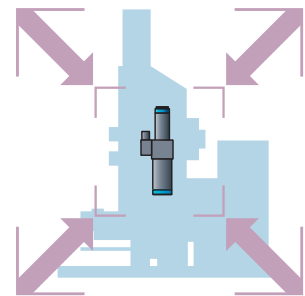
Observation can be performed without any effects from water, oil, and foreign objects generated or moved during processing.



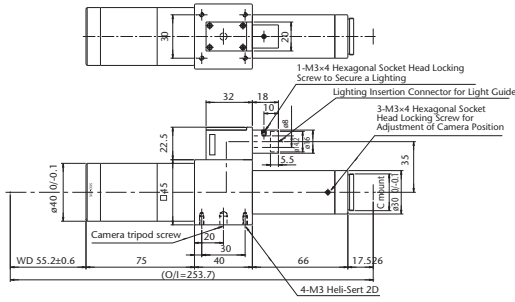
Use in environments where substances such as water & oil are disturbed

### 4 Compact

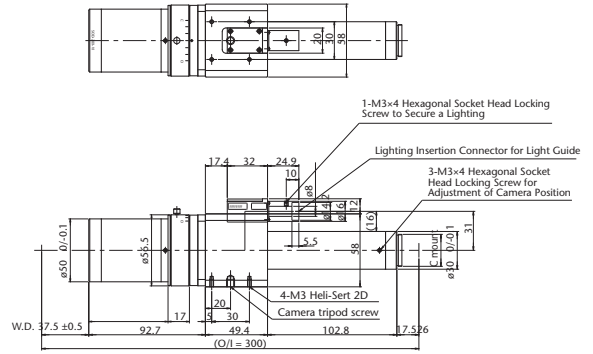
Compact design makes it possible to downsize peripheral parts and machinery.



SOD-10X

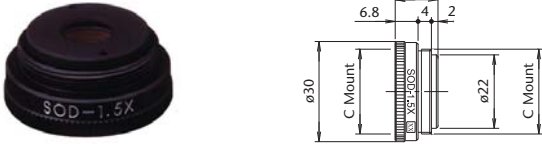


SOD-20X-VI

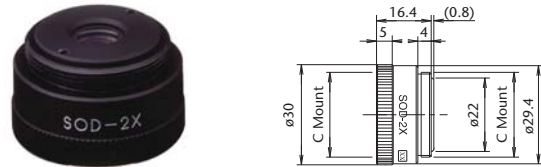


Rear Converter Lens (Option)

SOD-1.5X



SOD-2X

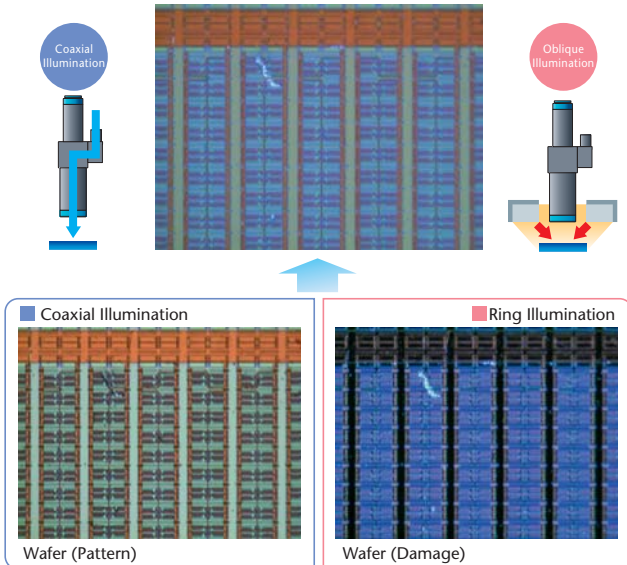


Model	Magnification	O/I	WD	Resolution	Depth of Field	NA	Effective F No	TV Distortion	Largest Compatible	Weight
SOD-10X	×10	253.7mm	55.2mm	1.5μm	0.017mm	0.23	22	0.01% or less	2/3"	500g
SOD-1.5X	×15	260.5mm	55.2mm	1.5μm	0.012mm	0.23	33	0.05% or less	2/3"	20g
SOD-2X	×20	266.1mm	55.2mm	1.5μm	0.009mm	0.23	44	0.04% or less	2/3"	30g
SOD-20X-VI	×20	300mm	37.5mm	1μm ~ 3μm	0.0057mm ~ 0.026mm	0.35 ~ 0.113	28.3 ~ 88	0.02% or less	2/3"	930g
SOD-1.5X	×30	306.8mm	37.5mm	1μm ~ 3μm	0.0038mm ~ 0.012mm	0.35 ~ 0.113	42.5 ~ 132	0.04% or less	2/3"	20g
SOD-2X	×40	312.4mm	37.5mm	1μm ~ 3μm	0.0029mm ~ 0.009mm	0.35 ~ 0.113	56.6 ~ 176	-0.07% or less	2/3"	30g

Application Sample

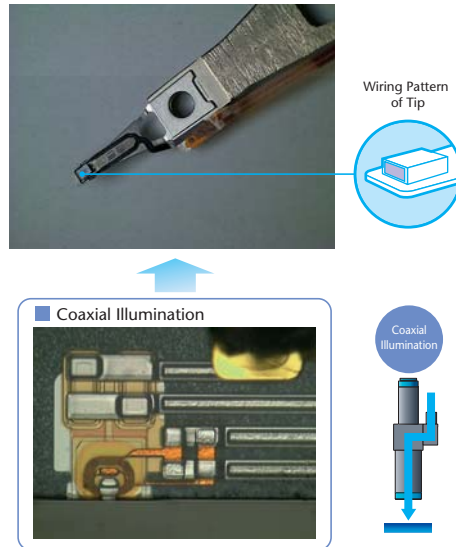
Silicon Wafers

Recognition of wafer patterns using coaxial illumination. Recognition of damage and foreign objects using ring illumination.



Hard Disk Reading Head

Highly uneven objects are covered by using a wide focus range.



# MML

Essential in alignment, gauging, and inspection applications, the Machine Micro Lens (MML) Series are the highest quality fixed magnification, compact telecentric lenses available. The Standard (ST), High Resolution (HR), and 5 Megapixel (HR 5M) Series offer solutions for a wide-range of machine vision systems including the NIR light range.

## MML High Resolution 5M MML-HR 5M Series

Top quality product types that boast the best contrast and NA among the entire MML Series. The highest possible image quality can be obtained in combination with high pixel count cameras such as the increasingly popular 5 mega pixel sensors. Various models also include iris control.



## MML High Resolution MML-HR Series

High performance MML Series models designed for cameras with 1.3 million pixels and up (i.e. ~4.65 microns/pixel) with relatively small barrel diameters.



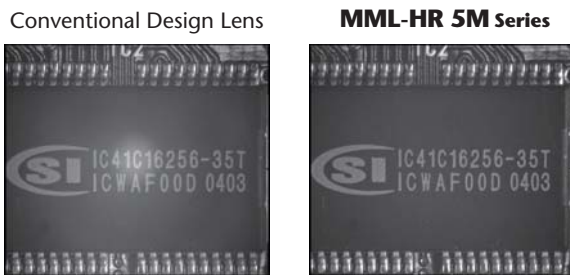
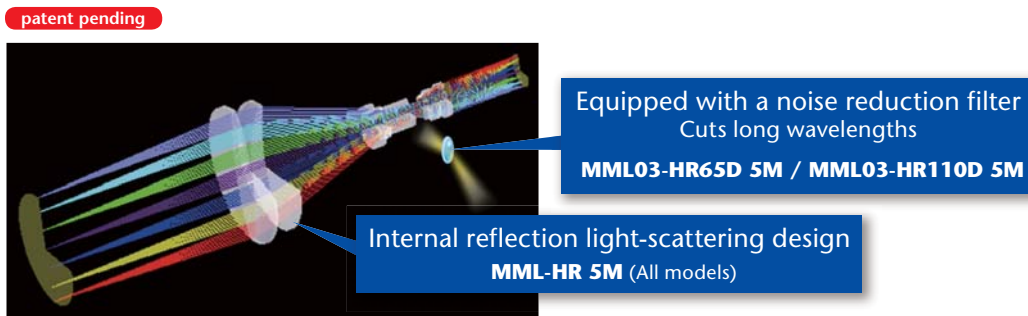
## MML Standard MML-ST Series

This series offers the highest level of optical performance when coupled with 410 thousand pixel cameras. Compact ( $\varnothing$  16mm) standard models with long DOF (Depth of Field) design.





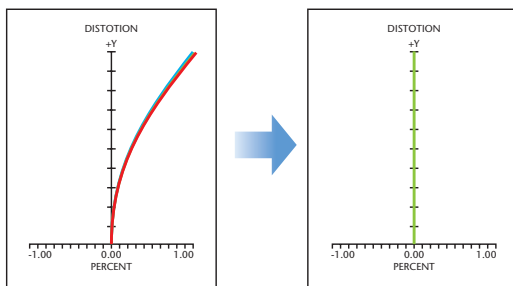
## Provisions made to reduce coaxial illumination hot spots seen in low magnification lenses



Please note that although the lens is structured to suppress hot spots, hot spots will occur for mat surface work.

## Extremely Low Distortion

The pursuit of high resolution with no aberration has resulted in the elimination of image bending. This means that it is no longer necessary to consider distortion offsets.



Conventional MML

**MML-HR & MML-ST**

## High Contrast

Contrast improvement has enabled image recognition with greater emphasis on the black and white shading. By converting the resolution chart image to binary form and then graphing and comparing the brightness levels, the MML-HR greatly emphasizes the difference in brightness between black and white object features when compared to our prior Mega MML.



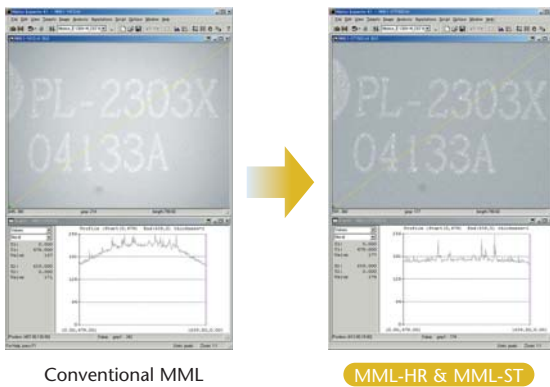
Conventional MML

**MML-HR & MML-ST**

## Illumination Uniformity

For object recognition on a matte surface with coaxial illumination, only a small amount of light is reflected from the surface requiring the coaxial light intensity to be increased. When this is done, however, the brightness in the center of the image increases due to reflection in the coaxial illumination lensing. The ST and HR Series solve this problem through a hot spot reduction technique that vastly reduces the reflection from the lens. This improves the uniformity of coaxial illumination for even matte surfaces.

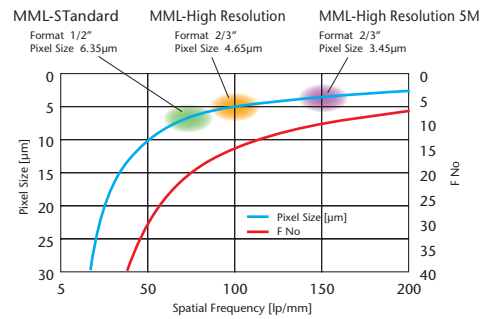
Below, OCR using coaxial illumination was performed on a rough, microcomputer chip surface. The MML-ST/HR brightness graph shows a reduction in the variation between the brightness in the center and periphery of the FOV which can also be seen in the sample images.



## Design Concept

Pixel size, resolution limitation frequency, F No relation

The MML HR/ST Series consist of three types of optical design focuses as well as for camera compatibility.



## C Mount

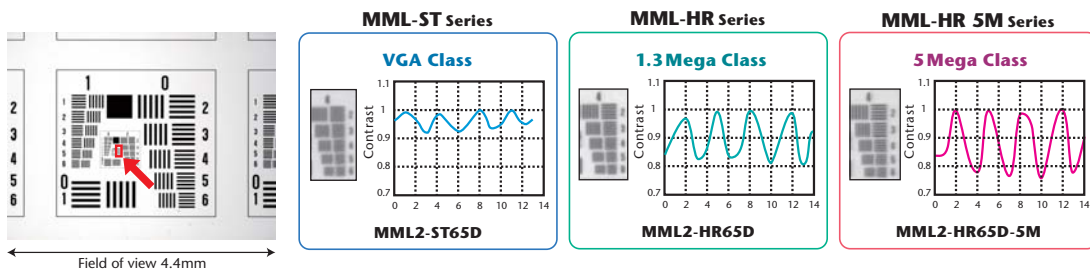
## 3 Different Mount Types



MORITEX provides customized responses to requests for modifications of mounts and special mounts.

## Image Comparison for MML Series

- Camera: 5 million pixels, 3.45µm/pixel
- Lens: Optical magnification 2x WD65 mm
- Test Chart : Resolving power 5.563µm (Resolution 179.6 lp/mm)



## Fixed Magnification Telecentric Lens

# MML High Resolution 5M Series

High-resolution models that possess the best contrast and NA of all MML Series. Image acquisition with even higher image quality is realized by combining these lenses with cameras with a high number of pixels, especially emerging 5 megapixel sensors.

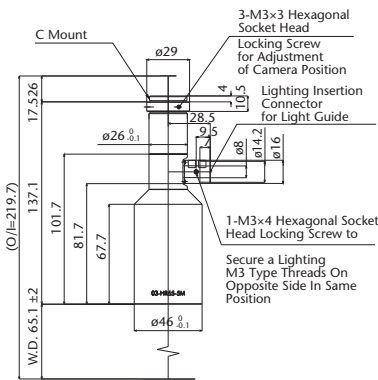
- Highest image quality model of the MMLs Series.
- Supports 5 million pixels (3.34 $\mu$ m/pixel)  
\* Except for MML4-HR65DVI-5M
- Use of internal reflection light-scattering design and noise reduction filter for hot spot reduction
- Variable iris available for most models
- Very low distortion



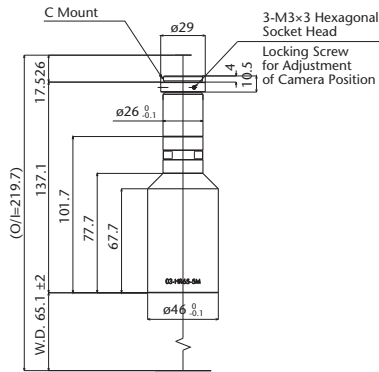
Model	Magnification	O/I	WD	Resolution	Depth of Field	NA	Effective FNo	TV Distortion	Largest Compatible Camera	Weight
MML03-HR65D-5M	×0.3	219.7mm	65.1mm	15.7 $\mu$ m	6.2mm	0.021	7	0.01% or less	2/3"	202g
MML03-HR65-5M	×0.3	219.7mm	65.1mm	15.7 $\mu$ m	6.2mm	0.021	7	0.01% or less	2/3"	198g
MML05-HR65DVI-5M	×0.5	219.8mm	65.3mm	9.3 $\mu$ m ~ 41 $\mu$ m	2.2mm ~ 9.8mm	0.036 ~ 0.008	7 ~ 30.6	0.01% or less	2/3"	210g
MML05-HR65VI-5M	×0.5	219.8mm	65.3mm	9.3 $\mu$ m ~ 41 $\mu$ m	2.2mm ~ 9.8mm	0.036 ~ 0.008	7 ~ 30.6	0.01% or less	2/3"	210g
MML1-HR65DVI-5M	×1	167.5mm	65mm	4.7 $\mu$ m ~ 19 $\mu$ m	0.56mm ~ 2.2mm	0.071 ~ 0.018	7 ~ 28	0.02% or less	2/3"	140g
MML1-HR65VI-5M	×1	167.5mm	65mm	4.7 $\mu$ m ~ 19 $\mu$ m	0.56mm ~ 2.2mm	0.071 ~ 0.018	7 ~ 28	0.02% or less	2/3"	135g
MML2-HR65DVI-5M	×2	185mm	65mm	2.4 $\mu$ m ~ 15.3 $\mu$ m	0.15mm ~ 0.9mm	0.14 ~ 0.022	7.3 ~ 44.9	0.04% or less	2/3"	200g
MML2-HR65VI-5M	×2	185mm	65mm	2.4 $\mu$ m ~ 15.3 $\mu$ m	0.15mm ~ 0.9mm	0.14 ~ 0.022	7.3 ~ 44.9	0.04% or less	2/3"	190g
MML3-HR65DVI-5M	×3	209.5mm	65mm	2.1 $\mu$ m ~ 10.5 $\mu$ m	0.085mm ~ 0.42mm	0.157 ~ 0.032	9.6 ~ 47.5	0.01% or less	2/3"	280g
MML3-HR65VI-5M	×3	209.5mm	65mm	2.1 $\mu$ m ~ 10.5 $\mu$ m	0.085mm ~ 0.42mm	0.157 ~ 0.032	9.6 ~ 47.5	0.01% or less	2/3"	275g
MML4-HR65DVI-5M	×4	225.1mm	65mm	2 $\mu$ m ~ 8.2 $\mu$ m	0.06mm ~ 0.24mm	0.167 ~ 0.041	12.1 ~ 48.6	0.01% or less	2/3"	290g
MML4-HR65VI-5M	×4	225.1mm	65mm	2 $\mu$ m ~ 8.2 $\mu$ m	0.06mm ~ 0.24mm	0.167 ~ 0.041	12.1 ~ 48.6	0.01% or less	2/3"	285g
MML014-HR110D-5M	×0.14	300mm	110mm	19.3 $\mu$ m	16.4mm	0.018	4	-0.01% or less	2/3"	730g
MML03-HR110D-5M	×0.3	269.9mm	110mm	15.7 $\mu$ m	6.2mm	0.021	7	0.02% or less	2/3"	212g
MML03-HR110-5M	×0.3	269.9mm	110mm	15.7 $\mu$ m	6.2mm	0.021	7	0.02% or less	2/3"	209g



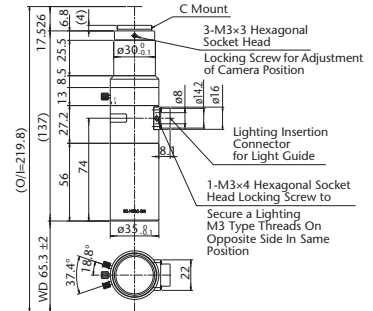
MML03-HR65D-5M



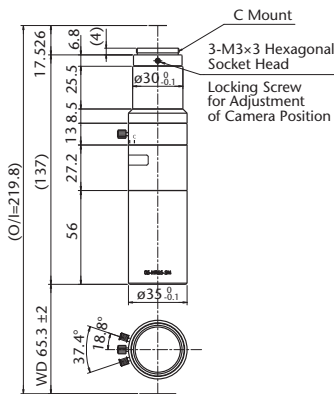
MML03-HR65-5M



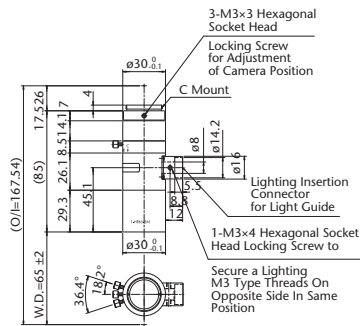
MML05-HR65DVI-5M



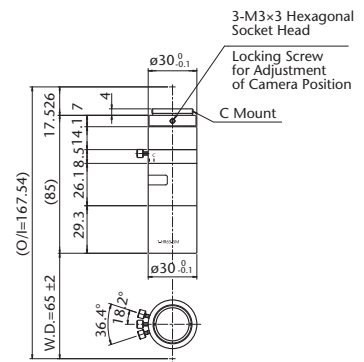
MML05-HR65VI-5M



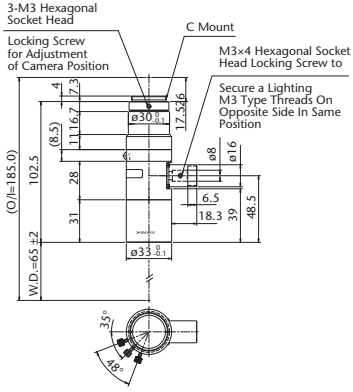
MML1-HR65DVI-5M



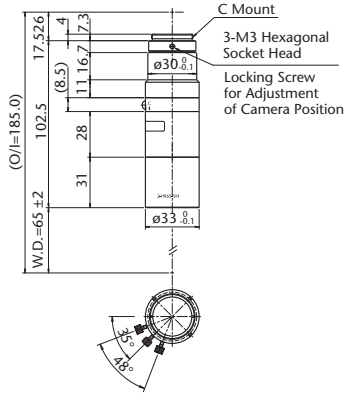
MML1-HR65VI-5M



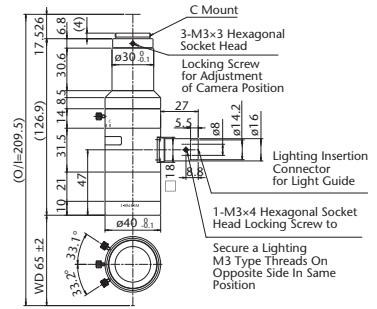
MML2-HR65DVI-5M



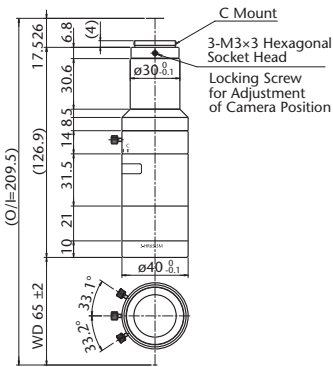
MML2-HR65VI-5M



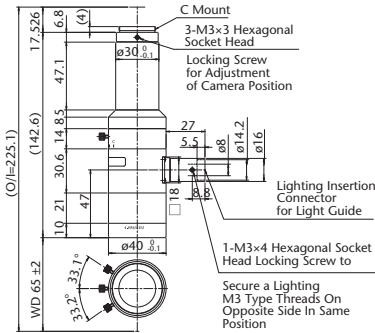
MML3-HR65DVI-5M



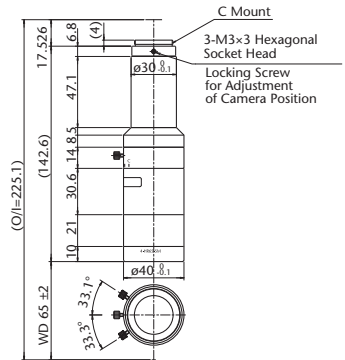
MML3-HR65VI-5M



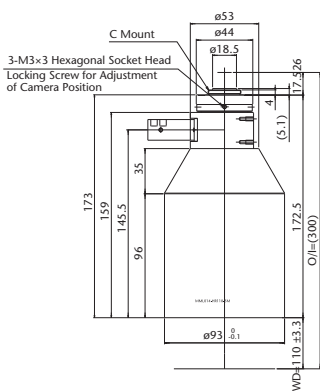
MML4-HR65DVI-5M



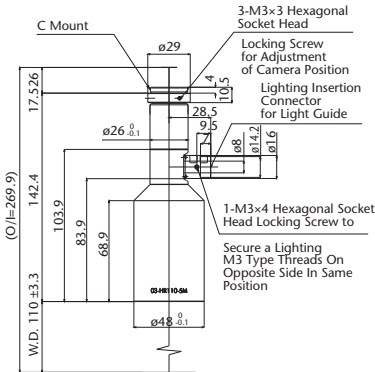
MML4-HR65VI-5M



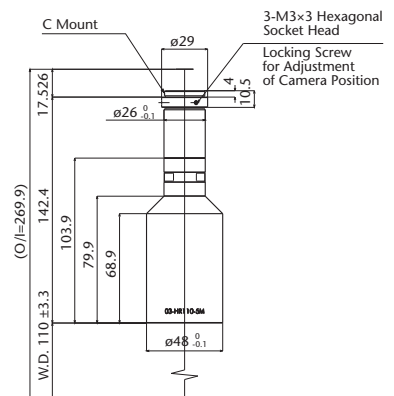
MML014-HR110D-5M



MML03-HR110D-5M



MML03-HR110-5M





# Fixed Magnification Telecentric Lens

## MML-HR Series

The MML-HR Series consists of highly versatile models that support mega pixel cameras with 1.3 million pixels or more (4.65 $\mu$ m/pixel).

The entire lineup features a high resolution and contrast design that realizes amazingly high image quality which cannot be shown by numbers alone. This series provides true imaging power in high end inspections and alignment applications.



- Supports mega pixel cameras, 1.3 million pixels or greater
- High resolution throughout the entire field of view
- High NA and contrast
- Most models compatible with 2/3" or smaller imaging sensors

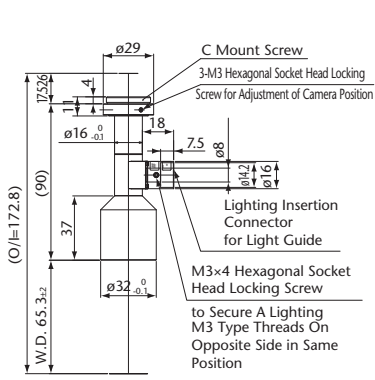
### WD65mm

Model	Magnification	O/I	WD	Resolution	Depth of Field	NA	Effective FNo	TV Distortion	Largest Compatible Camera	Weight
MML05-HR65D	×0.5	172.8mm	65.3mm	12.8 $\mu$ m	3mm	0.026	9.5	-0.01% or less	2/3"	75g
MML08-HR65D	×0.8	172.3mm	65mm	8.4 $\mu$ m	1.2mm	0.04	9.9	0.02% or less	2/3"	64g
MML1-HR65D	×1	162.5mm	65mm	7.5 $\mu$ m	0.88mm	0.045	11	0.02% or less	2/3"	58g
MML1.5-HR65D	×1.5	157.2mm	65mm	5.4 $\mu$ m	0.42mm	0.063	12	-0.04% or less	1/2"	53g
MML2-HR65D	×2	162.6mm	65mm	4.5 $\mu$ m	0.27mm	0.074	13.5	0.02% or less	2/3"	52g
MML4-HR65D	×4	187.2mm	65mm	3 $\mu$ m	0.09mm	0.112	17.9	0.02% or less	2/3"	94g
MML6-HR65D	×6	202.1mm	65mm	3 $\mu$ m	0.06mm	0.112	26.7	0.01% or less	2/3"	102g
MML4-HR65D-VI	×4	187.2mm	65mm	3 $\mu$ m ~ 13.3 $\mu$ m	0.09mm ~ 0.53mm	0.112 ~ 0.025	17.9 ~ 79.2	0.02% or less	2/3"	95g
MML6-HR65D-VI	×6	202.1mm	65mm	3 $\mu$ m ~ 13.9 $\mu$ m	0.06mm ~ 0.58mm	0.112 ~ 0.024	26.7 ~ 124	0.01% or less	2/3"	102g

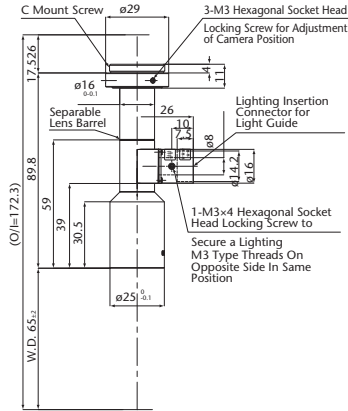
\* Resolution values indicate the theoretical resolution at a wavelength of 550nm.

\* Depth of field is calculated assuming a horizontal 240TV resolution using a 1/2 CCD camera. (Permissible circle of confusion on the image-formation side: 40 $\mu$ m)

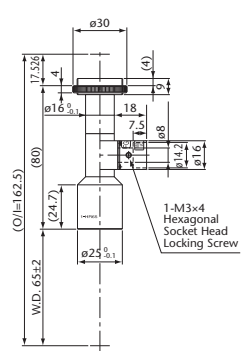
### MML05-HR65D



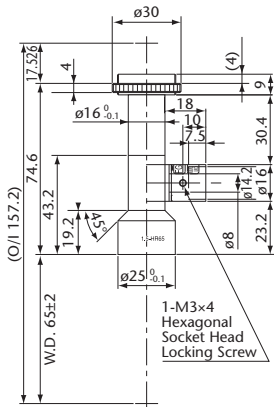
### MML08-HR65D



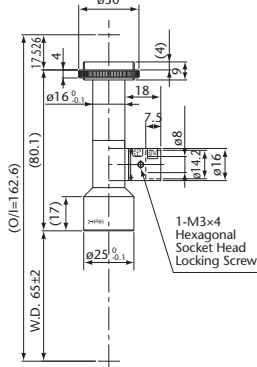
### MML1-HR65D



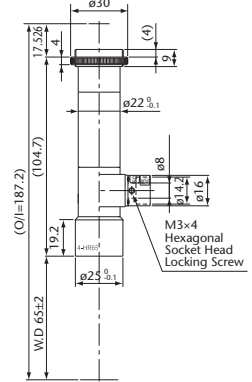
### MML1.5-HR65D



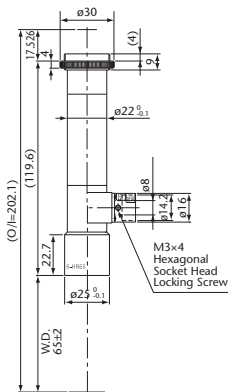
### MML2-HR65D



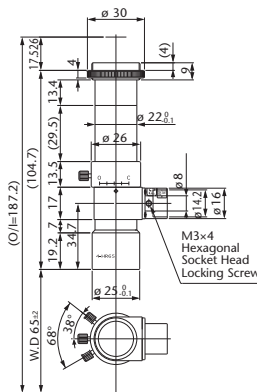
### MML4-HR65D



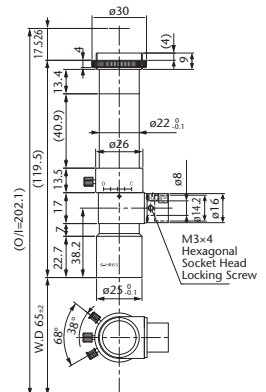
### MML6-HR65D



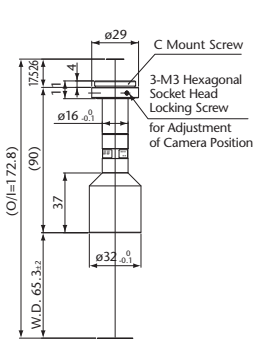
### MML4-HR65D-VI



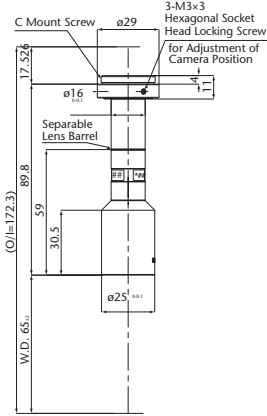
### MML6-HR65D-VI



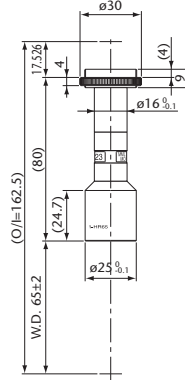
MML05-HR65



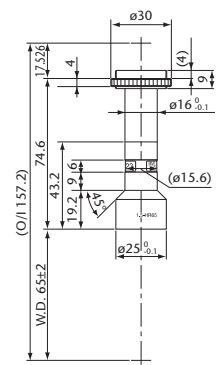
MML08-HR65



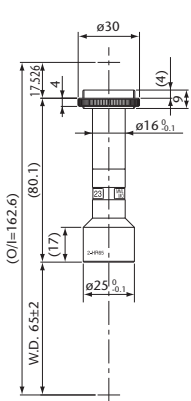
MML1-HR65



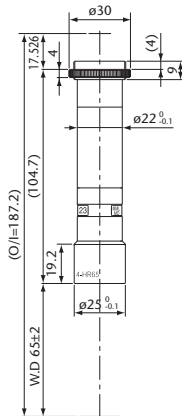
MML1.5-HR65



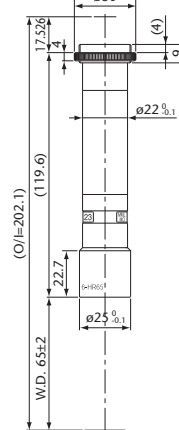
MML2-HR65



MML4-HR65



MML6-HR65



Model	Magnification	O/I	WD	Resolution	Depth of Field	NA	Effective FNo	TV Distortion	Largest Compatible Camera	Weight
MML05-HR65	×0.5	172.8mm	65.3mm	12.8µm	3mm	0.026	9.5	-0.01% or less	2/3"	70g
MML08-HR65	×0.8	172.3mm	65mm	8.4µm	1.2mm	0.04	9.9	0.02% or less	2/3"	60g
MML1-HR65	×1	162.5mm	65mm	7.5µm	0.88mm	0.045	11	0.02% or less	2/3"	50g
MML1.5-HR65	×1.5	157.2mm	65mm	5.4µm	0.42mm	0.063	12	-0.04% or less	1/2"	46g
MML2-HR65	×2	162.6mm	65mm	4.5µm	0.27mm	0.074	13.5	0.02% or less	2/3"	46g
MML4-HR65	×4	187.2mm	65mm	3µm	0.09mm	0.112	17.9	0.02% or less	2/3"	86g
MML6-HR65	×6	202.1mm	65mm	3µm	0.06mm	0.112	26.7	0.01% or less	2/3"	94g

\* Resolution values indicate the theoretical resolution at a wavelength of 550nm.

\* Depth of field is calculated assuming a horizontal 240TV resolution using a 1/2" CCD camera. (Permissible circle of confusion on the image-formation side: 40µm)



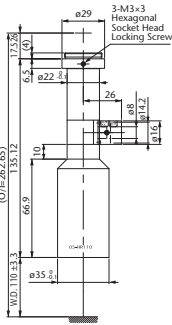
MML-PL25HR

Dedicated 90° prism for MML-HR. See page 46 for details.

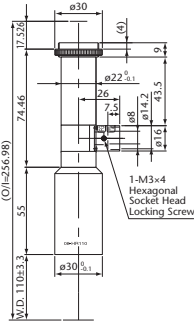
WD110mm



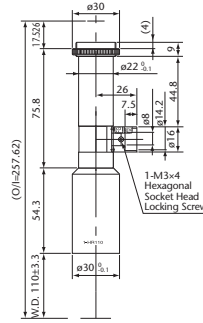
MML05-HR110D



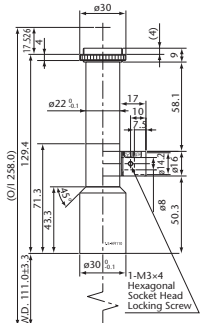
MML08-HR110D



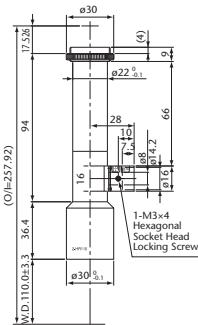
MML1-HR110D



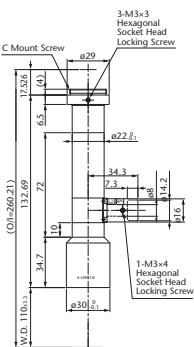
MML1.5-HR110D



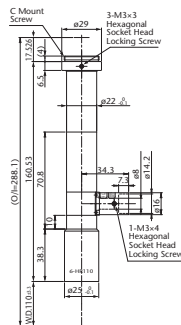
MML2-HR110D



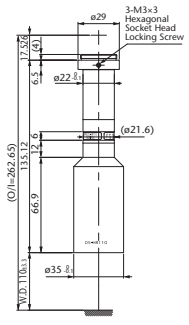
MML4-HR110D



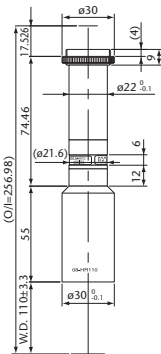
MML6-HR110D



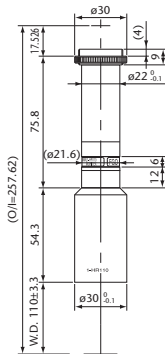
MML05-HR110



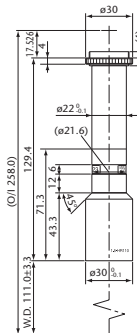
MML08-HR110



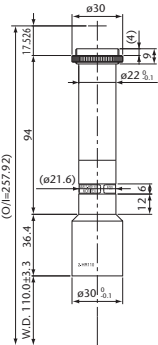
MML1-HR110



MML1.5-HR110



MML2-HR110



Model	Magnification	O/I	WD	Resolution	Depth of Field	NA	Effective FNo	TV Distortion	Largest Compatible Camera	Weight
MML05-HR110D	×0.5	262.6mm	110mm	12.8µm	3mm	0.026	9.5	0.02% or less	2/3"	142g
MML08-HR110D	×0.8	257mm	110mm	9.3µm	1.4mm	0.036	11	0.01% or less	2/3"	112g
MML1-HR110D	×1	257.6mm	110mm	7.4µm	0.88mm	0.045	11	0.01% or less	2/3"	115g
MML1.5-HR110D	×1.5	258mm	111mm	5.4µm	0.42mm	0.063	12	0.03% or less	2/3"	110g
MML2-HR110D	×2	257.9mm	110mm	4.5µm	0.27mm	0.074	13.5	0.02% or less	2/3"	110g
MML4-HR110D	×4	260.2mm	110mm	3.7µm	0.11mm	0.09	22.2	-0.01% or less	2/3"	125g
MML6-HR110D	×6	288.1mm	110mm	4.5µm	0.09mm	0.075	39.9	0.03% or less	2/3"	140g
MML05-HR110	×0.5	262.6mm	110mm	12.8µm	3mm	0.026	9.5	0.02% or less	2/3"	137g
MML08-HR110	×0.8	257mm	110mm	9.3µm	1.4mm	0.036	11	0.01% or less	2/3"	109g
MML1-HR110	×1	257.6mm	110mm	7.4µm	0.88mm	0.045	11	0.01% or less	2/3"	110g
MML1.5-HR110	×1.5	258mm	111mm	5.4µm	0.42mm	0.063	12	0.03% or less	2/3"	98g
MML2-HR110	×2	257.9mm	110mm	4.5µm	0.27mm	0.074	13.5	0.02% or less	2/3"	100g

\* Resolution values indicate the theoretical resolution at a wavelength of 550nm.

\* Depth of field is calculated assuming a horizontal 240TV resolution using a 1/2" CCD camera. (Permissible circle of confusion on the image-formation side: 40µm)

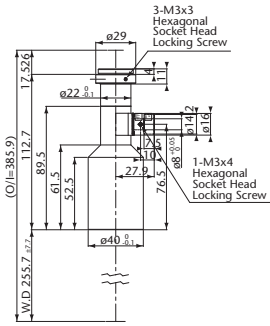
WD220mm



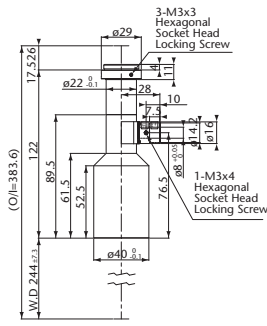
Fixed Magnification Telecentric Lens

MML-HR Series

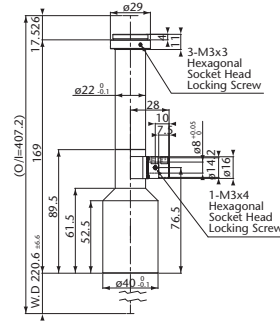
MML08-HR255D



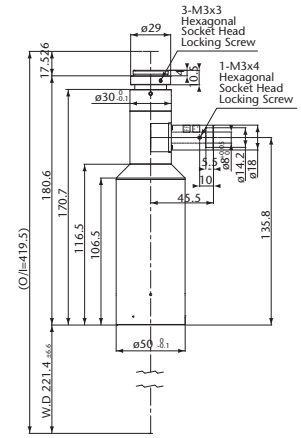
MML1-HR244D



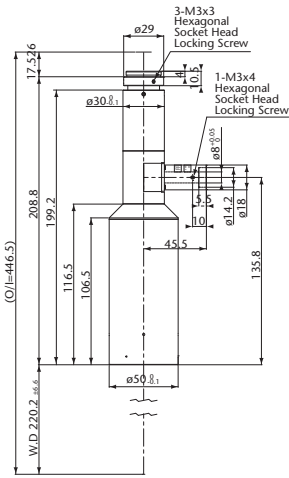
MML2-HR220D



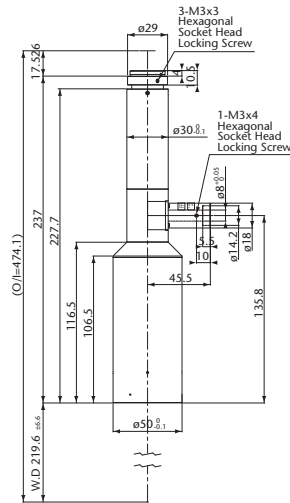
MML4-HR220D



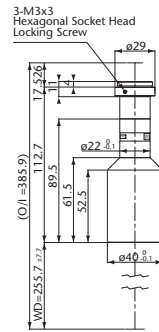
MML6-HR220D



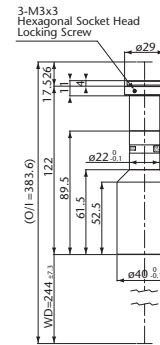
MML8-HR220D



MML08-HR255



MML1-HR244



Model	Magnification	O/I	WD	Resolution	Depth of Field	NA	Effective FNo	TV Distortion	Largest Compatible Camera	Weight
MML08-HR255D	×0.8	385.9mm	255.7mm	8.5μm	1.3mm	0.04	10.1	0.2% or less	2/3"	150g
MML1-HR244D	×1	383.6mm	244mm	8.4μm	1mm	0.04	12.6	0.1% or less	2/3"	155g
MML2-HR220D	×2	407.2mm	220.6mm	8.4μm	0.5mm	0.04	25	0.03% or less	2/3"	175g
MML4-HR220D	×4	419.5mm	221.4mm	4μm	0.12mm	0.08	24.3	0.04% or less	2/3"	490g
MML6-HR220D	×6	446.5mm	220.2mm	4μm	0.08mm	0.08	36.2	0.02% or less	2/3"	510g
MML8-HR220D	×8	474.1mm	219.6mm	4μm	0.06mm	0.08	48	0.01% or less	2/3"	530g
MML08-HR255	×0.8	385.9mm	255.7mm	8.5μm	1.3mm	0.04	10.1	0.2% or less	2/3"	145g
MML1-HR244	×1	383.6mm	244mm	8.4μm	1mm	0.04	12.6	0.1% or less	2/3"	150g

\* Resolution values indicate the theoretical resolution at a wavelength of 550nm.  
 \* Depth of field is calculated assuming a horizontal 240TV resolution using a 1/2" CCD camera. (Permissible circle of confusion on the image-formation side: 40μm)





# Fixed Magnification Telecentric Lens

## MML-ST Series

Through combination with 410 thousand pixel or greater cameras, the renewed design of the MML-ST Series realizes high level optical performance. These compact models with a diameter of 16mm feature a long depth of field making them ideal for installation in manufacturing equipment.

- Compact design with a lens barrel diameter from  $\varnothing 16$
- Long Depth of Field
- Number of pixels: 410 thousand or higher
- Camera Size: 1/2" or less in most cases



### WD40mm

Model	Magnification	O/I	WD	Resolution	Depth of Field	NA	Effective F No	TV Distortion	Largest Compatible Camera	Weight
MML1-ST40D	×1	105mm	40mm	7.2 $\mu$ m	0.88mm	0.046	11	-0.02% or less	1/2"	31g
MML1.5-ST40D	×1.5	105.1mm	40.1mm	5.6 $\mu$ m	0.44mm	0.06	12.5	0.02% or less	1/2"	31g
MML2-ST40D	×2	96.1mm	40.1mm	4.8 $\mu$ m	0.29mm	0.07	14.3	0.01% or less	1/2"	34g
★ MML3-ST40D	×3	106.9mm	37.9mm	4.8 $\mu$ m	0.19mm	0.07	21.3	-0.05% or less	1/2"	33g
MML4-ST40D	×4	103.9mm	40.9mm	4.8 $\mu$ m	0.14mm	0.07	28.5	0.01% or less	1/2"	36g
MML6-ST40D	×6	117.5mm	40.3mm	4.8 $\mu$ m	0.1mm	0.07	42.8	-0.02% or less	1/2"	39g
MML8-ST40D	×8	131.3mm	40mm	4.8 $\mu$ m	0.07mm	0.07	57	-0.02% or less	1/2"	42g
MML1-ST40	×1	105mm	40mm	7.2 $\mu$ m	0.88mm	0.046	11	-0.02% or less	1/2"	26g
MML1.5-ST40	×1.5	105.1mm	40.1mm	5.6 $\mu$ m	0.44mm	0.06	12.5	0.02% or less	1/2"	26g
MML2-ST40	×2	96.1mm	40.1mm	4.8 $\mu$ m	0.29mm	0.07	14.3	0.01% or less	1/2"	29g
★ MML3-ST40	×3	106.9mm	37.9mm	4.8 $\mu$ m	0.19mm	0.07	21.3	-0.05% or less	1/2"	28g
MML4-ST40	×4	103.9mm	40.9mm	4.8 $\mu$ m	0.14mm	0.07	28.5	0.01% or less	1/2"	31g
MML6-ST40	×6	117.5mm	40.3mm	4.8 $\mu$ m	0.1mm	0.07	42.8	-0.02% or less	1/2"	35g
★ MML8-ST40	×8	131.3mm	40mm	4.8 $\mu$ m	0.07mm	0.07	57	-0.02% or less	1/2"	37g

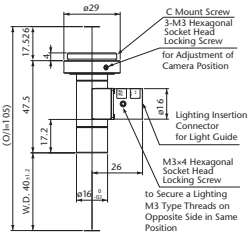
\*Depth of field is calculated assuming a horizontal 240TV resolution using a 1/2" CCD camera. (Permissible circle of confusion on the image-formation side: 40 $\mu$ m)

\*Resolution values indicate the theoretical resolution at a wavelength of 550nm.

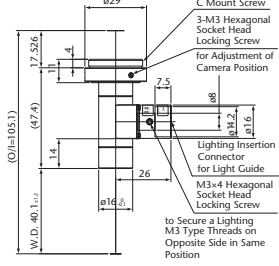
Caution: The WD 40mm series cannot be used with all prism adapter options.

★Made-to-order products.

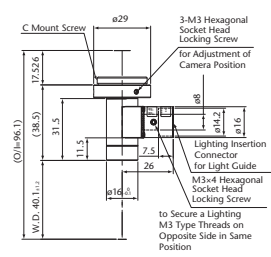
MML1-ST40D



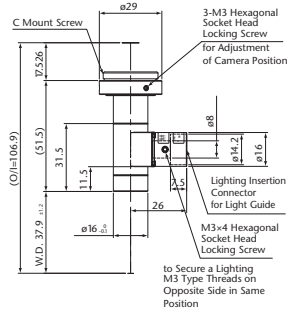
MML1.5-ST40D



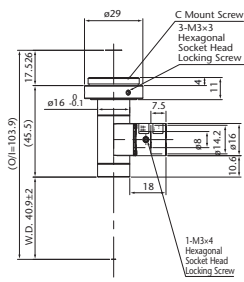
MML2-ST40D



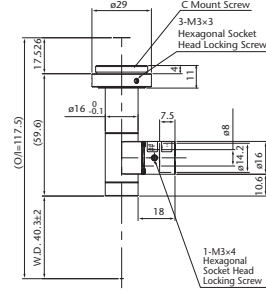
MML3-ST40D



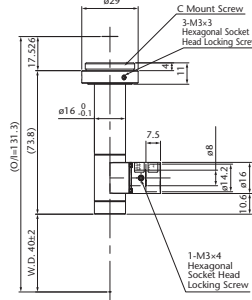
MML4-ST40D



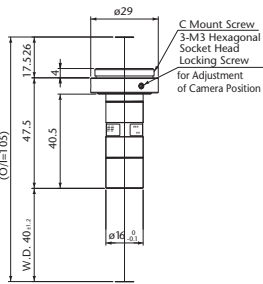
MML6-ST40D



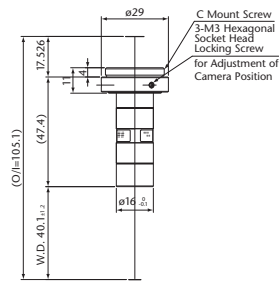
MML8-ST40D



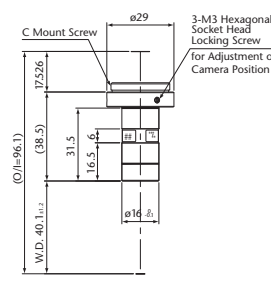
MML1-ST40



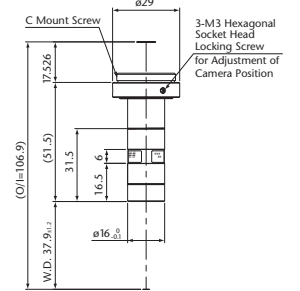
MML1.5-ST40



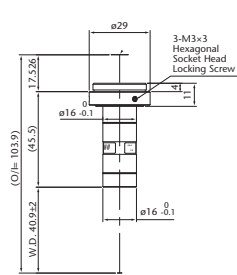
MML2-ST40



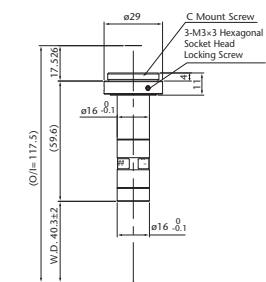
MML3-ST40



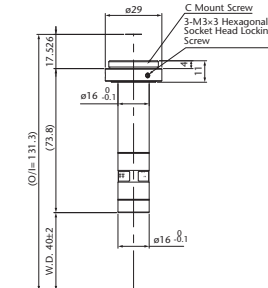
MML4-ST40



MML6-ST40

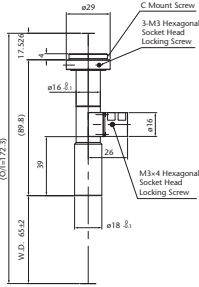


MML8-ST40

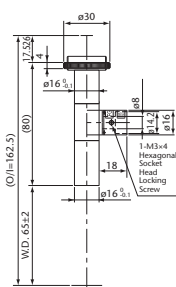


WD65mm

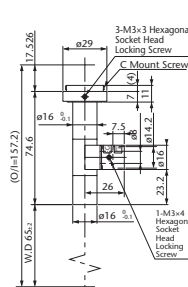
MML08-ST65D



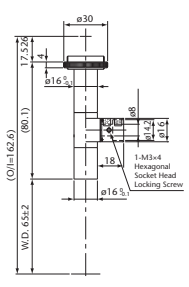
MML1-ST65D



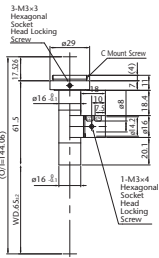
MML1.5-ST65D



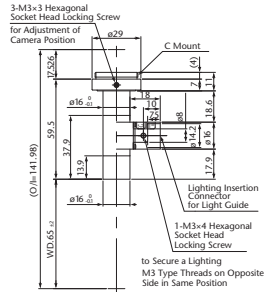
MML2-ST65D



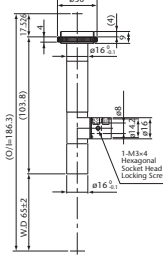
MML2-ST65DS



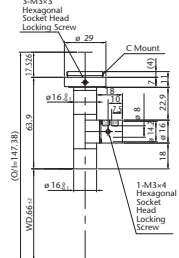
MML3-ST65DS



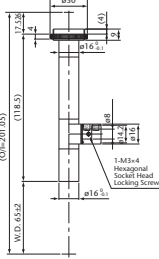
MML4-ST65D



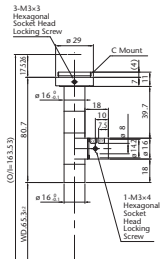
MML4-ST65DS



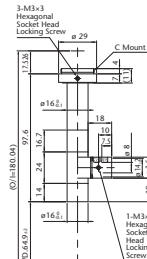
MML6-ST65D



MML6-ST65DS



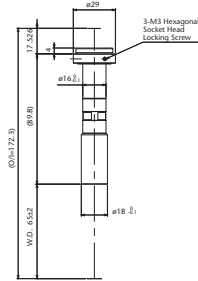
MML8-ST65DS



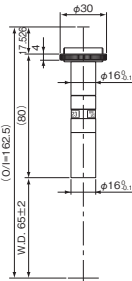
Model	Magnification	O/I	WD	Resolution	Depth of Field	NA	Effective FNo	TV Distortion	Largest Compatible Camera	Weight
MML08-ST65D	×0.8	172.3mm	65mm	12.4μm	1.9mm	0.027	14.9	0.01% or less	1/2"	49g
MML1-ST65D	×1	162.5mm	65mm	12.5μm	1.49mm	0.027	18.6	0.01% or less	1/2"	44g
MML1.5-ST65D	×1.5	157.2mm	65mm	7μm	0.56mm	0.048	15.5	-0.04% or less	1/2"	43g
MML2-ST65D	×2	162.6mm	65mm	5.8μm	0.35mm	0.057	17.3	0.02% or less	1/2"	44g
MML2-ST65DS	×2	144.1mm	65mm	5.8μm	0.35mm	0.057	17.3	0.01% or less	1/2"	37g
MML3-ST65DS	×3	142mm	65mm	4.7μm	0.19mm	0.07	21.9	0.01% or less	1/2"	35g
MML4-ST65D	×4	186.3mm	65mm	4.6μm	0.14mm	0.073	27	0.01% or less	1/2"	55g
MML4-ST65DS	×4	147.4mm	66mm	4.4μm	0.13mm	0.076	25.9	0.02% or less	1/2"	41g
MML6-ST65D	×6	201.1mm	65mm	4.6μm	0.091mm	0.073	40.9	0.01% or less	1/2"	60g
MML6-ST65DS	×6	163.5mm	65.3mm	4.4μm	0.09mm	0.076	39.3	0.01% or less	1/2"	43g
MML8-ST65DS	×8	180mm	64.9mm	4.4μm	0.07mm	0.076	52.3	-0.01% or less	1/2"	46g

\* Depth of field is calculated assuming a horizontal 240TV resolution using a 1/2" CCD camera. (Permissible circle of confusion on the image-formation side: 40μm)  
 \* Resolution values indicate the theoretical resolution at a wavelength of 550nm.

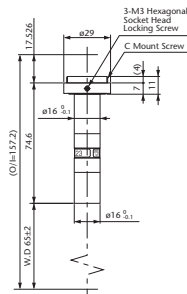
MML08-ST65



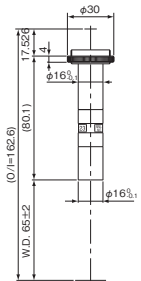
MML1-ST65



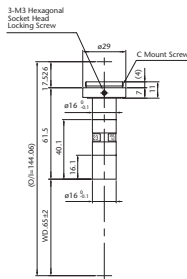
MML1.5-ST65



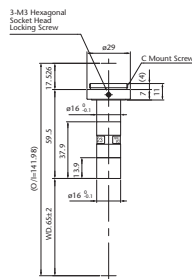
MML2-ST65



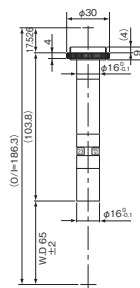
MML2-ST65S



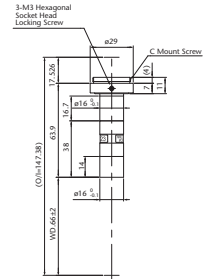
MML3-ST65S



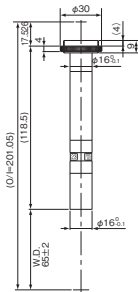
MML4-ST65



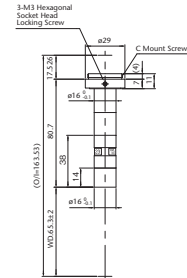
MML4-ST65S



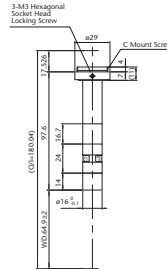
MML6-ST65



MML6-ST65S



MML8-ST65S



Model	Magnification	O/I	WD	Resolution	Depth of Field	NA	Effective FNo	TV Distortion	Largest Compatible Camera	Weight
MML08-ST65	×0.8	172.3mm	65mm	12.4µm	1.9mm	0.027	14.9	0.01% or less	1/2"	44g
MML1-ST65	×1	162.5mm	65mm	12.5µm	1.49mm	0.027	18.6	0.01% or less	1/2"	38g
MML1.5-ST65	×1.5	157.2mm	65mm	7µm	0.56mm	0.048	15.5	-0.04% or less	1/2"	36g
MML2-ST65	×2	162.6mm	65mm	5.8µm	0.35mm	0.057	17.3	0.02% or less	1/2"	38g
MML2-ST65S	×2	144.1mm	65mm	5.8µm	0.35mm	0.057	17.3	0.01% or less	1/2"	32g
MML3-ST65S	×3	142mm	65mm	4.7µm	0.19mm	0.07	21.9	0.01% or less	1/2"	30g
MML4-ST65	×4	186.3mm	65mm	4.6µm	0.14mm	0.073	27	0.01% or less	1/2"	50g
MML4-ST65S	×4	147.4mm	66mm	4.4µm	0.13mm	0.076	25.9	0.02% or less	1/2"	36g
★ MML6-ST65	×6	201.1mm	65mm	4.6µm	0.091mm	0.073	40.9	0.01% or less	1/2"	55g
MML6-ST65S	×6	163.5mm	65.3mm	4.4µm	0.09mm	0.076	39.3	0.01% or less	1/2"	38g
MML8-ST65S	×8	180mm	64.9mm	4.4µm	0.07mm	0.076	52.3	-0.01% or less	1/2"	42g

\* Depth of field is calculated assuming a horizontal 240TV resolution using a 1/2" CCD camera. (Permissible circle of confusion on the image-formation side: 40µm)

\* Resolution values indicate the theoretical resolution at a wavelength of 550nm.

★ Made-to-order products.

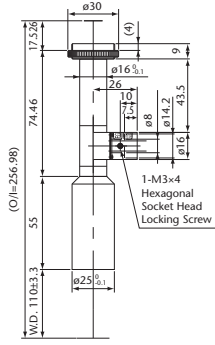
Optical Specifications for Recommended Combinations of MML Models and Rear Converter Lenses

Model	Converter Lenses	Magnification	Resolution	Depth of Field	Effective F No
MML1-ST65D/65	SOD-1.5X	1.5 X	12.5µm	0.99mm	27.9
	SOD-2X	2.0 X	12.5µm	0.74mm	37.2
MML1.5-ST65D/65	SOD-1.5X	2.25X	7µm	0.37mm	23.4
	SOD-2X	3X	7µm	0.28mm	31.3
MML2-ST65D/65	SOD-1.5X	3 X	5.8µm	0.23mm	26
	SOD-2X	4 X	5.8µm	0.17mm	34.6

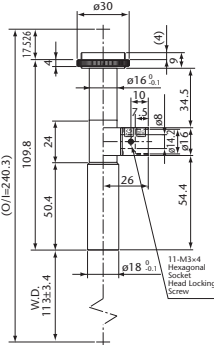
Caution: If combinations other than those recommended are used, dirt and scratches on the rear converter may be noticeable in the resulting images. For this reason, we do not recommend the use in any other setup for optimal performance.

# WD110mm

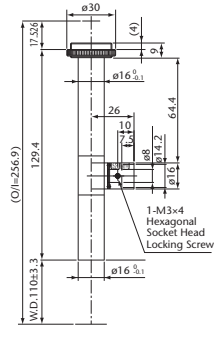
MML08-ST110D



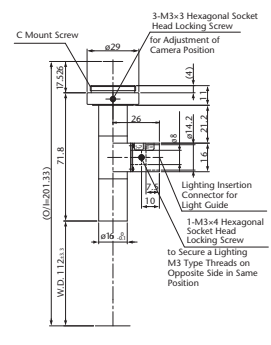
MML1-ST110D



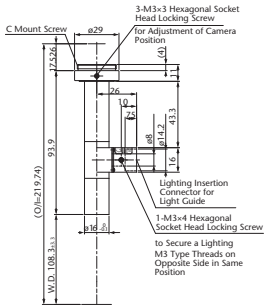
MML2-ST110D



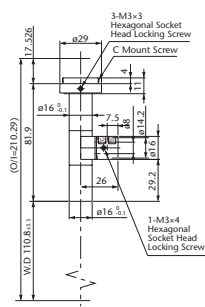
MML2-ST110DS



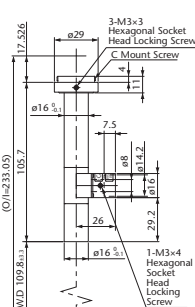
MML3-ST110DS



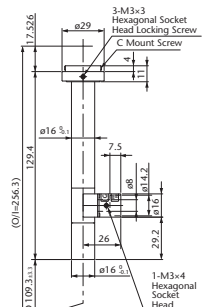
MML4-ST110D



MML6-ST110D

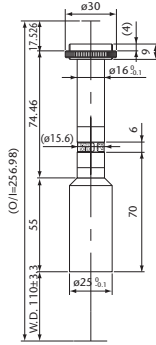


MML8-ST110D

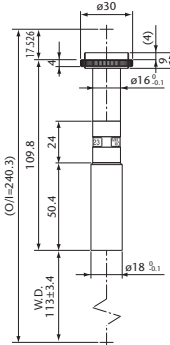


Model	Magnification	O/I	WD	Resolution	Depth of Field	NA	Effective FNo	TV Distortion	Largest Compatible Camera	Weight
MML08-ST110D	×0.8	257mm	110mm	13.5µm	2mm	0.024	16.1	0.01% or less	1/2"	85g
MML1-ST110D	×1	240.3mm	113mm	14µm	1.67mm	0.024	20.9	0.05% or less	1/2"	58g
MML2-ST110D	×2	256.9mm	110mm	11µm	0.66mm	0.03	33.2	0.01% or less	1/2"	55g
MML2-ST110DS	×2	201.3mm	112mm	11.2µm	0.66mm	0.03	33.2	0.01% or less	1/2"	39g
MML3-ST110DS	×3	219.7mm	108.3mm	11.2µm	0.44mm	0.03	49.7	0.01% or less	1/2"	43g
MML4-ST110D	×4	210.3mm	110.8mm	7.5µm	0.22mm	0.045	44.4	0.03% or less	1/2"	43g
MML6-ST110D	×6	233.1mm	109.8mm	7.5µm	0.17mm	0.045	66.4	-0.01% or less	1/2"	48g
MML8-ST110D	×8	256.3mm	109.3mm	7.5µm	0.17mm	0.045	88.4	-0.01% or less	1/2"	54g

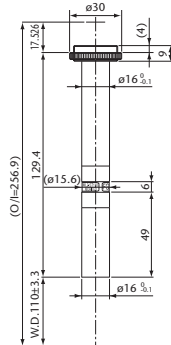
MML08-ST110



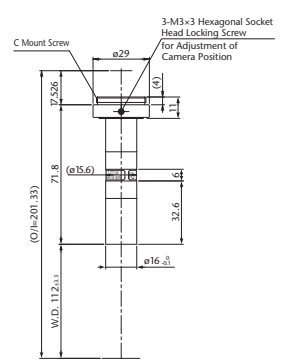
MML1-ST110



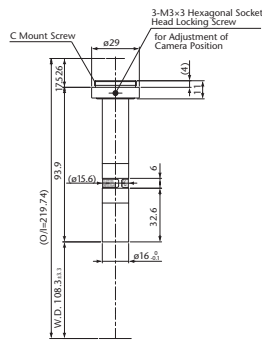
MML2-ST110



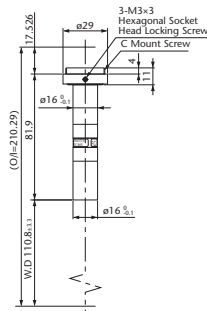
MML2-ST110S



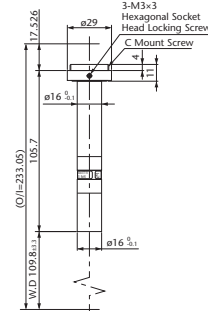
MML3-ST110S



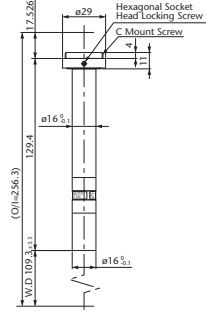
MML4-ST110



MML6-ST110



MML8-ST110



Model	Magnification	O/I	WD	Resolution	Depth of Field	NA	Effective F No	TV Distortion	Largest Compatible Camera	Weight
MML08-ST110	×0.8	257mm	110mm	13.5µm	2mm	0.024	16.1	0.01% or less	1/2"	79g
MML1-ST110	×1	240.3mm	113mm	14µm	1.67mm	0.024	20.9	0.05% or less	1/2"	50g
MML2-ST110	×2	256.9mm	110mm	11µm	0.66mm	0.03	33.2	0.01% or less	1/2"	50g
MML2-ST110S	×2	201.3mm	112mm	11.2µm	0.66mm	0.03	33.2	0.01% or less	1/2"	34g
MML3-ST110S	×3	219.7mm	108.3mm	11.2µm	0.44mm	0.03	49.7	0.01% or less	1/2"	37g
MML4-ST110	×4	210.3mm	110.8mm	7.5µm	0.22mm	0.045	44.4	0.03% or less	1/2"	38g
MML6-ST110	×6	233.1mm	109.8mm	7.5µm	0.17mm	0.045	66.4	-0.01% or less	1/2"	43g
MML8-ST110	×8	256.3mm	109.3mm	7.5µm	0.17mm	0.045	88.4	-0.01% or less	1/2"	49g

Optical Specifications for Machine Types Recommended for Combination with the Rear Converter

Model	Converter Lenses	Magnification	Resolution	Depth of Field	Effective F No
MML08-ST110D/110	SOD-1.5X	1.2 x	13.5µm	1.34mm	24.2
	SOD-2X	1.6 x	13.5µm	1.00mm	32.2
MML1-ST110D/110	SOD-1.5X	1.5 x	14µm	1.11mm	31.4
	SOD-2X	2.0 x	14µm	0.84mm	41.8
MML2-ST110D/110	SOD-1.5X	3 x	11µm	0.44mm	49.8

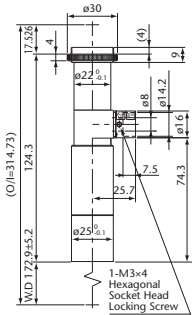
\* Depth of field is calculated assuming a horizontal 240TV resolution using a 1/2" CCD camera. (Permissible circle of confusion on the image-formation side: 40µm)

\* Resolution values indicate the theoretical resolution at a wavelength of 550nm.

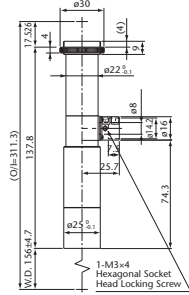
Caution: If combinations other than those recommended are used, dirt and scratches on the rear converter may be noticeable in the resulting images. For this reason, we do not recommend the use in any other setup for optimal performance

WD150mm

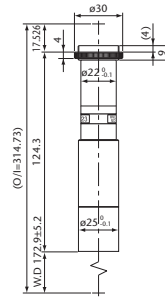
MML08-ST170D



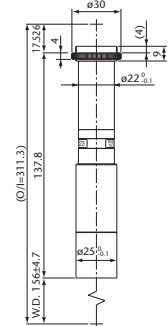
MML1-ST150D



MML08-ST170



MML1-ST150



Model	Magnification	O/I	WD	Resolution	Depth of Field	NA	Effective F No	TV Distortion	Largest Compatible Camera	Weight
MML08-ST170D	×0.8	314.7mm	172.9mm	12µm	1.8mm	0.028	14	0.03% or less	1/2"	80g
MML1-ST150D	×1	311.3mm	156mm	8.8µm	1.1mm	0.038	13	0.03% or less	1/2"	90g
MML08-ST170	×0.8	314.7mm	172.9mm	12µm	1.8mm	0.028	14	0.03% or less	1/2"	76g
MML1-ST150	×1	311.3mm	156mm	8.8µm	1.1mm	0.038	13	0.03% or less	1/2"	84g

\* Resolution values indicate the theoretical resolution at a wavelength of 550nm.

\* Depth of field is calculated assuming a horizontal 240TV resolution using a 1/2" CCD camera. (Permissible circle of confusion on the image-formation side: 40µm)

Optical Specifications for Machine Types Recommended for Combination with Rear Converter

Model	Converter Lenses	Magnification	Resolution	Depth of Field	Effective F No
MML08-ST170D/170	SOD-1.5X	1.2x	12µm	1.17mm	21
	SOD-2X	1.6x	12µm	0.88mm	28
MML1-ST150D/150	SOD-1.5X	1.5x	8.8µm	0.69mm	19.5
	SOD-2X	2.0x	8.8µm	0.52mm	26

Caution: If combinations other than those recommended are used, dirt and scratches on the rear converter may be noticeable in the resulting images. For this reason, we do not recommend the use in any other setup for optimal performance.



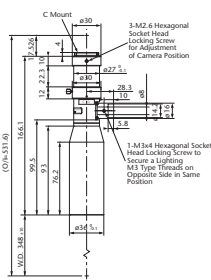
### WD300mm

Lenses with a very long working distance of 300mm are available with optical magnifications of 0.5x, 1x, 3x, & 4x for long stand-off applications. Improved flexibility and ease-of-use is achieved with variable iris control.

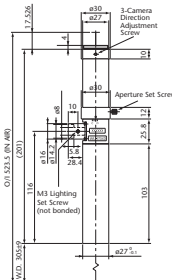


- Magnifications: 0.5x, 1x, 3x, & 4x
- WD=300 mm
- With variable iris of 22.7-C32

### MML05-ST300DVI



### MML1-ST300D



Model	Magnification	O/I	WD	Resolution	Depth of Field	NA	Effective FNo	TV Distortion	Largest Compatible Camera	Weight
MML05-ST300DVI	×0.5	531.6mm	348mm	15.3μm ~ 37.3μm	3.6mm ~ 8.9mm	0.022 ~ 0.009	11.4 ~ 27.8	0.06% or less	1/2"	200g
MML1-ST300D	×1	523.5mm	305mm	15μm ~ 27μm	1.8mm ~ 2.6mm	0.022 ~ 0.016	22.7 ~ 32	0.05% or less	1/2"	150g

\* Resolution values indicate the theoretical resolution at a wavelength of 550nm.  
 \* Depth of field is calculated assuming a horizontal 240TV resolution using a 1/2" CCD camera. (Permissible circle of confusion on the image-formation side: 40μm)

### Optical Specifications for Recommended Combinations of MML Models & Rear Converters

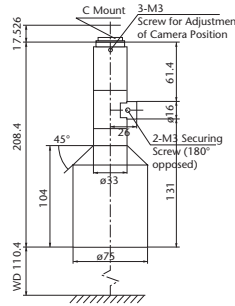
Model	Converter Lenses	Magnification	Resolution	Depth of Field	Effective F No
MML1-ST300D	SOD-1.5X	1.5x	15μm	1.21mm	34.1
	SOD-2X	2.0x	15μm	0.91mm	45.4

Caution: If combinations other than those recommended are used, dirt and scratches on the rear converter may be noticeable in the resulting images. For this reason, we do not recommend the use in any other setup for optimal performance.

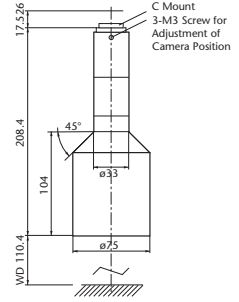
# Fixed Magnification Telecentric Lens

## MML Series

MML018-110D



MML018-110

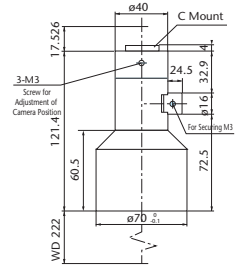


### WD110mm

Model	Magnification	O/I	WD	Resolution	Depth of Field	NA	Effective FNo	TV Distortion	Largest Compatible Camera	Weight
MML018-110D	×0.18	336.3mm	110.4mm	24μm	15mm	0.01	6.4	0.1% or less	2/3"	700g
MML018-110	×0.18	336.3mm	110.4mm	24μm	15mm	0.01	6.4	0.1% or less	2/3"	700g

\* Depth of field is calculated assuming a horizontal 240TV resolution using a 1/2" CCD camera. (Permissible circle of confusion on the image-formation side: 40μm)  
 \* Resolution values indicate the theoretical resolution at a wavelength of 550nm.

MML02-220D



### WD200mm~

Model	Magnification	O/I	WD	Resolution	Depth of Field	NA	Effective FNo	TV Distortion	Largest Compatible Camera	Weight
MML02-220D	×0.2	360.9mm	222mm	16.7μm	10mm	0.02	5	0.1% or less	2/3"	450g

\* Depth of field is calculated assuming a horizontal 240TV resolution using a 1/2" CCD camera. (Permissible circle of confusion on the image-formation side: 40μm)  
 \* Resolution values indicate the theoretical resolution at a wavelength of 550nm.

# For Near-Infrared Applications

## MML-NIR Series

The MML-NIR Series is designed for a wavelength band of 770 to 1200nm. This series provides special use MML lenses that allow the observation of in-wafer defects and rear patterns when combined with an infrared camera and illumination.

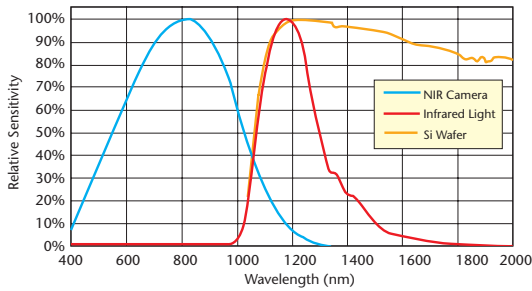


Model	Magnification	O/I	WD	Resolution	Depth of Field	NA	Effective FNo	TV Distortion	Largest Compatible Camera	Weight
MML4-80D-IR	×4	228.7mm	82.4mm	4μm	0.05mm	0.15	13.3	0.01% or less	2/3"	90g
MML6-80D-IR	×6	249.8mm	81.5mm	4μm	0.033mm	0.15	20.1	0.01% or less	2/3"	100g
MML8-80D-IR	×8	271.4mm	81mm	4μm	0.027mm	0.15	26.9	0.01% or less	2/3"	110g

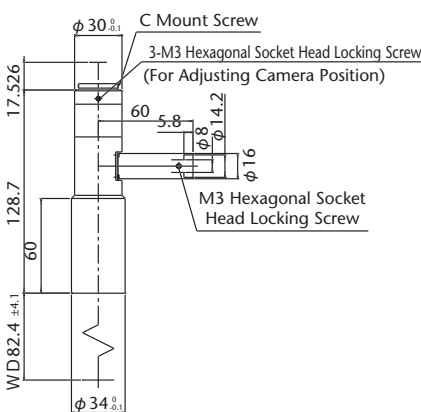
\* Depth of field is calculated assuming a horizontal 435TV resolution using a 2/3" CCD camera. (Permissible circle of confusion on the image-formation side: 30μ)  
 \* Resolution values indicate the theoretical resolution at a wavelength of 985nm.

IR Illumination on P.134, P184 and Infrared 100W Halogen Light Source on P.198 are available.

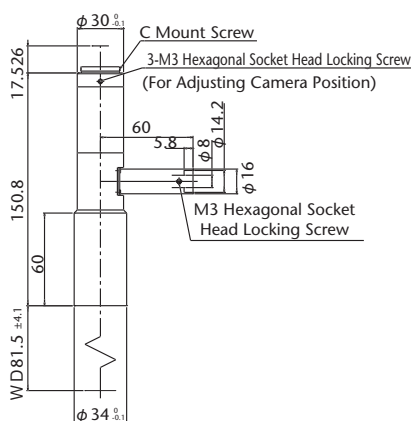
### Spectral Characteristics



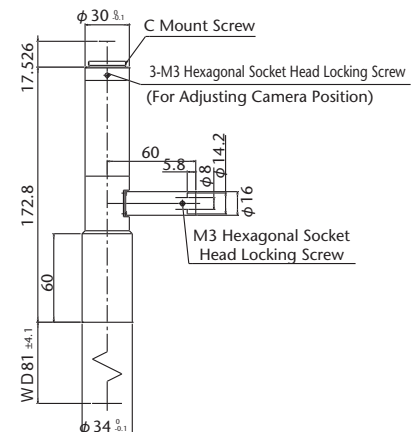
### MML4-80D-IR



### MML6-80D-IR



### MML8-80D-IR



# High Resolution Zoom Lens

## ML-Z07545HR Series

To exploit the full potential of high pixel count cameras, this unique high NA, high resolution telecentric zoom lens series has a long working distance and wide zoom ratio as well as adjustable iris & focus. Available with an integrated coaxial illumination system as well as other options, this lens series is versatile and ideal for extremely accurate gauging and inspection applications at various field of views (FOVs).

- Zoom Ratio 6:1 0.75x – 4.5x
- Effective F No 8.4 – Variable iris
- Focus Range +/- 3mm
- NA 0.12 (4.5x)
- Working Distance = 70.9 mm



### Lineup : 2 Models



ML-Z07545HR

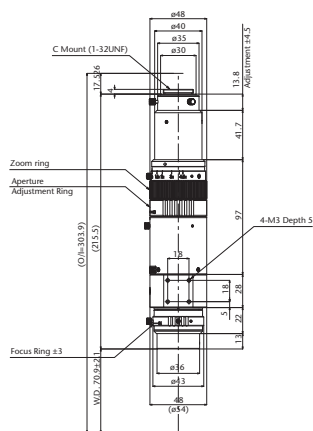
ML-Z07545HRD  
Coaxial Illumination Model D

Model	Magnification	O/I	WD	Motor Option	Focus	Zoom Position	Resolution	Depth of Field	NA	Effective Fno	TV Distortion	Largest Compatible Camera	Weight
ML-Z07545HR	0.75x ~ 4.5x (Zoom ratio of 6:1)	303.9 mm	70.9 mm	Not Available (Manual Zoom)	±3mm	at 0.75x	7.5µm	1.2mm	0.04	8.4	-0.02% or less	1/2"	600g
ML-Z07545HRD						at 2x	4µm	0.2mm	0.08	12	0.01% or less	1/2"	610g

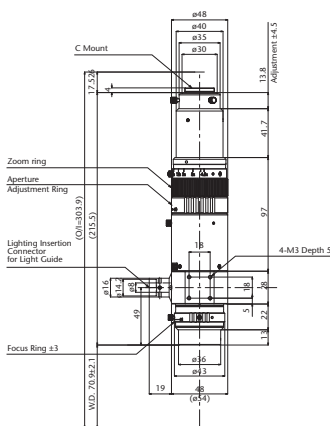
\* Effective F No indicates designed value when iris is open

\* Calculated based on permissible circle of confusion on the image-formation side:40µm

**ML-Z07545HR**



**ML-Z07545HRD**



**Front Converter Lens (Optional)**

**ML-ZHR Series**

Attach to the end of the lens to change magnification and WD.

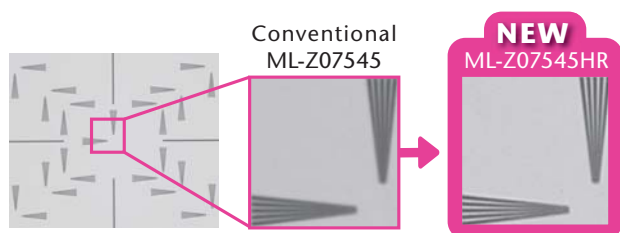


**Magnification and W.D. chart**

Model	Focus Position	Magnification Range		WD	Coaxial light Matching Chart
		Low	High		
ML-Z025HR	Near	0.21x	~ 1.30x	201.5mm	Coaxial Illumination Cannot Cover Entire View
	Middle	0.19x	~ 1.14x	243mm	
	Far	0.16x	~ 0.97x	299mm	
ML-Z03HR	Near	0.25x	~ 1.52x	170mm	Coaxial Illumination Cannot Cover Entire View
	Middle	0.23x	~ 1.36x	200mm	
	Far	0.20x	~ 1.21x	237mm	

\* Indicated values are based on calculation and not guaranteed values.  
 \* When you used ML-Z025HR,ML-Z03HR,ML-Z05HR,ML-Z075HR,coaxial illumination does not cover entire view

**HR Series Improves Resolution**



# Standard Zoom Lens

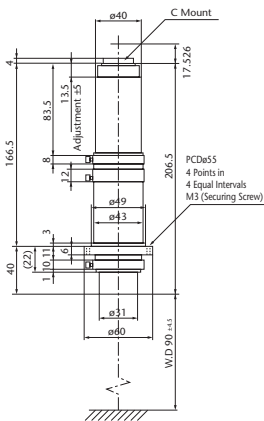
## ML-Z07545 Series

Standard model zoom lens with outstanding functionality. Adjustment of magnification and working distance is possible through combination with optional optics.

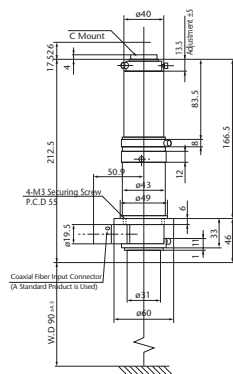
- Magnification range : 0.75x~4.5x (zoom ratio of 6:1)
- WD=90mm
- Includes a uniform coaxial illumination function that covers the entire view.
- Equipped with built-in focus adjustment function (WD can be adjusted to -6 mm)



### Manual Zoom ML-Z07545



### Zoom with Coaxial Illumination ML-Z07545D



### Motorized Zoom Options Available



Motor type :  
Stepping motor with limit sensors

Model	Magnification	O/I	WD	Motor Option	Focus	Zoom Position	Resolution	Depth of Field	NA	Effective Fno	TV Distortion	Largest Compatible Camera	Weight
ML-Z07545	0.75x ~ 4.5x (Zoom ratio of 6:1)	314mm	90mm	Not Available (Manual Zoom)	0 ~ -6mm	at 0.75x	9.9μm	1.6mm	0.03	11	0.02% or less	1/2"	440g
ML-Z07545D		320mm				at 2x	5.4μm	0.3mm	0.06	16	0.01% or less	1/2"	470g

\* Effective F No indicates designed value when iris is open  
\* Calculated based on permissible circle of confusion on the image-formation side:40μm

All models with focus, aperture and zoom

# Standard Zoom Lens

## Accessories (Sold Separately)

### Front Converter Lens

#### ML-Z Series



Attach to end of lens to change magnification and working distance.

Model	Focus Position	ML-Z07545				Matching Chart	ML-Z07545D			
		Magnification Range		WD	Magnification Range		WD	Matching Chart		
		MIN	MAX		MIN				MAX	
ML-Z03	Near	0.24x	~ 1.43x	255mm	○	0.23x	~ 1.4x	263mm	▲ Coaxial Illumination Cannot Cover the Entire View	
	Middle	0.23x	~ 1.36x	283mm		0.22x	~ 1.33x	292mm		
	Far	0.21x	~ 1.28x	315mm		0.21x	~ 1.25x	325mm		
ML-Z04	Near	0.31x	~ 1.87x	195mm	○	0.31x	~ 1.84x	200mm	▲ Coaxial Illumination Cannot Cover the Entire View	
	Middle	0.3x	~ 1.81x	211mm		0.3x	~ 1.81x	216mm		
	Far	0.29x	~ 1.72x	229mm		0.29x	~ 1.72x	234mm		
ML-Z05	Near	0.38x	~ 2.27x	160mm	○	0.37x	~ 2.25x	163mm	▲ Coaxial Illumination Cannot Cover the Entire View	
	Middle	0.37x	~ 2.24x	170mm		0.37x	~ 2.21x	174mm		
	Far	0.36x	~ 2.2x	181mm		0.36x	~ 2.17x	185mm		
ML-Z07	Near	0.52x	~ 3.17x	114mm	○	0.52x	~ 3.16x	115mm	▲ Coaxial Illumination Cannot Cover the Entire View	
	Middle	0.53x	~ 3.16x	119mm		0.52x	~ 3.16x	121mm		
	Far	0.53x	~ 3.17x	125mm		0.52x	~ 3.16x	126mm		
ML-Z20	Near	1.45x	~ 8.77x	32.1mm	○	1.46x	~ 8.77x	32.3mm	○	
	Middle	1.49x	~ 9.01x	32.7mm		1.5x	~ 9.09x	32.9mm		
	Far	1.54x	~ 9.26x	33.4mm		1.54x	~ 9.35x	33.6mm		

\*Magnification and working distance can be altered slightly by turning the focus adjustment ring (N⇄F)  
Indicated values are based on calculation formulas. Actual measurement may differ depending on tolerance. Cannot be mounted on ML-Z07545D-PL.

### Rear Converter Lens

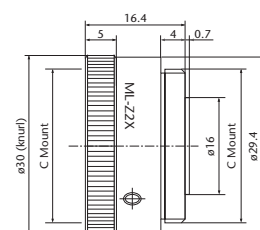
#### ML-Z2X

Specially designed 2x rear converter. Mounting this between a lens and camera can double the magnification easily without changing working distance.

\*May decrease the resolution.



ML-Z2X



# Prism Adapters

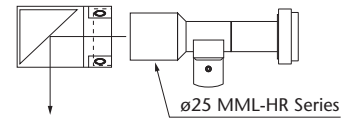
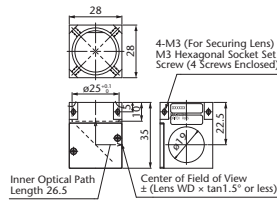
Prism adapters make it possible to bend the optical axis at a right angle of 90°, and to perform a mark recognition for microscopic objects by modifying the pitch between 2 MML lenses to a fine pitch.

## 90° Side View Mirror Type Prism for MML-HR MML-PL25HR

When used in optical systems, images may blur or bend due to the strong effects of profile irregularity of prisms. A clear image can be acquired, however, even for HR type lenses with large NA by sorting and removing prisms with high profile irregularity during the QC process.

- Exclusive for MML-High Resolution
- Lens barrel diameter :  $\varnothing 25$
- Length of inner optical path : length 26.5mm

### MML-PL25HR

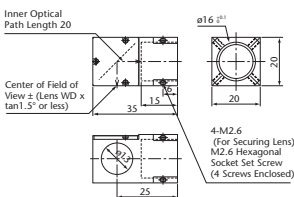


Model	MML-PL25HR
Specifications	90° Side View Mirror for HR For $\varnothing 25$

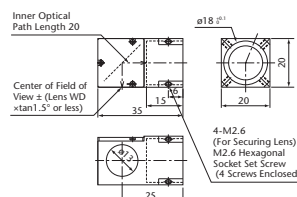
## 90° Side View Mirror Type Prism MML-PL Series

Using these prisms, the optical axis can be bent at a 90° right angle which is useful when space is limited. Resulting images become mirror images.

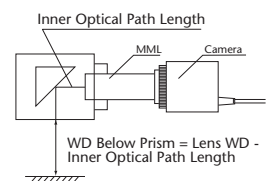
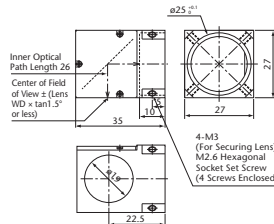
### MML-PL16



### MML-PL18



### MML-PL25



### Cover Glass

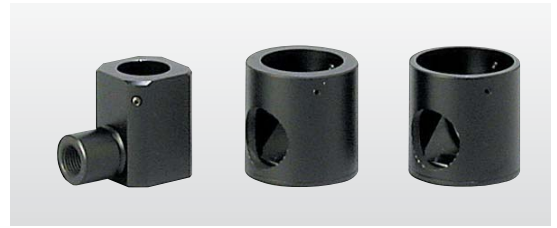


Model	Compatible Sizes	Inner Optical Path Length
MML-PL16	For $\varnothing 16$ Lens	20mm
MML-PL18	For $\varnothing 18$ Lens	20mm
MML-PL25	For $\varnothing 25$ Lens	26mm
MML-GA20	Cover Glass $\varnothing 20$ t=1mm	



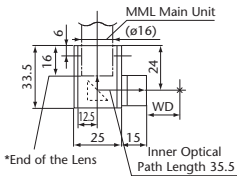
## 90° Side View Mirror Type Prism MML-P1,3,4

Resulting images become mirror images



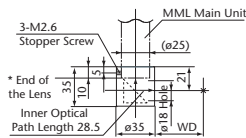
### MML-P1

For  $\phi 16$  Lens



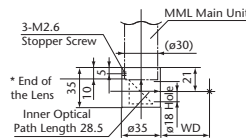
### MML-P3

For  $\phi 25$  Lens



### MML-P4

For  $\phi 30$  Lens



\*WD in the diagrams is the lens working distance minus the inner optical path length.

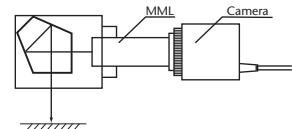
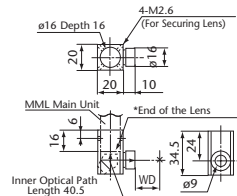
## 90° Side View Pentaprism Type Prism MML-P6

Resulting images are shown in an upright, normal position by the pentaprism.



### MML-P6

For  $\phi 16$  Lens



\*WD in the diagrams is the lens working distance minus the inner optical path length.

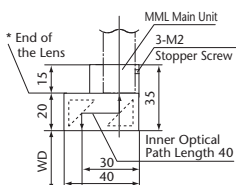
## Variable Optical Axis Pitch Type MML-P2,7

Mark recognition is possible for fine pitch between 2 points of microscopic objects.



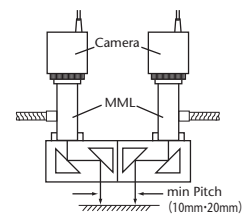
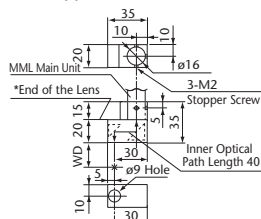
### MML-P2

For  $\phi 16$  Lens  
Distance to Optical Path  
10mm Type



### MML-P7

For  $\phi 16$  Lens  
Distance to Optical Path  
5mm Type



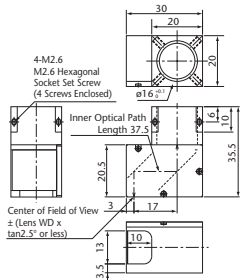
\*WD in the diagrams is the lens working distance minus the inner optical path length.

# Variable Optical Axis Pitch Type (Distance to Optical Path 3mm) MML-PP Series

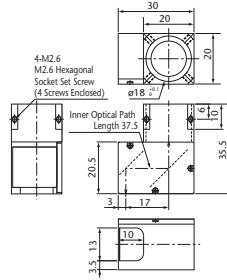


Prism Adapters

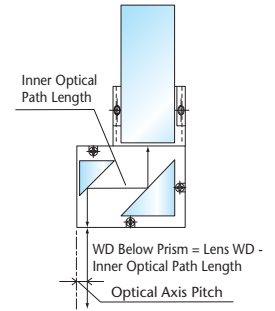
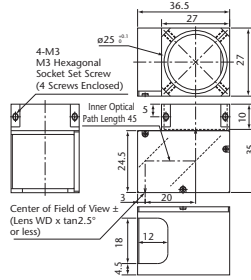
## MML-PP16



## MML-PP18



## MML-PP25



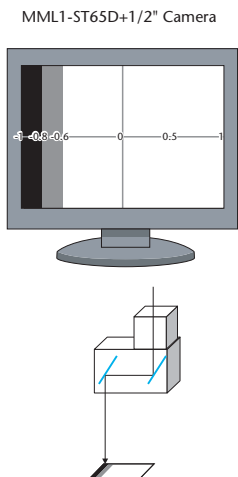
Model	Specification	Inner Optical Path Length	Optical Axis Pitch
MML-PP16	For ø16 Lens	37.5mm	3mm
MML-PP18	For ø18 Lens	37.5mm	3mm
MML-PP25	For ø25 Lens	45mm	3mm

## Variable Optical Axis Prism MML-PP Series Field of View Vignetting Chart

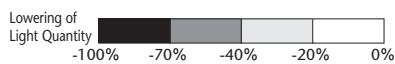
Because of its narrow-pitch design, the MML-PP Series is subject to vignetting.

Since vignetting varies depending on the object, illumination etc., in the environment that the customer uses, the prism must be tested in the actual machine.

\*This is a calculated value only and is not guaranteed. For reference only.



Model	Camera	Field of View (Horizontal Field of View Divided into 20 Equal Sections)																					
		-1	-0.9	-0.8	-0.7	-0.6	-0.5	-0.4	-0.3	-0.2	-0.1	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	
MML08-ST65D/65	1/2"	-100	-100	-100	-100	-82	-50	-18															
	1/3"	-100	-99	-82	-58	-33	-11																
MML1-ST65D/65	1/2"	-100	-100	-92	-70	-43	-18	-1															
	1/3"	-100	-100	-43	-24	-8																	
MML2-ST65D/65	1/2"	-34	-28	-22	-17	-12	-7	-3	-1														
	1/3"	-19	-15	-12	-8	-5	-3	-1															
MML4-ST65D/65	1/2"	-15	-13	-11	-9	-7	-6	-4	-3	-2	-1												
	1/3"	-10	-9	-7	-6	-5	-4	-3	-2	-1	-1												
MML6-ST65D/65	1/2"	-9	-7	-6	-5	-4	-3	-3	-2	-1	-1												
	1/3"	-6	-5	-4	-4	-3	-2	-2	-1	-1													
MML08-ST110D/110	1/2"	-100	-100	-96	-83	-67	-50	-33	-17	-4													
	1/3"	-90	-80	-67	-54	-41	-28	-17	-7														
MML1-ST110D/110	1/2"	-93	-83	-72	-60	-47	-34	-22	-12	-3													
	1/3"	-66	-56	-47	-37	-28	-19	-12	-5	-1													
MML2-ST110D/110	1/2"	-37	-32	-27	-22	-17	-13	-9	-6	-3	-1												
	1/3"	-24	-21	-17	-14	-11	-8	-6	-3	-1													
MML4-ST110D	1/2"	-25	-24	-22	-21	-19	-18	-16	-15	-14	-12	-11	-10	-8	-7	-6	-5	-4	-3	-2	-2	-1	
	1/3"	-17	-16	-16	-15	-14	-14	-13	-12	-12	-11	-10	-10	-9	-8	-8	-7	-6	-6	-5	-4	-3	
MML6-ST110D	1/2"	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-11	-10	-9	-8	-7	-7	-6	-5	-4	-4	-3	
	1/3"	-17	-17	-16	-15	-15	-14	-13	-13	-12	-11	-11	-10	-9	-9	-8	-8	-7	-6	-6	-5	-5	
MML8-ST110D	1/2"	-17	-16	-16	-15	-14	-14	-13	-12	-12	-11	-10	-10	-9	-8	-7	-7	-6	-6	-5	-5	-5	
	1/3"	-15	-15	-14	-14	-13	-13	-12	-12	-11	-11	-10	-10	-9	-9	-8	-8	-7	-7	-6	-6	-6	
MML1-ST150D/150	1/2"	-70	-65	-60	-54	-49	-43	-38	-32	-27	-22	-17	-13	-9	-5	-2							
	1/3"	-57	-53	-49	-44	-40	-36	-32	-28	-25	-21	-17	-14	-11	-8	-5	-3	-1					
MML08-ST170D/170	1/2"	-88	-81	-74	-66	-58	-50	-42	-34	-26	-19	-12	-6	-2									
	1/3"	-70	-64	-58	-52	-46	-40	-34	-28	-22	-17	-12	-8	-4	-1								



## Variable Pitch Side View Prism MML-PSV16L/R

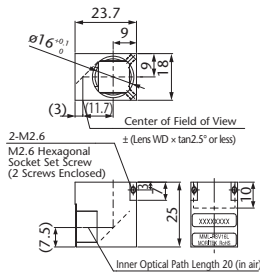
Fine pitch and small space observation at a 90° angle are possible for alignment marks. Because of the prism's compact design, 40mm working distance lenses can also be used.

- MML-Standard for  $\phi 16$
- Optical axis pitch 3mm
- Length of inner optical path length: 20mm
- WD=40mm lens can also be attached

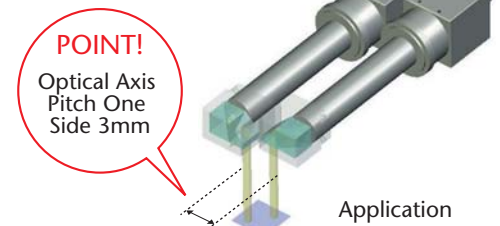
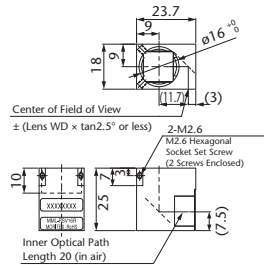


Prism Adapters

### MML-PSV16L



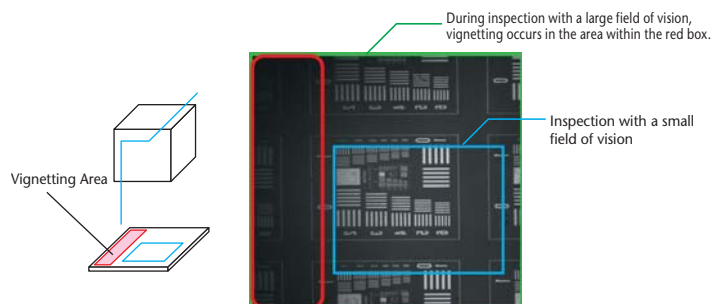
### MML-PSV16R



Model	Specifications	Optical Axis Pitch
MML-PSV16R	Side View Prism for ST Series (Right Side)	One Side 3mm
MML-PSV16L	Side View Prism for ST Series (Left Side)	One Side 3mm

## MML-PSV 16L/R Vignetting Reference Data

Note that the MML-PSV16 is designed for fine pitch which may cause vignetting in a portion of the screen when observation is performed with a wide field of view. (Differences exist depending on the kind of lens or camera being used.)

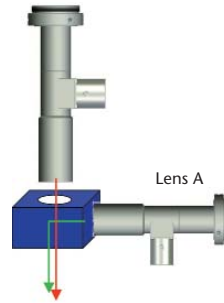


## Dual Field of View Prism MML-P2S16

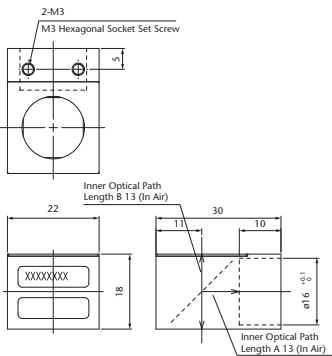
On-axis dual view type in MML-PL Series

- Same object with two fields of view, same field of view at different working distances, etc.
- Lens A should have a diameter of 16mm

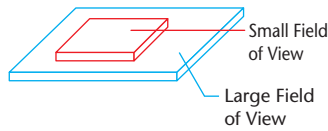
Model	Specifications
MML-P2S16	ST Series, 2 field of views (FOV) prism for $\phi 16\text{mm}$



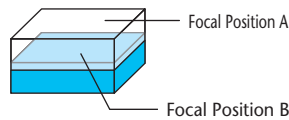
### MML-P2S16



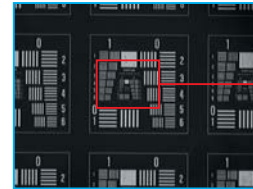
Low Magnification / High Magnification Alignment



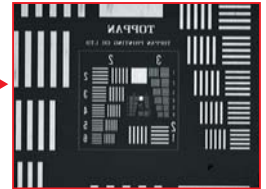
Two Focus Point Alignment



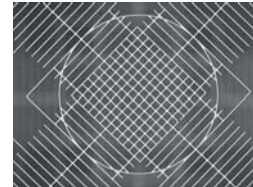
Large Field of View Rough Alignment



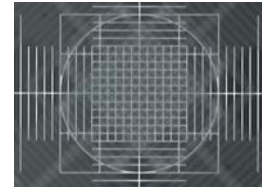
Small Field of View Fine Alignment



Focal Position A



Focal Position B



## High Accuracy Two Fields of View Optical Unit ML-2PLBOX Made-to-order

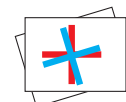
Two field of views and two focus points can be observed using two lenses & cameras. MORITEX adjusts cameras and optical units to positions desired by customers to provide support to meet specific customer requirements for lenses and illumination, condition of optical units, etc. These adjustments and quality inspection ensure high accuracy of mounted components and the resulting images.



MORITEX performs adjustment and inspection to ensure high accuracy cameras, prisms and lenses.



Center Position Accuracy  
 $\pm(\text{Lens WD} \times \text{Tan}1.5^\circ)$



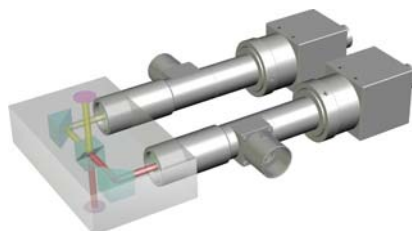
Rotation Alignment Accuracy  
Relative Position Within  $\pm 0.5^\circ$



## High Accuracy Two Fields of View Optical Unit

### ML-W1000

Made-to-order



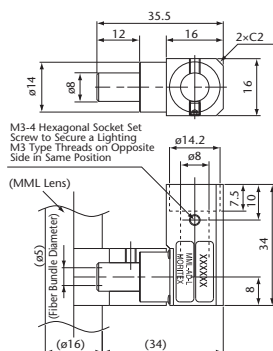
## L-Shaped Coaxial Adapter

### MML-AD-L

By connecting to a lens's coaxial input, illumination can be inserted at right angles. A very convenient adapter for small spaces.



#### MML-AD-L



Model	Specifications
MML-AD-L	L-Shaped Coaxial Adapter

## Lens Unit for Vacuum Environments

# Vacuum Lenses

This new lens unit avoids leakage of gas even under vacuum environments by applying our unique manufacturing method and through the use of special materials. Combining this lens with vacuum-resistant light guides enables image recognition inside vacuum chambers which conventional products could not achieve.

- Telecentric lens for vacuum applications
- Vacuum Level: < 1E-5Pa
- Optical magnification:1.0×, WD: 110 mm
- C-Mount (Vacuum-resistant camera under development by partner)
- F No. 10, fixed aperture
- • Coaxial illumination function (using vacuum-resistant light guides)

### Related products:

#### Vacuum-resistant light guide VAC Series

MORITEX insulation technology enables light transmission between air and vacuum environment without using a second light guide. Can be used for applications such as lighting inside vacuum chambers, UV curing, sensor applications, measuring film pressure and bonding liquid crystal panels.



## Waterproof Lens Unit

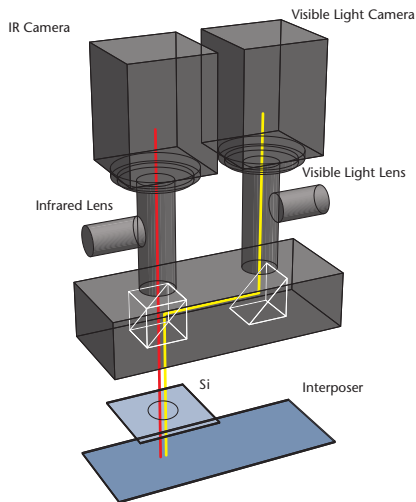
Imaging unit suitable for various applications requiring environmental resistance such as machine tools, food facilities and medical device manufacturing.

- Water-resistant unit integrating camera and lens in one body
- Telecentric optical system enables observation and inspection at long working distances
- IP67 protection (Maximum immersion depth: approximately 10 m)
- Aluminum body ensures good heat dissipation and resistance



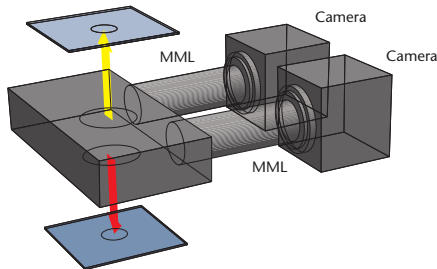
# Total Optical Illumination System

## Infrared & Visible Ray Transmission System



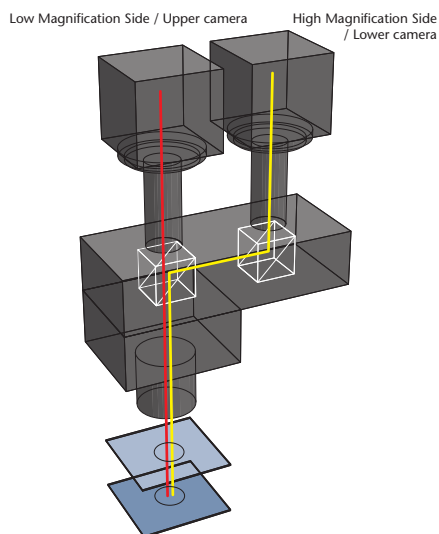
A complete lens and lighting system which uses infrared rays to transmit through a Si, GaAs, or Ge substrate to recognize IR penetration patterns.

## Top and Bottom Dual Field Optical System (2 camera Type)



A space-saving optical system for attaching 2 opposite-facing objects with accuracy.

## Twin-View, Dual Magnification/Twin-View, Dual Focal Optical System



A space-saving optical system that is used to simultaneously observe an object at two focus distances, and two magnifications on one optical path utilizing a specific prism structure.

Various OEM applications are available with combinations of more than 100 standard products and lights. Please contact us with inquiries.







# FA Lens Macro

# FA Lens Macro Zoom



## FA Lens Macro

These short, compact non-telecentric lenses with high performance and reasonable cost are an alternative to our MML and CCTV lenses for alignment and inspection applications.

**ML-MCHR Series**  
**ML-N Series**  
**WD=90mm Series**



## FA Lens Macro Zoom

The Macro Zoom Lens Series are flexible, quality lenses with a number of options that can be used for a variety of vision applications.

**ML-Z0108**  
**MLH Series**

## 2 Mega Pixel Macro Lens

# ML-MCHR Series

High quality image and image format 12.8mm, the ML-MCHR Series is not only the best machine vision lens compatible with the latest 2 Mega pixel CMOS sensor, but also vibration resistance design is one of great benefit for industrial applications.

2 Mega Pixel Macro Lens

ML-MCHR Series

- Vibration resistance up to 5G <sup>(\*)</sup>, 10G version option available
- Five models with magnification range from 0.05× to 1.72× <sup>(\*)</sup>
- Close-up rings can be used to adjust magnification and working distance
- Distortion-free, high performance design
- Maximum compatible image format :  $\varnothing 12.8$



\*1 Vibration conditions:

Frequency range: 10-200 [Hz]

Test cycle: 8 minutes  $\times$  10 sets against X, Y, and Z directions

Maximum acceleration: 5G

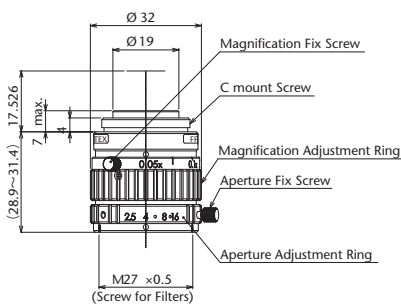
Maximum amplitude: 1 mm

Lock screws used

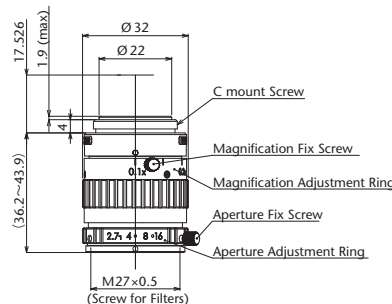
\*2 Magnification using close-up rings

	Focal Distance	Magnification	O/I	WD	Fno	TV Distortion	Image Format	Weight
ML-MC16HR	16	$\times 0.05 \sim \times 0.2$	363.9mm~118.7mm	317.5mm~69.8mm	2.5~16	-0.12% or less	$\varnothing 12.8$	43g
ML-MC25HR	25	$\times 0.1 \sim \times 0.4$	309.6mm~126mm	255.9mm~64.6mm	2.7~16	0.05% or less	$\varnothing 12.8$	52g
ML-MC35HR	35	$\times 0.25 \sim \times 0.7$	211.3mm~137.9mm	139.8mm~51mm	3.6~16	0.05% or less	$\varnothing 12.8$	73g
ML-MC50HR	50	$\times 0.5 \sim \times 0.8$	228.4mm~205.5mm	149.1mm~111.1mm	3~16	0.07% or less	$\varnothing 12.8$	95g
ML-MC75HR	75	$\times 0.18 \sim \times 0.38$	580.3mm~377.3mm	494.3mm~276.4mm	3.8~16	0.1% or less	$\varnothing 12.8$	105g

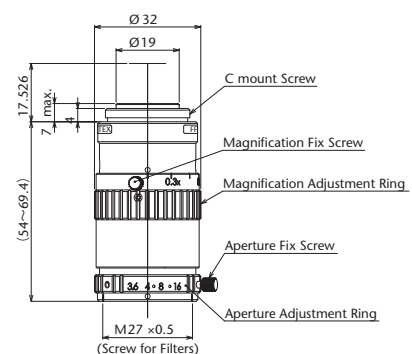
### ML-MC16HR



### ML-MC25HR



### ML-MC35HR



Field of View, WD and Magnification using Close-up Ring

Close-up Ring (mm)	ML-MC16HR				
	Field of View (Length x Width) 2/3"	Field of View (Length x Width) 1/2"	Field of View (Length x Width) 1/3"	WD (mm)	Magnification
0	33.0 X 44.0	24.0 X 32.0	18.0 X 24.0	71	X0.20
	132.0 X 176.0	96.0 X 128.0	72.0 X 96.0	318	X0.05

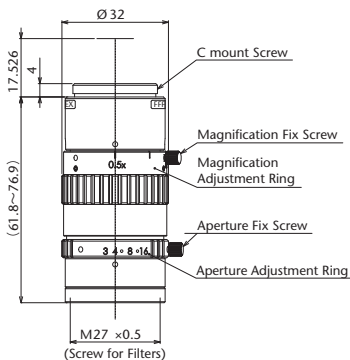
Close-up Ring (mm)	ML-MC25HR				
	Field of View (Length x Width) 2/3"	Field of View (Length x Width) 1/2"	Field of View (Length x Width) 1/3"	WD (mm)	Magnification
0	16.5 X 22.0	12.0 X 16.0	9.0 X 12.0	67	X0.40
	66.0 X 88.0	48.0 X 64.0	36.0 X 48.0	258	X0.10
0.5	15.7 X 21.0	11.4 X 15.3	8.6 X 11.4	64	X0.42
	55.2 X 73.6	40.1 X 53.5	30.1 X 40.1	216	X0.12
1	15.0 X 20.0	10.9 X 14.6	8.2 X 10.9	61	X0.44
	47.4 X 63.2	34.5 X 46.0	25.9 X 34.5	186	X0.14
1.5	14.4 X 19.2	10.5 X 13.9	7.8 X 10.5	59	X0.46
	41.6 X 55.4	30.2 X 40.3	22.7 X 30.2	164	X0.16
2	13.8 X 18.4	10.0 X 13.4	7.5 X 10.0	57	X0.48
	37.0 X 49.3	26.9 X 35.9	20.2 X 26.9	146	X0.18
5	11.1 X 14.8	8.1 X 10.7	6.0 X 8.1	46	X0.60
	22.3 X 29.7	16.2 X 21.6	12.2 X 16.2	89	X0.30
10	8.3 X 11.1	6.1 X 8.1	4.5 X 6.1	35	X0.79
	13.4 X 17.9	9.8 X 13.0	7.3 X 9.8	55	X0.49
15	6.7 X 8.9	4.9 X 6.5	3.6 X 4.9	29	X0.99
	9.6 X 12.8	7.0 X 9.3	5.2 X 7.0	40	X0.69
20	5.6 X 7.4	4.1 X 5.4	3.0 X 4.1	25	X1.18
	7.5 X 10.0	5.4 X 7.2	4.1 X 5.4	32	X0.88

Close-up Ring (mm)	ML-MC50HR				
	Field of View (Length x Width) 2/3"	Field of View (Length x Width) 1/2"	Field of View (Length x Width) 1/3"	WD (mm)	Magnification
0	8.2 X 11.0	6.0 X 8.0	4.5 X 6.0	111	X0.80
	13.2 X 17.6	9.6 X 12.8	7.2 X 9.6	149	X0.50
0.5	8.1 X 10.9	5.9 X 7.9	4.4 X 5.9	110	X0.81
	12.9 X 17.3	9.4 X 12.6	7.1 X 9.4	147	X0.51
1	8.1 X 10.7	5.9 X 7.8	4.4 X 5.9	110	X0.82
	12.7 X 16.9	9.2 X 12.3	6.9 X 9.2	145	X0.52
1.5	8.0 X 10.6	5.8 X 7.7	4.3 X 5.8	109	X0.83
	12.5 X 16.6	9.1 X 12.1	6.8 X 9.1	143	X0.53
2	7.9 X 10.5	5.7 X 7.6	4.3 X 5.7	108	X0.84
	12.2 X 16.3	8.9 X 11.9	6.7 X 8.9	142	X0.54
5	7.3 X 9.8	5.3 X 7.1	4.0 X 5.3	104	X0.90
	11.0 X 14.7	8.0 X 10.7	6.0 X 8.0	132	X0.60
10	6.6 X 8.8	4.8 X 6.4	3.6 X 4.8	99	X1.00
	9.5 X 12.6	6.9 X 9.2	5.2 X 6.9	120	X0.70
15	6.0 X 8.0	4.4 X 5.8	3.3 X 4.4	94	X1.10
	8.3 X 11.0	6.0 X 8.0	4.5 X 6.0	111	X0.80
20	5.5 X 7.4	4.0 X 5.4	3.0 X 4.0	90	X1.20
	7.4 X 9.8	5.4 X 7.1	4.0 X 5.4	104	X0.90
25	5.1 X 6.8	3.7 X 4.9	2.8 X 3.7	87	X1.29
	6.6 X 8.9	4.8 X 6.4	3.6 X 4.8	99	X0.99
30	4.7 X 6.3	3.4 X 4.6	2.6 X 3.4	84	X1.39
	6.0 X 8.0	4.4 X 5.9	3.3 X 4.4	94	X1.09
35	4.4 X 5.9	3.2 X 4.3	2.4 X 3.2	82	X1.49
	5.5 X 7.4	4.0 X 5.4	3.0 X 4.0	90	X1.19

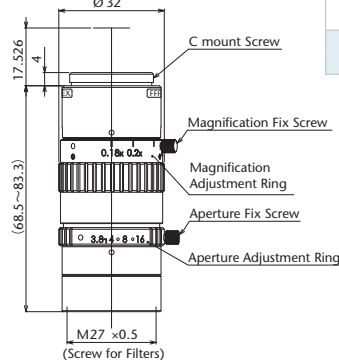
Close-up Ring (mm)	ML-MC35HR				
	Field of View (Length x Width) 2/3"	Field of View (Length x Width) 1/2"	Field of View (Length x Width) 1/3"	WD (mm)	Magnification
0	9.4 X 12.6	6.9 X 9.1	5.1 X 6.9	54	X0.70
	26.4 X 35.2	19.2 X 25.6	14.4 X 19.2	143	X0.25
0.5	9.2 X 12.3	6.7 X 9.0	5.0 X 6.7	53	X0.71
	25.0 X 33.3	18.1 X 24.2	13.6 X 18.1	135	X0.26
1	9.1 X 12.1	6.6 X 8.8	4.9 X 6.6	52	X0.73
	23.7 X 31.5	17.2 X 22.9	12.9 X 17.2	128	X0.28
1.5	8.9 X 11.8	6.5 X 8.6	4.8 X 6.5	51	X0.74
	22.5 X 30.0	16.4 X 21.8	12.3 X 16.4	122	X0.29
2	8.7 X 11.6	6.3 X 8.4	4.7 X 6.3	50	X0.76
	21.4 X 28.6	15.6 X 20.8	11.7 X 15.6	117	X0.31
5	7.8 X 10.4	5.7 X 7.6	4.3 X 5.7	46	X0.84
	16.7 X 22.3	12.2 X 16.2	9.1 X 12.2	92	X0.39
10	6.7 X 8.9	4.8 X 6.5	3.6 X 4.8	40	X0.99
	12.2 X 16.3	8.9 X 11.9	6.7 X 8.9	69	X0.54
15	5.8 X 7.8	4.2 X 5.6	3.2 X 4.2	35	X1.13
	9.6 X 12.9	7.0 X 9.3	5.3 X 7.0	55	X0.68
20	5.2 X 6.9	3.8 X 5.0	2.8 X 3.8	32	X1.28
	8.0 X 10.6	5.8 X 7.7	4.3 X 5.8	46	X0.83

Close-up Ring (mm)	ML-MC75HR				
	Field of View (Length x Width) 2/3"	Field of View (Length x Width) 1/2"	Field of View (Length x Width) 1/3"	WD (mm)	Magnification
0	17.4 X 23.2	12.6 X 16.8	9.5 X 12.6	276	X0.38
	37.3 X 49.7	27.1 X 36.2	20.3 X 27.1	501	X0.18
0.5	17.1 X 22.8	12.4 X 16.5	9.3 X 12.4	273	X0.39
	35.9 X 47.9	26.1 X 34.8	19.6 X 26.1	486	X0.18
1	16.8 X 22.4	12.2 X 16.3	9.2 X 12.2	270	X0.39
	34.7 X 46.2	25.2 X 33.6	18.9 X 25.2	472	X0.19
1.5	16.5 X 22.0	12.0 X 16.0	9.0 X 12.0	267	X0.40
	33.5 X 44.6	24.3 X 32.5	18.3 X 24.3	458	X0.20
2	16.2 X 21.6	11.8 X 15.7	8.8 X 11.8	264	X0.41
	32.4 X 43.2	23.5 X 31.4	17.7 X 23.5	446	X0.20
5	14.8 X 19.7	10.7 X 14.3	8.1 X 10.7	247	X0.45
	27.0 X 36.0	19.7 X 26.2	14.7 X 19.7	386	X0.24
10	12.8 X 17.1	9.3 X 12.4	7.0 X 9.3	225	X0.51
	21.2 X 28.3	15.4 X 20.6	11.6 X 15.4	320	X0.31
15	11.4 X 15.1	8.3 X 11.0	6.2 X 8.3	209	X0.58
	17.4 X 23.3	12.7 X 16.9	9.5 X 12.7	277	X0.38
20	10.2 X 13.6	7.4 X 9.9	5.6 X 7.4	195	X0.65
	14.8 X 19.8	10.8 X 14.4	8.1 X 10.8	248	X0.45
25	9.2 X 12.3	6.7 X 8.9	5.0 X 6.7	184	X0.72
	12.9 X 17.2	9.4 X 12.5	7.0 X 9.4	226	X0.51
30	8.4 X 11.2	6.1 X 8.2	4.6 X 6.1	176	X0.78
	11.4 X 15.2	8.3 X 11.0	6.2 X 8.3	209	X0.58
35	7.8 X 10.4	5.6 X 7.5	4.2 X 5.6	168	X0.85
	10.2 X 13.6	7.4 X 9.9	5.6 X 7.4	196	X0.65
40	7.2 X 9.6	5.2 X 7.0	3.9 X 5.2	162	X0.92
	9.2 X 12.3	6.7 X 9.0	5.0 X 6.7	185	X0.71
45	6.7 X 8.9	4.9 X 6.5	3.7 X 4.9	156	X0.98
	8.5 X 11.3	6.1 X 8.2	4.6 X 6.1	176	X0.78
50	6.3 X 8.4	4.6 X 6.1	3.4 X 4.6	151	X1.05
	7.8 X 10.4	5.7 X 7.5	4.2 X 5.7	168	X0.85
60	5.6 X 7.4	4.0 X 5.4	3.0 X 4.0	143	X1.19
	6.7 X 9.0	4.9 X 6.5	3.7 X 4.9	156	X0.98
70	5.0 X 6.7	3.6 X 4.8	2.7 X 3.6	137	X1.32
	5.9 X 7.9	4.3 X 5.7	3.2 X 4.3	147	X1.12
80	4.5 X 6.1	3.3 X 4.4	2.5 X 3.3	132	X1.45
	5.3 X 7.0	3.8 X 5.1	2.9 X 3.8	140	X1.25
90	4.2 X 5.5	3.0 X 4.0	2.3 X 3.0	127	X1.59
	4.8 X 6.4	3.5 X 4.6	2.6 X 3.5	134	X1.39
100	3.8 X 5.1	2.8 X 3.7	2.1 X 2.8	124	X1.72
	4.3 X 5.8	3.2 X 4.2	2.4 X 3.2	129	X1.52

ML-MC50HR



ML-MC75HR



- Indicated values are based on calculation and actual measurements may differ. Please use values as a reference.
- Accuracy of the products is guaranteed only when used without additional attachments. Please note that when using in combination with a close-up ring or other equipment, working distance, distortion and image quality may be distorted due to enlargement of the lens tolerance.

# Non-Telecentric Macro Lens

## ML-N Series

ML-N Series lenses were developed to be compact, high performance models. Based on many years of experience producing MMLs (Machine Micro Lens), we adopted the non-telecentric optical system as the lens design for this series. By limiting the number of lenses in each layer to less than 3, we have succeeded in developing high performance models at reasonable prices.

Magnification and working distances can be tailored to your needs by using an optional close-up ring adapter.



- Compact body of  $\varnothing 16$
- High resolution, low optical distortion
- Reasonable prices
- Best matching with peripherals

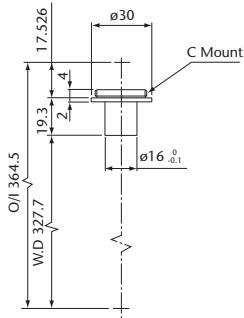
Model	Magnification	O/I	WD	Focal Length	Resolution	Depth of Field	Effective F No	TV Distortion	Largest Compatible Camera	Weight
ML01-327N	$\times 0.1$	364.5mm	327.7mm	30.1	33.9 $\mu$ m	37.7mm	4.7	0.4% or less	1/2"	10g
ML03-181N	$\times 0.3$	240.9mm	181.3mm	42.6	14.6 $\mu$ m	5.43mm	6.1	0.2% or less	1/2"	15g
ML05-132N	$\times 0.5$	199mm	132.5mm	43	11.7 $\mu$ m	1.95mm	6.1	0.08% or less	1/2"	18g
ML05-250N	$\times 0.5$	382.3mm	250mm	81.6	13.3 $\mu$ m	2.27mm	7.1	0.06% or less	1/2"	90g
ML1-89N	$\times 1$	177.5mm	89.6mm	43	7.9 $\mu$ m	0.7mm	8.8	0.04% or less	1/2"	15g

\* Depth of field is calculated assuming a horizontal 240TV resolution using a 1/2" CCD camera. (Permissible circle of confusion on the image-formation side: 40 $\mu$ m)  
 \* Resolution values indicate the theoretical resolution at a wavelength of 550nm.

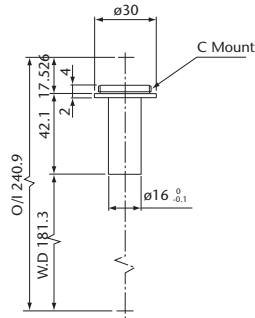
### Magnification Conversion Table

	Close-Up Ring Thickness	0mm	1mm	2mm	5mm	7mm	10mm	15mm	17mm	20mm
ML01-327N	Magnification	0.1x	0.13x	0.17x	0.27x	0.33x	0.43x	0.6x	0.67x	0.77x
	WD	327.7mm	253mm	204mm	138.8mm	118.6mm	97.5mm	77.7mm	72.5mm	67.2mm
ML03-181N	Magnification	0.3x	0.32x	0.35x	0.42x	0.47x	0.54x	0.65x	0.7x	0.77x
	WD	181.3mm	170mm	162mm	140.7mm	131mm	119mm	104.6mm	100mm	94.6mm
ML05-132N	Magnification	0.5x	0.53x	0.55x	0.62x	0.66x	0.73x	0.85x	0.9x	0.97x
	WD	132.5mm	128.4mm	125mm	116.3mm	111.3mm	105.2mm	97.4mm	94.2mm	91mm
ML05-250N	Magnification	0.5x	0.51x	0.52x	0.56x	0.58x	0.62x	0.68x	0.71x	0.74x
	WD	250mm	246mm	242.3mm	232mm	225.8mm	217.5mm	205.6mm	201.5mm	195.7mm
ML1-89N	Magnification	1x	1.02x	1.05x	1.12x	1.16x	1.2x	1.35x	1.4x	1.47x
	WD	89mm	88mm	87mm	85mm	83.5mm	81.5mm	78.5mm	77.3mm	75.9mm

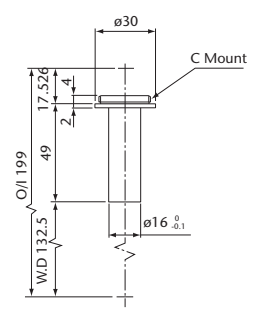
**ML01-327N**



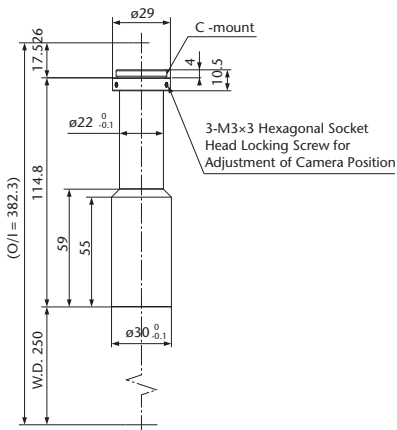
**ML03-181N**



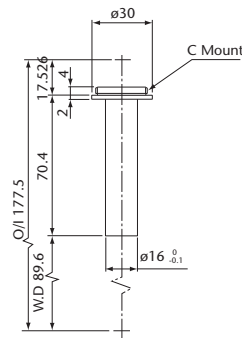
**ML05-132N**



**ML05-250N**



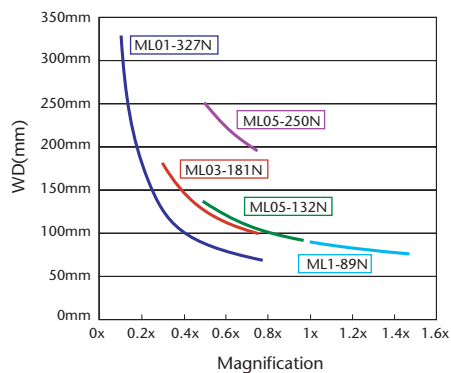
**ML1-89N**



Magnification can be changed by using the ML-EXR Series close-up ring.



Reference magnification and WD data for close-up ring combinations



# High Performance Macro Zoom Lens

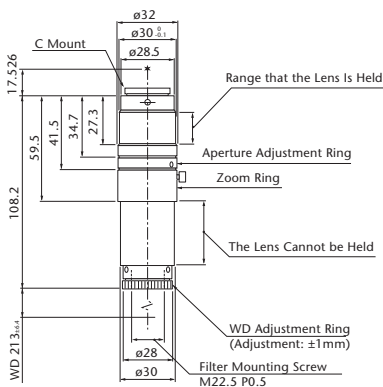
## ML-Z0108

High performance macro lens with 8:1 magnification ratio and long working distance. By using the focus ring on the end, working distance can be changed within a range of 20mm.

- Zoom ratio of 8:1. Magnification range of 0.1x~0.8x
- WD=213mm
- Focus adjustment  $\pm 20$ mm (magnification variation  $\pm 13\%$ )
- Iris, focus, and zoom are adjustable
- Equipped with locking screws



### ML-Z0108



Model	Magnification	WD	Motor Option	Zoom Position	Effective F No	Depth of Field	Resolution	TV Distortion	Operation Function	Weight	Largest Compatible Camera
ML-Z0108	0.1x to 0.8x (Zoom Ratio of 8:1)	213 mm	Not available (Manual Zoom)	at 0.1x	8.2	32.8mm	55 $\mu$ m	-0.02% or less	Manual (Adjusting Aperture, Zoom, and Focus)	140g	1/2"
				at 0.4x		2.1mm	14 $\mu$ m	0.18% or less			
				at 0.8x	9.3	0.6mm	8 $\mu$ m	0.17% or less			

\* Depth of field is calculated assuming a horizontal 240TV resolution using a 1/2" CCD camera. (Permissible circle of confusion on the image-formation side: 40 $\mu$ m)  
 \* Resolution values indicate the theoretical resolution at a wavelength of 550nm.



# Mega Pixel Macro Zoom Lens

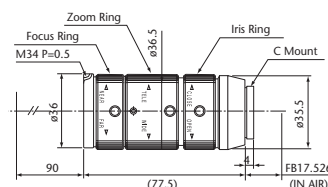
## MLH-3XMP

This high-performance macro zoom lens supports cameras of the 1 million pixel class. The zoom range is 0.3x~1x by optical magnification. The resolution of 100/mm or more is realized at the center and periphery of the entire zoom range. Combination with a mega pixel camera realizes wide-range image recognition with excellent contrast.



- Zoom: Optical magnification of 0.3x~1x
- WD=90mm
- Variable focus
- Variable iris Effective F no 4.5~Close
- Equipped with screws to lock movable parts (Zoom, focus, and iris)
- Maximum compatible camera format ~2/3"
- C mount

MLH-3XMP



Model	MLH-3XMP
Magnification	0.3x to 1x (Manual Zoom)
O/I	185mm
WD	90mm
F No	4.5~Close
Filter Screw	M34 P=0.5
Weight	150g
Largest Compatible Camera	2/3"

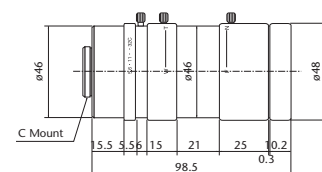
# 10x Zoom Lens

## MLH-10X

A wide zoom ratio lens developed for large field of view imaging. Zoom ratio of 10:1 at a working distance of 150mm to 450mm by adjusting the focus. This lens can be used for FA, laboratory work, weak eyesight correction, and environment-related projects.



MLH-10X



- Zoom ratio of 10:1 (Magnification range: 0.084x(min)~0.84x(max))
- WD=450mm(min)~150mm(max)
- Iris, focus, and zoom are adjustable
- Equipped with locking screws

Chart for Field of View

WD	Magnifications	Field of View	
		1/2" (Length mm × Width mm)	1/3" (Length mm × Width mm)
150mm	0.086x ~ 0.84x	55.8 x 74.4 ~ 5.7 x 7.6	42 x 56 ~ 4.3 x 5.7
200mm	0.06x ~ 0.58x	80 x 107 ~ 8.3 x 11	60 x 80 ~ 6.2 x 8.3
250mm	0.045x ~ 0.44x	107 x 142 ~ 10.9 x 14.5	80 x 107 ~ 8.2 x 10.9
300mm	0.037x ~ 0.36x	130 x 173 ~ 13.3 x 17.8	97 x 130 ~ 10 x 13.3
350mm	0.031x ~ 0.3x	155 x 206 ~ 16 x 21.3	116 x 155 ~ 12 x 16
400mm	0.026x ~ 0.25x	185 x 246 ~ 19.2 x 25.6	138 x 185 ~ 14.4 x 19.2
450mm	0.023x ~ 0.22x	209 x 278 ~ 21.8 x 29.1	157 x 209 ~ 16.4 x 21.8

Model	MLH-10X
Magnification	0.084x to 0.84x (Zoom Ratio of 10:1)
WD	150~450mm
Iris	F5.6~Close
Filter Size	M46 P=0.75
Weight	233g
largest Compatible Camera	1/2"



## FA Lens CCTV



### CCTV Lens

The most common machine vision lenses, we offer Standard, Megapixel (ML-MP), 3 Megapixel (ML-MP3) and a telecentric CCTV lens models.

**MTE-55**  
**ML-M MP5 Series**  
**ML-MP Series**  
**ML Series**



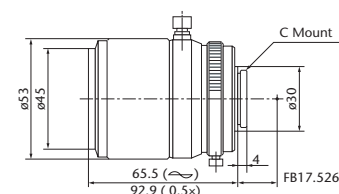
# Telecentric FA Lens CCTV

## MTE-55

The MTE-55 lens adopts F2.8/ f=55mm telecentric optical system that reduces angle and magnification errors when observing objects. Accurate telecentric performance is achieved when combined with the optional lens MTE2 with at a magnification of 0.4x ~ 0.9x. Although no telecentric effect is achieved at the magnification of infinity ~ 0.4x, it is designed to correct aberrations far better than regular lenses.



MTE-55



Model	MTE-55
Magnification	Infinity to 0.5x (when dedicated converter is used. 1.0x at max)
Focal Distance f (mm)	55
F No	2.8~close
Photographing Distance	Infinite to 140mm
Optical Distortion	0.6% at max
Marginal Light Quantity	78.50%
Filter Size	M43 P0.75
Largest Compatible Camera	2/3"
Weight	320g

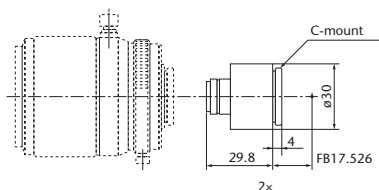
Chart for Field of View by Camera Size (MTE-55)

WD (mm)	MTE-55				Optical Magnification
	2/3" (Length x Width)	1/2" (Length x Width)	1/3" (Length x Width)		
5000	550x733	415x550	300x400		x0.012
3000	330x440	240x320	170x220		x0.02
1000	132x176	090x120	61x82		x0.05
500	55x73	40x53	30x40		x0.12
300	31x41	24x32	17x22		x0.21
200	22x29	15x20	11x15		x0.3
140	13x18	10x13	7x10		x0.48

## Accessories

### ×2 Converter Lens MTE2

#### MTE2



### ×0.75 Converter Lens MTE075

#### MTE075

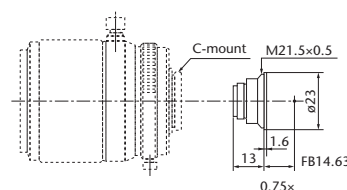


Chart for Field of View by Camera Size (MTE-55+MTE2)

WD (mm)	MTE-55 +2xConverter Lenses (MTE2)				Optical Magnification
	2/3" (Length x Width)	1/2" (Length x Width)	1/3" (Length x Width)		
5000	275x366	207x275	150x200		x0.024
3000	165x220	120x160	85x110		x0.04
1000	66x88	45x60	30x41		x0.1
500	27x36	20x26	15x20		x0.24
300	15x20	12x16	8x11		x0.42
200	11x14	07x10	5x7		x0.6
140	6x9	5x6	3x5		x0.9

Chart for Field of View by Camera Size (MTE-55+MTE075)

WD (mm)	MTE-55 +0.75xConverter Lenses (MTE075)				Optical Magnification
	2/3" (Length x Width)	1/2" (Length x Width)	1/3" (Length x Width)		
5000	733x977	553x733	400x533		x0.009
3000	440x586	320x426	226x293		x0.015
1000	176x234	120x160	081x109		x0.03
500	73x97	53x70	40x53		x0.09
300	41x54	32x42	22x29		x0.15
200	29x38	20x26	14x20		x0.22
140	17x24	13x17	9x13		x0.36

# 5 Mega Pixel FA Lens CCTV

## ML-M MP5 Series

The ML-M MP5 Series is our newest lineup of high end CCTV lenses addressing the needs of applications using high pixel count image sensors. The ability of the lenses to realize a resolution of 150lp/mm when imaging at close distances is a particularly strong feature.

In combination with a 5 mega pixel camera, imaging with higher resolution and contrast than conventional CCTV lenses is achieved. With all models, the variable iris and focus can be set with locking screws as needed.<sup>(\*1)</sup>

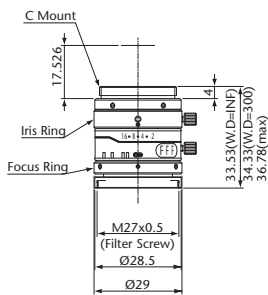
The lenses also support small FOV imaging when combined with close-up rings and rear converter lenses.<sup>(\*2)</sup>



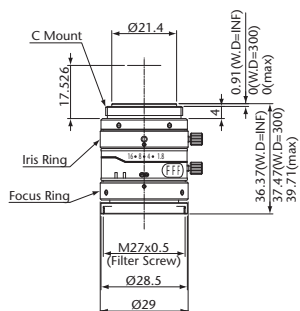
(\*1) Vibration resistance is not considered in design.  
 (\*2) If a close-up ring and a rear converter lens are used, individual differences in product performance, or image deterioration occurs due to an enlargement of lens tolerance. (Images must be checked when using the lenses. Contact us if uncertain.)

- High resolving power of 5 mega pixels or higher
- Supports 2/3" camera
- Close distance (0.2 m) design suitable for machine vision
- Low distortion : 0.1% or less
- Includes focus lock screws and iris lock screws

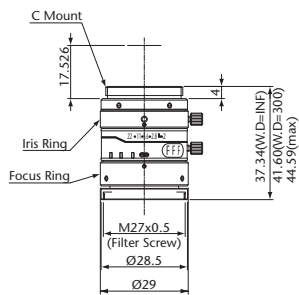
ML-M1620MP5



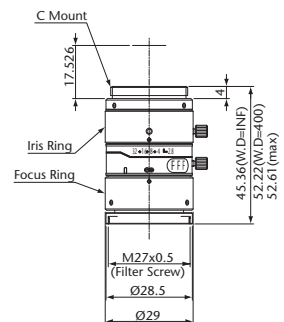
ML-M2518MP5



ML-M3520MP5



ML-M5028MP5



Model	Focal Distance	F No	Field of View (HxV)	Closest Distance	Filter Screw	Weight	Largest compatible Camera
ML-M1620MP5	16mm	2.0 - 16	37.7°	100mm	M27.0 P=0.5mm	53g	2/3"
ML-M2518MP5	25mm	1.8 - 16	24.6°	150mm	M27.0 P=0.5mm	60g	2/3"
ML-M3520MP5	35mm	2.0 - 22	17.8°	200mm	M27.0 P=0.5mm	59g	2/3"
ML-M5028MP5	50mm	2.8 - 32	12.5°	400mm	M27.0 P=0.5mm	69g	2/3"

# Mega Pixel FA Lens CCTV

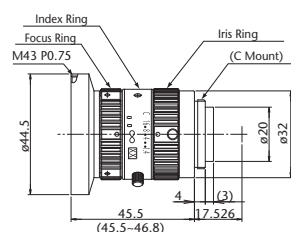
## ML-MP Series

Compact CCTV lenses with high resolution design for use with 1 mega pixel or higher count sensors.

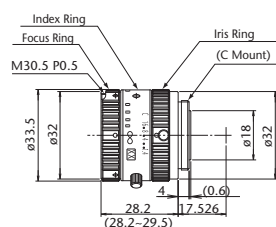
- Lineup of 6 models (f = 5-50mm)
- Compatible with mega pixel cameras
- Variable focus and iris
- Equipped with screws to lock movable parts (focus and iris)
- Maximum compatible camera format up to 2/3"
- C mount



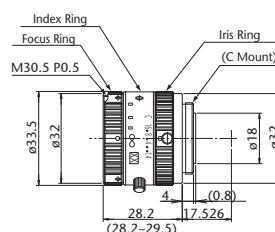
ML-H0514MP



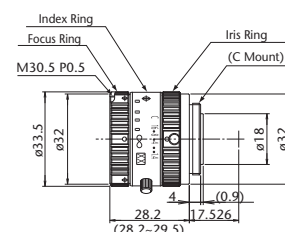
ML-M0814MP



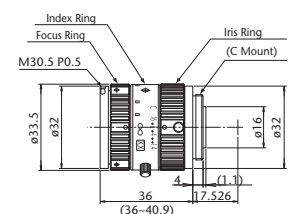
ML-M1214MP



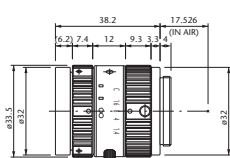
ML-M1614MP



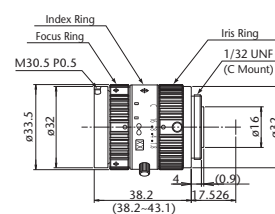
ML-M2514MP



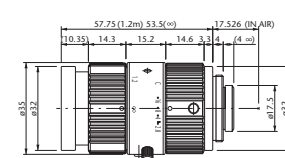
ML-M3514MP



ML-M5018MP



ML-M7528MP



Model	Focal Distance	F No	Field of View(HxV)	Closest Distance	Filter Screw	Weight	Largest compatible Camera
ML-H0514MP	5mm	F1.4 - 16C	51.4° x 65.5°	0.3m	M43 P0.75	107g	1/2"
ML-M0814MP	8mm	F1.4 - 16C	43.7° x 56.3°	0.1m	M30.5 P0.5	70g	2/3"
ML-M1214MP	12mm	F1.4 - 16C	30.8° x 40.4°	0.15m	M30.5 P0.5	65g	2/3"
ML-M1614MP	16mm	F1.4 - 16C	23.4° x 30.8°	0.3m	M30.5 P0.5	65g	2/3"
ML-M2514MP	25mm	F1.4 - 16C	15.1° x 20°	0.3m	M30.5 P0.5	75g	2/3"
ML-M3514MP	35mm	F1.4 - 16C	10.4° x 13.9°	0.3m	M30.5 P0.5	87g	2/3"
ML-M5018MP	50mm	F1.8 - 16C	7.9° x 10.5°	0.5m	M30.5 P0.5	90g	2/3"
ML-M7528MP	75mm	F2.8 - 16C	5.1° x 6.8°	0.3m	M30.5 P0.5	113g	2/3"

# FA Lens CCTV

## ML Series

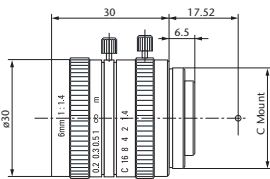
CCTV (Closed Circuit Television) lenses were developed to recognize images in a wide field of view. With all models, the variable iris and focus can be set with locking screws as needed.<sup>(\*1)</sup> The lenses also support micro imaging in combination with close-up ring and rear converter lenses.<sup>(\*2)</sup>



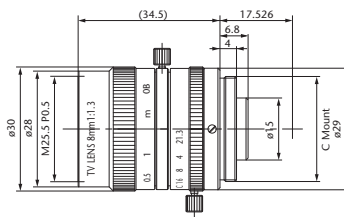
(\*1) Vibration resistance is not considered in design.  
 (\*2) Image quality may be distorted with enlargement of lens tolerance.

- A wide range of products from f=6mm to 100mm
- Variable focus and iris equipped with lock screws
- Camera mount: C mount

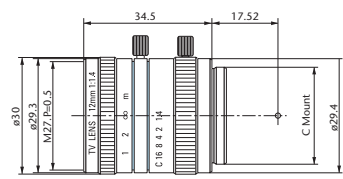
**ML-0614**



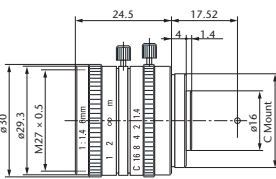
**ML-0813**



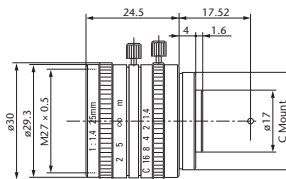
**ML-1214**



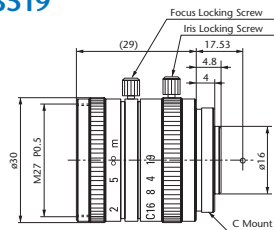
**ML-1614**



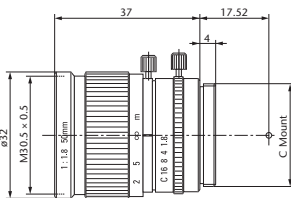
**ML-2514**



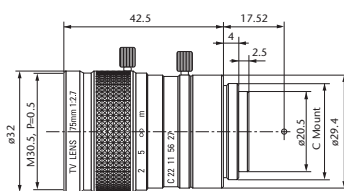
**ML-3519**



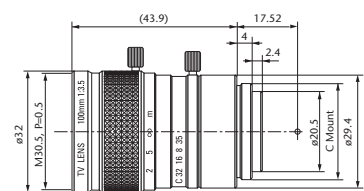
**ML-5018**



**ML-7527**



**ML-10035**



Model	Focal Distance	F No	Field of View(HxV)	Closest Distance	Filter Screw	Weight	Largest compatible Camera
ML-0614	6mm	F1.4 - close	42.3° x 54.6°	0.2m	M27 P0.5	60g	1/2"
ML-0813	8mm	F1.3 - close	45.0° x 57.8°	0.2m	M25.5 P0.5	60g	2/3"
ML-1214	12mm	F1.4 - close	21.9° x 29.0°	0.3m	M27 P0.5	60g	1/2"
ML-1614	16mm	F1.4 - close	23.0° x 30.4°	0.4m	M27 P0.5	40g	2/3"
ML-2514	25mm	F1.4 - close	21.6° x 28.5°	0.5m	M27 P0.5	45g	1"
ML-3519	35mm	F1.9 - close	10.8° x 14.4°	0.5m	M27 P0.5	50g	2/3"
ML-5018	50mm	F1.8 - close	7.9° x 10.5°	1m	M30.5 P0.5	60g	2/3"
ML-7527	75mm	F2.7 - close	4.9° x 6.5°	1m	M30.5 P0.5	65g	2/3"
ML-10035	100mm	F3.5 - close	3.8° x 5.1°	1m	M30.5 P0.5	65g	2/3"

ML Series FOV chart

Close-Up Ring (mm)	ML-0614				ML-0813				ML-1214			
	Field of View (Length x Width)		WD (mm)	Magnification	Field of View (Length x Width)		WD (mm)	Magnification	Field of View (Length x Width)		WD (mm)	Magnification
	1/2"	1/3"			1/2"	1/3"			1/2"	1/3"		
0	165 x 221	124 x 165	200	0.03x	96 x 128	72 x 96	148	0.05x	103 x 137	77 x 103	248	0.05x
0.5	44 x 58	33 x 44	43	0.11x	43 x 57	32 x 43	59	0.11x	55 x 73	41 x 55	125	0.09x
	60 x 79	45 x 60	63	0.08x	77 x 102	57 x 77	115	0.06x	119 x 159	89 x 119	289	0.04x
1	25 x 34	19 x 25	19	0.19x	27 x 37	21 x 27	34	0.18x	38 x 50	28 x 38	80	0.13x
	30 x 40	22 x 30	25	0.16x	38 x 51	29 x 38	52	0.13x	59 x 79	45 x 59	136	0.08x
1.5					20 x 27	15 x 20	22	0.24x	29 x 38	21 x 29	57	0.17x
					26 x 34	19 x 26	31	0.19x	40 x 53	30 x 40	85	0.12x
2									23 x 31	17 x 23	42	0.21x
									30 x 40	22 x 30	59	0.16x

Close-Up Ring (mm)	ML-1614				ML-2514				ML-3519			
	Field of View (Length x Width)		WD (mm)	Magnification	Field of View (Length x Width)		WD (mm)	Magnification	Field of View (Length x Width)		WD (mm)	Magnification
	1/2"	1/3"			1/2"	1/3"			1/2"	1/3"		
0	109 x 145	82 x 109	358	0.04x	87 x 115	65 x 87	458	0.06x	66 x 87	49 x 66	500	0.07x
0.5	64 x 86	48 x 64	206	0.07x	64 x 85	48 x 64	338	0.08x	55 x 73	41 x 55	422	0.09x
	156 x 208	117 x 156	515	0.03x	242 x 322	181 x 242	1270	0.02x	335 x 447	251 x 335	2459	0.01x
1	45 x 61	34 x 45	143	0.11x	50 x 67	38 x 50	269	0.10x	47 x 63	35 x 47	366	0.10x
	78 x 104	58 x 78	252	0.06x	121 x 161	91 x 121	637	0.04x	168 x 223	126 x 168	1240	0.03x
1.5	35 x 47	26 x 35	108	0.14x	42 x 56	31 x 42	223	0.12x	41 x 55	31 x 41	324	0.12x
	52 x 69	39 x 52	164	0.09x	81 x 107	60 x 81	425	0.06x	112 x 149	84 x 112	834	0.04x
2	29 x 38	22 x 29	86	0.17x	36 x 47	27 x 36	191	0.13x	37 x 49	28 x 37	291	0.13x
	39 x 52	29 x 39	120	0.12x	60 x 81	45 x 60	320	0.08x	84 x 112	63 x 84	631	0.06x
5	14 x 18	10 x 14	35	0.35x	19 x 25	14 x 19	103	0.25x	22 x 30	17 x 22	185	0.22x
	16 x 21	12 x 16	42	0.31x	24 x 32	18 x 24	130	0.20x	34 x 45	25 x 34	265	0.14x
10	7.3 x 9.7	5.4 x 7.3	14	0.66x	11 x 14	8 x 11	60	0.45x	13 x 18	10 x 13	121	0.36x
	7.8 x 10	5.8 x 7.8	15	0.62x	12 x 16	9.1 x 12	66	0.40x	17 x 22	13 x 17	143	0.29x
15					7.4 x 9.8	5.5 x 7.4	43	0.65x	9.5 x 13	7.2 x 9.5	93	0.50x
					8.1 x 11	6 x 8.1	45	0.60x	11 x 15	8.4 x 11	103	0.43x
20					5.6 x 7.5	4.2 x 5.6	34	0.85x	7.4 x 9.9	5.6 x 7.4	78	0.65x
					6 x 8.1	4.5 x 6	35	0.79x	8.4 x 11	6.3 x 8.4	82	0.57x
25									6.1 x 8.1	4.6 x 6.1	68	0.79x
									6.7 x 8.9	5 x 6.7	70	0.72x

Close-Up Ring (mm)	ML-5018				ML-7527				ML-10035			
	Field of View (Length x Width)		WD (mm)	Magnification	Field of View (Length x Width)		WD (mm)	Magnification	Field of View (Length x Width)		WD (mm)	Magnification
	1/2"	1/3"			1/2"	1/3"			1/2"	1/3"		
0	90 x 120	68 x 90	943	0.05x	60 x 80	45 x 60	1000	0.08x	46 x 62	35 x 46	1000	0.10x
1.5	57 x 76	43 x 57	610	0.08x								
	154 x 205	115 x 154	1577	0.03x								
2	51 x 67	38 x 51	548	0.10x	43 x 57	32 x 43	776	0.11x				
	115 x 154	86 x 115	1193	0.04x	184 x 246	138 x 184	3189	0.03x				
5	31 x 41	23 x 31	347	0.16x	30 x 40	23 x 30	607	0.16x	27 x 37	21 x 27	724	0.18x
	46 x 61	35 x 46	503	0.10x	74 x 98	55 x 74	1422	0.07x	95 x 127	71 x 95	2413	0.05x
10	18 x 25	14 x 18	226	0.26x	20 x 27	15 x 20	475	0.24x	19 x 26	15 x 19	609	0.25x
	23 x 31	17 x 23	273	0.21x	37 x 49	28 x 37	833	0.13x	48 x 63	36 x 48	1432	0.10x
15	13 x 18	10 x 13	174	0.37x	15 x 20	11 x 15	408	0.32x	15 x 20	11 x 15	546	0.32x
	15 x 21	12 x 15	196	0.31x	25 x 33	18 x 25	636	0.20x	32 x 42	24 x 32	1105	0.15x
20	10 x 14	7.7 x 10	145	0.47x	12 x 16	9 x 12	369	0.40x	12 x 16	9 x 12	505	0.39x
	12 x 15	8.6 x 12	158	0.42x	18 x 25	14 x 18	538	0.26x	24 x 32	18 x 24	941	0.20x
25	8.4 x 11	6.3 x 8.4	126	0.57x	10 x 14	7.6 x 10	342	0.47x	10 x 14	8 x 10	478	0.46x
	9.2 x 12	6.9 x 9.2	134	0.52x	15 x 20	11 x 15	479	0.33x	19 x 25	14 x 19	843	0.25x
30	7.1 x 9.4	5.3 x 7.1	113	0.68x	8.7 x 12	6.5 x 8.7	323	0.55x	9 x 12	6.7 x 9	458	0.54x
	7.7 x 10	5.8 x 7.7	119	0.63x	12 x 16	9.2 x 12	440	0.39x	16 x 21	12 x 16	778	0.30x
35	6.1 x 8.2	4.6 x 6.1	104	0.78x	7.6 x 10	5.7 x 7.6	309	0.63x	7.9 x 11	5.9 x 7.9	443	0.61x
	6.6 x 8.8	4.9 x 6.6	108	0.73x	11 x 14	7.9 x 11	412	0.46x	14 x 18	10 x 14	731	0.35x
40	5.4 x 7.2	4.1 x 5.4	97	0.89x	6.7 x 9	5.1 x 6.7	297	0.71x	7.1 x 9.4	5.3 x 7.1	430	0.68x
	5.8 x 7.7	4.3 x 5.8	100	0.83x	9.2 x 12	6.9 x 9.2	391	0.52x	12 x 16	8.9 x 12	696	0.40x
45					6.1 x 8.1	4.6 x 6.1	289	0.79x	6.4 x 8.5	4.8 x 6.4	421	0.75x
					8.2 x 11	6.1 x 8.2	375	0.59x	11 x 14	7.9 x 11	669	0.45x
50					5.5 x 7.4	4.1 x 5.5	281	0.87x	5.8 x 7.8	4.4 x 5.8	412	0.82x
					7.4 x 9.8	5.5 x 7.4	361	0.65x	9.5 x 13	7.1 x 9.5	647	0.50x
60									5 x 6.6	3.7 x 5	400	0.97x
									7.9 x 11	5.9 x 7.9	614	0.61x

- Indicated values are based on calculation and actual measurements may differ. Please use values as a reference.
- Accuracy of the products is guaranteed only when used without additional attachments. Please note that when using in combination with a close-up ring or other equipment, working distance, distortion and image quality may be distorted due to enlargement of the lens tolerance.

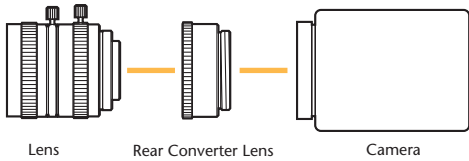
# Rear Converter Lens ML-X

Attaching these lenses between a CCTV lens and a camera enables the adjustment of magnification without changing the working distance of the system.

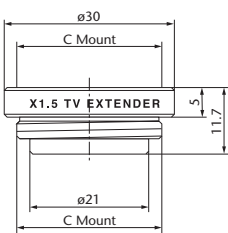


\*May decrease the resolution.

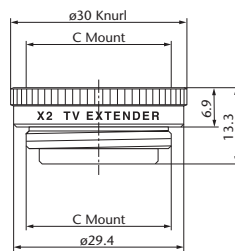
### Configuration



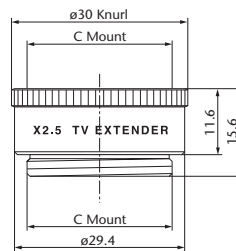
### ML-1.5X



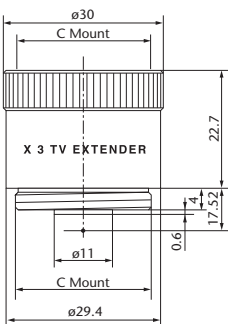
### ML-2X



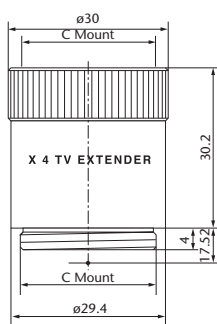
### ML-2.5X



### ML-3X



### ML-4X



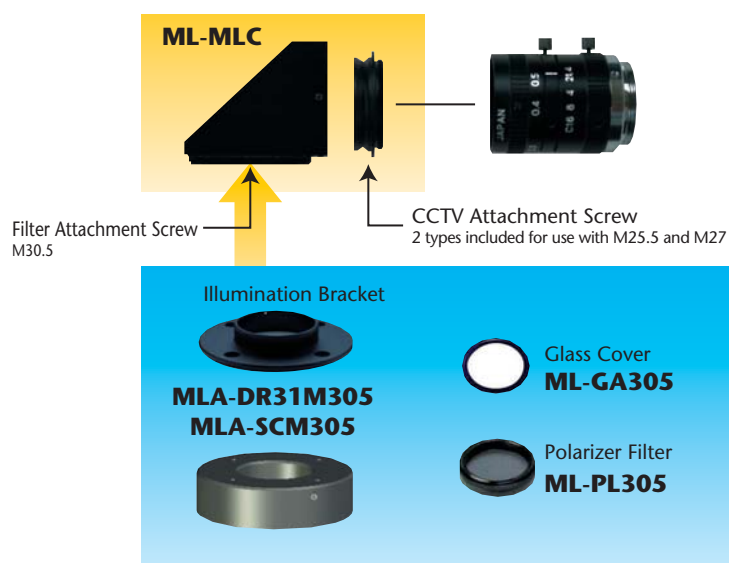
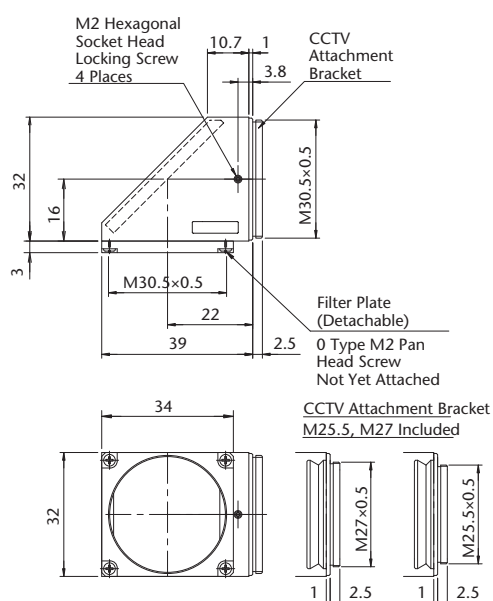
# 90° Mirror Prism ML-MLC

This prism adapter functions similar to the accessories provided for our telecentric lenses, allowing to bend the optical axis at a right angle.

- Fully supports CCTV M25.5, 27, and 30.5
- Equipped with screws to attach filters



## ML-MLC





## Accessories for CCTV Lenses

### Glass Covers

#### ML-GA Series



A glass cover adapter for preventing the adhesion of dirt and foreign objects to the lens surface.

### Polarizer Filters

#### ML-PL Series



Enhanced polarizing effect can be expected by using ML-PL Series second polarizer on lens side, in combination with MPL Series polarizer.

### Accessories

Screw Pitch	M25.5 P0.5 Model	M27 P0.5 Model	M30.5 P0.5 Model
Glass Covers	ML-GA255	ML-GA270	ML-GA305
Polarizer Filter	ML-PL255	ML-PL270	ML-PL305
Polarizer Filter (With Locking Screw)	ML-PL255LB	ML-PL270LB	ML-PL305LB
Sharp Cut Filter		ML-R64-27	
Close-Up Ring		ML-EXR	

### Close-Up Ring

#### ML-EXR Series

Used when using the CCTV lens at a close distance or when enlarging the magnification.

See comparison table on page P.73 for the field of view, working distance, and magnification when close-up ring is attached.

Model	Remarks
ML-EXR	Set of 7 (0.5, 1, 2, 5, 10, 20, 40)
ML-EXR05	0.5mm
ML-EXR1	1mm
ML-EXR2	2mm
ML-EXR5	5mm
ML-EXR10	10mm
ML-EXR15	15mm
ML-EXR20	20mm
ML-EXR25	25mm
ML-EXR30	30mm
ML-EXR40	40mm
ML-EXR50	50mm



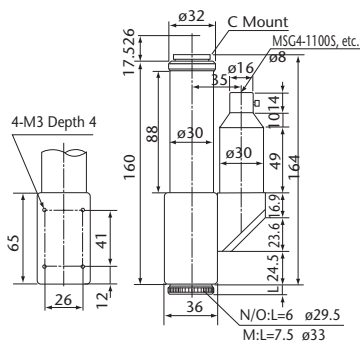


# Coaxial Epi-illumination Unit for Objective Lens

## SOD-III

The SOD-III is an optical unit used for coaxial illumination with objective lenses. If you are using a metallurgical microscope, this unit is effective for image input because it produces video of the same level. It is designed for infinity corrected objective lenses (bright vision) and can be used with the lenses listed below. In addition to the monocular type, the 5-hole revolver type (manual and electric) is available, which can be mounted with 5 objective lenses.

### SOD-III



### Compact Objective Lens



#### Mitsutoyo

Model	NA	WD (mm)
M Plan Apo 2 x	0.055	34
M Plan Apo 5 x	0.14	34
M Plan Apo 10 x	0.28	33.5
M Plan Apo 20 x	0.42	20
M Plan Apo SL 20 x	0.28	30.5
M Plan Apo SL 50 x	42.00%	20.5

#### Nikon

Model	NA	WD (mm)
CF IC EPI Plan 2.5 x	0.075	8.8
CF IC EPI Plan 5 x	0.13	22.5
CF IC EPI Plan 10 x A	0.3	16.5
CF IC EPI SLWDPlan 10 x A	0.21	20.3
CF IC EPI SLWDPlan 20 x A	0.35	20.5
CF IC EPI SLWDPlan 50 x A	45.00%	13.8





## Line Scan / Large Format Lens

With the increasing number of line scan and large format applications, we have continued to expand our product offering beyond the compact telecentric lenses that have become an industry standard for area scan applications.

We offer an assorted range of lens solutions designed for large format high resolution line and area scan cameras used for Glass, Web, TFT inspection and other applications which call for a high performance and low distortion lens. Our models support line image sensors from 2k to 16k with models compatible up to 82 mm wide and a pixel pitch of down to 3.5  $\mu\text{m}$ .



### Line Scan Lens

With the increasing number of line scan and large format applications, we have continued to expand our product become an industry standard for area scan applications.

**ML-F90C Series**  
**ML-F80C Series**  
**ML-L12K5A Series**

### Image Format

- < 82 mm** Up to 82mm
- < 62 mm** Up to 62mm
- < 58 mm** Up to 58mm
- < 35 mm** Up to 35mm

### Compatible Camera Pixel

- 3.5 $\mu\text{m}$**  3.5  $\mu\text{m}$ /Pixel
- 5 $\mu\text{m}$**  5  $\mu\text{m}$ /Pixel
- 7 $\mu\text{m}$**  7  $\mu\text{m}$ /Pixel
- 10 $\mu\text{m}$**  10  $\mu\text{m}$ /Pixel

# High resolution Line scan lens for 16K sensor

## ML-F90C Series

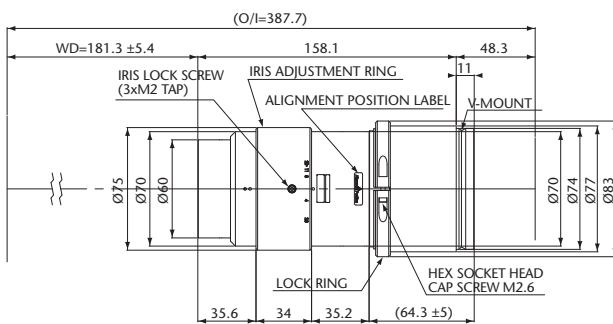
< 62 mm  
3.5 $\mu$ m

The ML-F90C Series is optimized for the use of 16K line scan sensor. The best features of the new lenses is excellent resolution. 150lp/mm makes full use of latest 3.5 $\mu$ m pixel sensor. Designed High brightness (Fno 2.8 ) can be used for high-speed application. RGB chromatic aberration correction provides true color image.

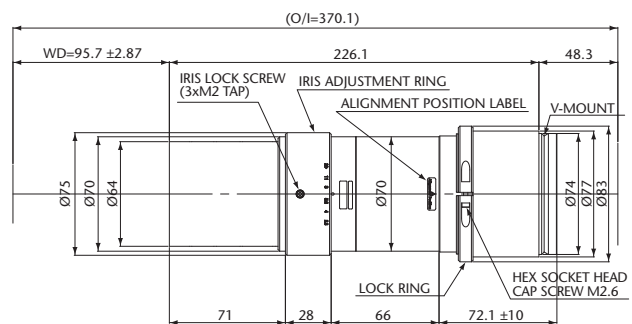


- High Resolution 150lp/mm >10%
- High brightness design Fno2.8 ~
- Image circle 62.5mm

### ML-F90C-07



### ML-F90C-175



Model	Magnification	Focal Distance	F No	WD	O/I	TV Distortion	Image Format	Weight	Mount
ML-F90C-07	0.7x	97.8mm	2.8 - 22	181.3mm	387.7mm	0.01% or less	62.5mm	1550g	CA-V series
ML-F90C-175	1.75x	97.7mm	2.8 - 22	95.7mm	370.1mm	0.03% or less	62.5mm	1470g	CA-V series

# Color Line Scan Lens

## ML-F80C Series

< 82 mm  
5-10 μm

Designed to address the challenges of color line scan applications, this new low-magnification line scan lens features RGB chromatic aberration correction to provide excellent performance for line sensors up to 82mm. By utilizing flange focal distance magnification control, magnifications of 0.2× – 0.5× are achievable over varying working distances without the added cost of a complex zoom system.



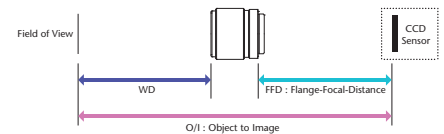
Color Line Scan Lens

ML-F80C Series

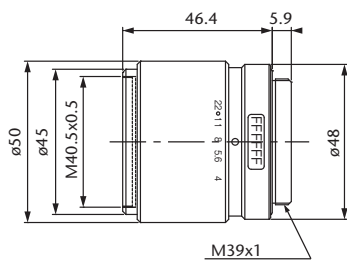
- Magnification adjustable 0.2 to 0.5× / 0.5 to 1.0× with flange focal distance adjustment
- Designed with RGB chromatic correction
- Maximum applicable sensor size: 82mm
- Variable iris

### Magnification Range

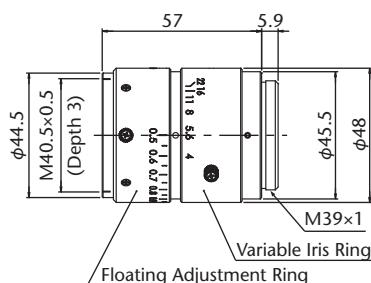
Magnification control between 0.2× and 0.5× / 0.5× and 1.0× can be done by adjusting the flange focal distance.



### ML-F80C-0205



### ML-F80C-0510



### Specifications at Different Magnifications

Model	Magnification	O/I (mm)	WD (mm)	Field of View* (mm)	FFD (mm)
ML-F80C-0205	×0.2	601.7	476.8	410	78.6
	×0.25	521.4	392.3	328	82.8
	×0.3	469.3	335.9	273.3	87
	×0.35	433.2	295.6	234.3	91.2
	×0.4	407.3	265.4	205	95.5
	×0.45	388	242	182.2	99.7
ML-F80C-0510	×0.5	373.5	223.2	164	103.9
	×0.5	370.1	220.1	164	93
	×0.55	358.7	204.4	149.1	97.3
	×0.6	349.9	191.4	136.7	101.6
	×0.65	343.1	180.3	126.2	105.8
	×0.7	337.9	170.8	117.1	110.1
	×0.75	333.8	162.5	109.3	114.3
	×0.8	330.8	155.2	102.5	118.5
	×0.85	328.6	148.8	96.5	122.7
	×0.9	327	143.1	91.1	126.9
	×0.95	326	137.9	86.3	131.1
	×1.0	325.6	133.3	82	135.3

\*Field of View: When using 82 mm sensors

Model	Magnification	O/I	WD	FNo	TV Distortion	Image Format	Mount	Weight
ML-F80C-0205	×0.2 ~ ×0.5	601.7mm ~ 373.5mm	476.8mm ~ 223.2mm	4 ~ 22	0.07% or less	82mm	M39×1	200g
ML-F80C-0510	×0.5 ~ ×1.0	370.1mm ~ 325.6mm	220.1mm ~ 133.3mm	4 ~ 22	-0.05% or less	82mm	M39×1	200g

# Line Scan Lenses for 62mm Sensor

## ML-L12K5A Series

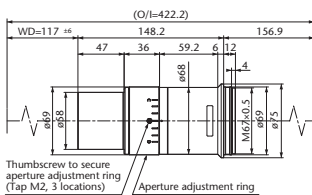
62mm  
5 $\mu$ m

The 12K5 Series consists of high resolution models with a large format design compatible with 12,000 bit, 5 $\mu$ m pixel line sensor cameras. Utilizing the various lens barrel & mount adapters, a large number of lens variations are possible allowing flexibility. Very high light uniformity, low distortion, and high resolution are achieved by these models making them ideal for line scan and large format area scan applications.

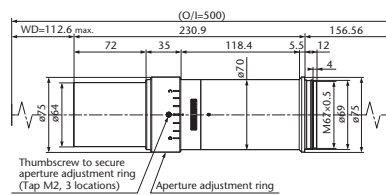


- High-resolution models compatible with 5 $\mu$ m pixel sensors
- Maximum imager size of  $\varnothing$ 61.4
- Equipped with base lens and various lens barrels making the series versatile and compatible with all types of cameras
- The barrels are equipped with camera adjustment ring

### ML-L2.4-12K5A



### ML-L3.0-12K5A



### Base Lens

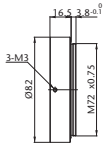
Model	Focal Length	Magnification	O/I	WD	Effective F No	TV Distortion	Image Format	Mount	Weight
★ ML-L2.4-12K5A	98.5	×2.46	422.2mm	117mm	8.8 ~ 47	0.02 or less	61.4mm	Mount Adapter 12K5	900g
★ ML-L3.0-12K5A	112	×3	500mm	112.6mm	9.5 ~ 53.8	0.01 or less	61.4mm	Mount Adapter 12K5	1500g

★Made-to-order

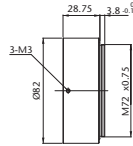
## Camera Adapters (Optional)

### For ML-F90C/F80C

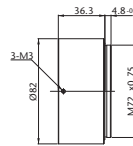
CA-V74M72-31.8



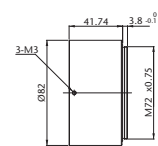
CA-V74M72-19.55



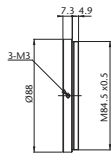
CA-V74M72-12.0



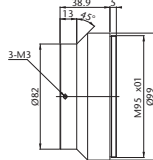
CA-V74M72-6.56



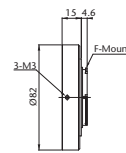
CA-V74M84.5-41



CA-V74M95-9.4



CA-V74FMT

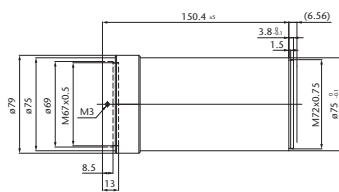


Model	★CA-V74M72-31.8	★CA-V74M72-19.55	★CA-V74M72-12.0	★CA-V74M72-6.56	★CA-V74M84.5-41	★CA-V74M95-9.4	★CA-V74FMT
Camera Mount	M72	M72	M72	M72	M84.5	M95	F
Flange back (mm)	31.8	19.55	12	6.56	41	9.4	46.5

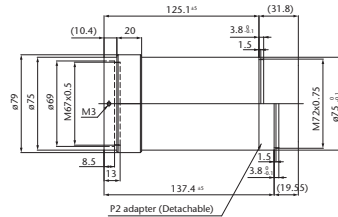
★Made-to-order

### For ML-L12K5A

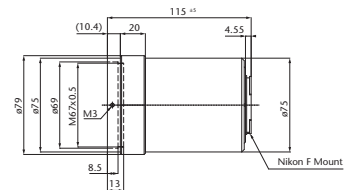
12K5-M72-6.56



12K5-M72-31.8/19.55



12K5-FMT



Model	★ 12K5-M72-6.56	★ 12K5-M72-31.8/19.55	★ 12K5-FMT
Camera Mount	M72	M72	F
Flange back (mm)	6.56	19.55	46.5

★Made-to-order







# Telecentric Illuminator

New large collimated light illumination design with high performance that only the leading lens and lighting manufacturer in machine vision can bring to market. The perfect match can be made when combined with the MORITEX MML Series for precision image processing applications.

# Telecentric Illuminator

Collimated Light Illumination for High Contrast Silhouette

## MTI-78

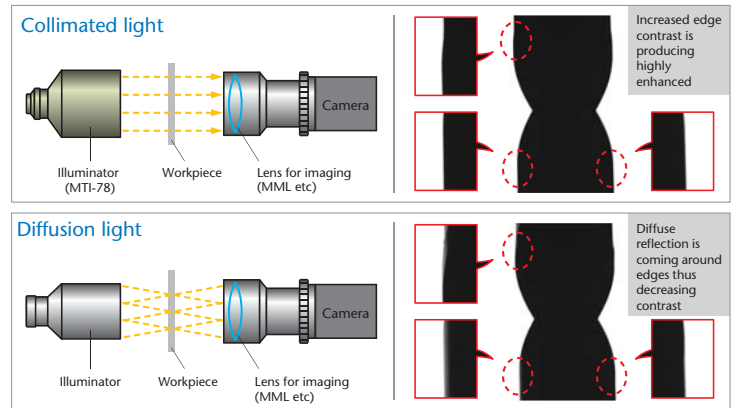
Designed to provide the best collimated light performance possible over a large field of view, the MTI-78 has a flexible design allowing it to be coupled with the various coaxial lights in our LED portfolio. For optimal system results, this illuminator should be matched with our industry leading telecentric lenses.



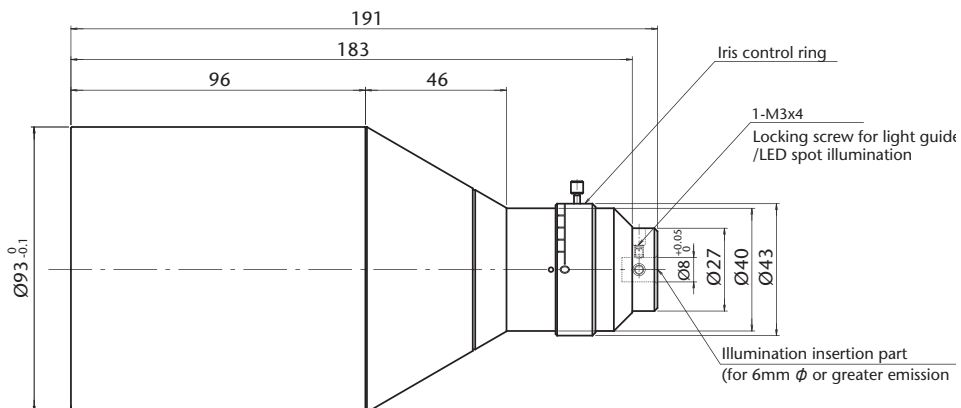
- Realizes illumination uniformity within an area 78 mm in diameter, at 110 mm WD
- Intensity and divergent rays can be adjusted by the variable iris of the lens

Model Name	MTI-78
Lighting Area	78 mm
Working Distance (WD)	110 mm
Applicable Wavelength	400 nm to 700 nm (Design value: 588 nm)
Divergent Angle	0 to 1.1 degrees
Weight	Approx. 620 g
Applicable Illumination Size (Insertion Part)	Ext diameter: 8mm Protrusion part length: 12mm Emission part diameter: 6mm or greater
Operating Environment	Temperature: 0 to 40 Humidity: 0 to 70% (with no condensation)
Storage Environment	Temperature: 0 to 40 Humidity: 0 to 70% (with no condensation)

### Benefit of collimated light backlighting compared to diffusion light in contour inspection



### MTI-78



# Example of Attachment

## Lens tube Dimensions & Mounting positions

Model	A	B	C	D
MML-HR 5M Series				
MML03-HR65D-5M	20	68	111	101.7
MML03-HR65-5M	20	68	111	101.7
MML05-HR65DVI-5M	10	65	105	x
MML05-HR65VI-5M	10	65	105	x
MML1-HR65DVI-5M	16	36	64	x
MML1-HR65VI-5M	16	36	64	x
MML2-HR65DVI-5M	27	39	68	x
MML2-HR65VI-5M	27	39	68	x
MML3-HR65DVI-5M	10	37	90	x
MML3-HR65VI-5M	10	37	90	x
MML4-HR65DVI-5M	10	37	89	x
MML4-HR65VI-5M	10	37	89	x
MML014-HR110D-5M*2	20	96	-	x
MML03-HR110D-5M	20	69	114	103.9
MML03-HR110-5M	20	69	114	103.9

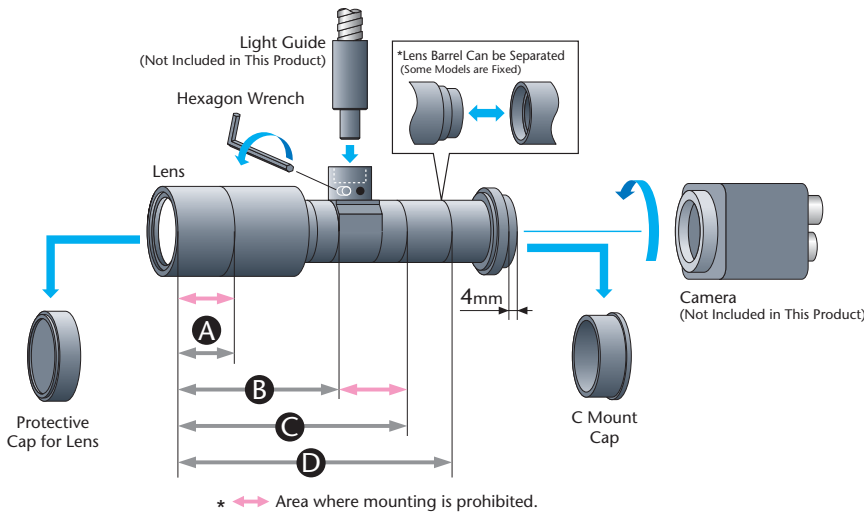
(UNIT:mm)

Model	A	B	C	D
MML-HR Series				
MML05-HR65D/HR65	10	25	69	61
MML08-HR65D/HR65	15	35	64	59
MML1-HR65D/HR65	15	33	53	53.2
MML1.5-HR65D/HR65	11	23	41	43.2
MML2-HR65D/HR65	15	25	46	45.5
MML4-HR65D/HR65	20	26	47	86.2
MML6-HR65D/HR65	20	30	47	101.1
MML4-HR65D-VI	20	26	58	86.2
MML6-HR65D-VI	20	30	62	101.1
MML05-HR110D/HR110	11	67	102	93.4
MML08-HR110D/HR110	20	65	91	81.5
MML1-HR110D/HR110	30	64	95	80.8
MML1.5-HR110D/HR110	13	50	76	71.3
MML2-HR110D/HR110	20	43	70	68.4
MML4-HR110D	20	44	120	106.7
MML6-HR110D	15	48	120	109.1
MML08-HR255D/HR255	18	68	86	89.5
MML1-HR244D/HR244	18	68	86	89.5
MML2-HR220D	18	68	86	89.5
MML4-HR220D	52	125	149	x
MML6-HR220D	52	125	149	x
MML8-HR220D	52	125	149	x

(UNIT:mm)

Model	A	B	C	D
MML-ST Series				
MML1-ST40D	11	17	34	37.2
MML1-ST40	11	17	34	x
MML1.5-ST40D	10	14	30	34
MML1.5-ST40	10	14	30	x
MML2-ST40D	9	12	27	31.5
MML2-ST40	9	12	27	x
MML3-ST40D	9	12	27	31.5
MML3-ST40	9	12	27	x
MML4-ST40D	10	10	27	30.6
MML4-ST40	10	10	27	x
MML6-ST40D	10	10	27	30.6
MML6-ST40	10	10	27	x
MML8-ST40D	10	10	27	30.6
MML8-ST40	10	10	27	x
MML08-ST65D/ST65	15	39	62	59
MML1-ST65D	15	33	53	53.2
MML1-ST65	15	33	53	x
MML1.5-ST65D	11	23	41	43.2
MML1.5-ST65	11	23	41	x
MML2-ST65D	15	25	46	45.5
MML2-ST65	15	25	46	x
MML2-ST65DS	20	20	40	40.1
MML2-ST65S	20	20	40	x
MML3-ST65DS	17	17	47	37.9
MML3-ST65S	17	17	47	x
MML4-ST65D	20	26	47	85.3
MML4-ST65	20	26	47	x
MML4-ST65DS	18	18	34	54.7
MML4-ST65S	18	18	34	x
MML6-ST65D	20	30	47	100.1
MML6-ST65	20	30	47	x
MML6-ST65DS	18	18	55	54.7
MML6-ST65S	18	18	55	x
MML8-ST65DS	18	18	55	54.7
MML8-ST65S	18	18	55	x
MML08-ST110D/ST110	20	65	93	85
MML1-ST110D/ST110	20	50	75	74.4
MML2-ST110D	20	44	68	64
MML2-ST110	20	44	68	x
MML2-ST110DS	12	27	50	47.6
MML2-ST110S	12	27	50	x
MML3-ST110DS	12	27	50	47.6
MML3-ST110S	12	27	50	x
MML4-ST110D	15	29	68	49.2
MML4-ST110	15	29	68	x
MML6-ST110D	15	29	68	49.2
MML6-ST110	15	29	68	x
MML8-ST110D	15	29	68	49.2
MML8-ST110	15	29	68	x
MML12-ST110D	15	29	68	49.2
MML1-ST150D/ST150	10	74	91	90.8
MML08-ST170D/ST170	10	74	91	90.8
MML05-ST300DVI	14	99	134	x
MML1-ST300D	20	106	145	x

(UNIT:mm)



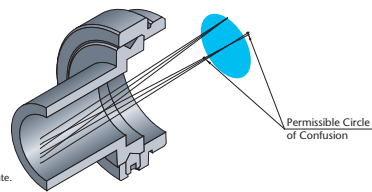
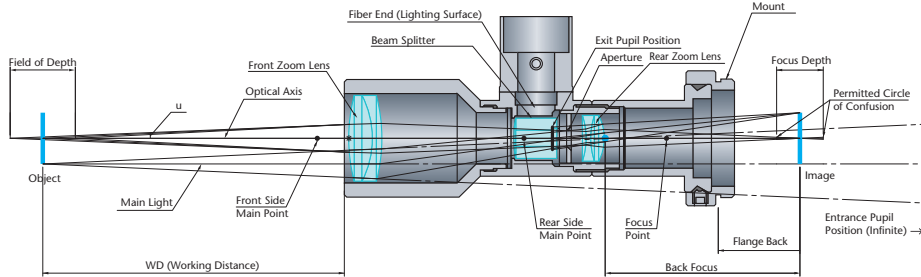
\*1 Where the lens tube segment in the table is marked with an "x", the lens cannot be detached at that point.  
 \*2 It is recommended to fix the unit at the original screw hole locations.

# Chart for Field of View

Chart for Field of View

Magnification	Sensor Size											
	2/3"			1/1.8"			1/2"			1/3"		
	Length	Width	Angle	Length	Width	Angle	Length	Width	Angle	Length	Width	Angle
0.1x	66.00	88.00	110.00	53.19	71.76	89.32	48.00	64.00	80.00	36.00	48.00	60.00
0.14x	47.14	62.86	78.57	37.99	51.26	63.80	34.29	45.71	57.14	25.71	34.29	42.86
0.16x	41.25	55.00	68.75	33.24	44.85	55.83	30.00	40.00	50.00	22.50	30.00	37.50
0.18x	36.67	48.89	61.11	29.55	39.87	49.62	26.67	35.56	44.44	20.00	26.67	33.33
0.2x	33.00	44.00	55.00	26.60	35.88	44.66	24.00	32.00	40.00	18.00	24.00	30.00
0.3x	22.00	29.33	36.67	17.73	23.92	29.77	16.00	21.33	26.67	12.00	16.00	20.00
0.4x	16.50	22.00	27.50	13.30	17.94	22.33	12.00	16.00	20.00	9.00	12.00	15.00
0.5x	13.20	17.60	22.00	10.64	14.35	17.86	9.60	12.80	16.00	7.20	9.60	12.00
0.6x	11.00	14.67	18.33	8.87	11.96	14.89	8.00	10.67	13.33	6.00	8.00	10.00
0.7x	9.43	12.57	15.71	7.60	10.25	12.76	6.86	9.14	11.43	5.14	6.86	8.57
0.75x	8.80	11.73	14.67	7.09	9.57	11.91	6.40	8.53	10.67	4.80	6.40	8.00
0.8x	8.25	11.00	13.75	6.65	8.97	11.17	6.00	8.00	10.00	4.50	6.00	7.50
0.9x	7.33	9.78	12.22	5.91	7.97	9.92	5.33	7.11	8.89	4.00	5.33	6.67
1x	6.60	8.80	11.00	5.32	7.18	8.93	4.80	6.40	8.00	3.60	4.80	6.00
1.5x	4.40	5.87	7.33	3.55	4.78	5.95	3.20	4.27	5.33	2.40	3.20	4.00
2x	3.30	4.40	5.50	2.66	3.59	4.47	2.40	3.20	4.00	1.80	2.40	3.00
2.5x	2.64	3.52	4.40	2.13	2.87	3.57	1.92	2.56	3.20	1.44	1.92	2.40
3x	2.20	2.93	3.67	1.77	2.39	2.98	1.60	2.13	2.67	1.20	1.60	2.00
3.5x	1.89	2.51	3.14	1.52	2.05	2.55	1.37	1.83	2.29	1.03	1.37	1.71
4x	1.65	2.20	2.75	1.33	1.79	2.23	1.20	1.60	2.00	0.90	1.20	1.50
4.5x	1.47	1.96	2.44	1.18	1.59	1.98	1.07	1.42	1.78	0.80	1.07	1.33
5x	1.32	1.76	2.20	1.06	1.44	1.79	0.96	1.28	1.60	0.72	0.96	1.20
6x	1.10	1.47	1.83	0.89	1.20	1.49	0.80	1.07	1.33	0.60	0.80	1.00
7x	0.94	1.26	1.57	0.76	1.03	1.28	0.69	0.91	1.14	0.51	0.69	0.86
8x	0.83	1.10	1.38	0.66	0.90	1.12	0.60	0.80	1.00	0.45	0.60	0.75
9x	0.73	0.98	1.22	0.59	0.80	0.99	0.53	0.71	0.89	0.40	0.53	0.67
10x	0.66	0.88	1.10	0.53	0.72	0.89	0.48	0.64	0.80	0.36	0.48	0.60
11x	0.60	0.80	1.00	0.48	0.65	0.81	0.44	0.58	0.73	0.33	0.44	0.55
12x	0.55	0.73	0.92	0.44	0.60	0.74	0.40	0.53	0.67	0.30	0.40	0.50
15x	0.44	0.59	0.73	0.35	0.48	0.60	0.32	0.43	0.53	0.24	0.32	0.40
20x	0.33	0.44	0.55	0.27	0.36	0.45	0.24	0.32	0.40	0.18	0.24	0.30

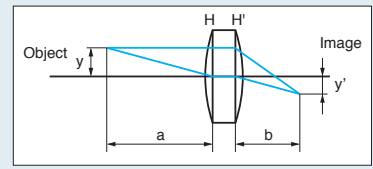
# Data and Glossary



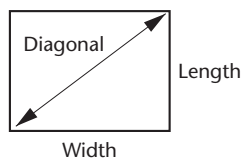
\*This diagram is intended for the purpose of explaining technology. The positions and distances shown in this diagram are not necessarily accurate.

Performance	Telecentric Optics	<p>An optical system where the principal ray is parallel to the lens optical axis. An optical system where the light comes from an object toward a lens and stays parallel to the optical axis, even outside the axis, is called object side telecentric optics. A system where the light comes from lens toward an image and stays parallel to the optical axis, even outside the axis, is called image side telecentric optics. Telecentric optics indicated in this catalog are object side telecentric optics.</p>	
	Resolution (μm)	<p>Resolution is measured by how closely 2 points can be before they cannot be distinguished. For example, 1μm resolution means that 2 points that are 1μm away from each other can be distinguished. Resolution values in this catalog are theoretical resolutions for the lenses. The following is a formula to calculate theoretical resolution based on a lens's ray diffraction with no aberration. (Rayleigh formula)</p> $\text{Resolution} = \frac{0.61 \times \lambda}{NA}$ <p>λ: Wavelength    0.61: Fixed Number</p>	
	Resolving Power (Lines/ mm)	<p>Resolving power indicates the number of black and white lines distinguished within 1mm in an image through a black and white grid-like chart lens. Resolving power is expressed by lines/ mm. For example, 100 lines/mm means that black and white pitch 1/100mm (10μm) can be distinguished. Width of both the black and white lines is 1/200mm (5μm).</p>	
	Horizontal TV Resolution (TV lines)	<p>The total number of black and white horizontal stripes in the width, equivalent to the height of the vertical height on a TV monitor screen. The total stripes in the horizontal width would be 3/4, because the ratio of vertical and horizontal length of the screen is usually 3:4. When the horizontal TV resolution is 240TV lines, total stripes in the horizontal width of the TV monitor would be 320 lines. When measuring resolution of a lens, a pair of black and white lines is counted as one line. However, for TV lines, one pair is counted as 2TV lines.</p>	
	Distortion (%)	<p>Distortion is the aberration of a lens where a straight object outside of the optical axis appears curved. Distortion of a straight line towards the center is called pincushion distortion, while distortion expanding outwards is called barrel distortion</p>	
	TV Distortion (%)	<p>Image distortion on a TV monitor. The closer to zero, the better the performance.</p>	<p>TV distortion (%) = <math>\frac{\Delta h}{2h} \times 100</math></p> <p>The curve amount on the long side is considered as distortion. Percentage of the depth of distortion h against vertical screen is TV distortion</p>
	Aperture Efficiency Marginal Light Quantity (%)	<p>Aperture efficiency indicates the brightness difference between the optical axis of the image formation plane and its surrounding area when an evenly bright object is captured with a lens. It is expressed by percent (%) assuming that the center brightness is 100. It is one of the optical characteristics of a lens. Marginal light quantity in this catalog indicates aperture efficiency.</p>	
	Shading (%)	<p>Shading is the brightness difference between the center of a TV monitor and its edges when an evenly bright object is captured with a lens and a camera. It is expressed by percent (%). Generally, this percentage is calculated based on power ratio of light receiving elements. Shading indicates comprehensive performance of a lens and TV camera. To make shading smaller, telecentric optics is used.</p>	
	Chromatic Aberration	<p>In lens optics, positions where images are formed and image magnification differ according to the light's wavelength. Rays of different wavelengths have different colors. This is called chromatic aberration. Aberration on the optical axis is called chromatic aberration on the axis, and magnification difference is called magnification chromatic aberration.</p>	
Floating Mechanism	<p>This system is used to compensate for lens aberration which occurs in shooting an image of an object in close proximity. When moving (extending) the lenses for close-up shooting or adjusting the object distance, the aberration changes in accordance with the magnification or shooting distance, resulting in degraded resolution in some cases. The floating mechanism minimizes the change in aberration by moving some of the lenses according to the shooting conditions, thus correcting for the aberration.</p>		

Distance	WD (Working Distance) (mm)	Distance from the front end of a lens system to the object under inspection.							
	Focal Distance f (mm) Back Focus / Front Focus	Focal distance is the distance from the optical system's principle point to the focal point. Distance from the vertex of the last lens to the back focal point is called back focus. Distance from the vertex of the first lens to the front focal point is called front focus.							
	Depth of Field	Depth is the distance between the nearest and farthest points that appear in acceptably sharp focus when an object is shifted back and forth from the best focal point. Depth range of the object side is called depth of field. <b>Depth of Field = 2 (Permissible Circle of Confusion x Effective F No Magnification<sup>2</sup>)</b> Images through lenses theoretically form as points. Acceptable blur on an acceptably clear image is called the permissible circle of confusion							
	Depth of Focus	Depth is the distance between the nearest and farthest points that appear in acceptably sharp focus when a sensors is shifted back and forth from the best focal point. Depth range of the image side is called depth of focus.							
	Flange Back (mm)	Distance from the front of the camera mount plane to the image.							
	C-Mount Specifications	<table border="1"> <thead> <tr> <th>Name</th> <th>Standard External Diameter</th> <th>No. of Screw Threads (for 25.4mm)</th> <th>Flange Back</th> </tr> </thead> <tbody> <tr> <td>U1</td> <td>25.400mm</td> <td>32 Threads</td> <td>17.526mm</td> </tr> </tbody> </table>	Name	Standard External Diameter	No. of Screw Threads (for 25.4mm)	Flange Back	U1	25.400mm	32 Threads
Name	Standard External Diameter	No. of Screw Threads (for 25.4mm)	Flange Back						
U1	25.400mm	32 Threads	17.526mm						
Brightness	Numerical Aperture NA, NA'	When the half angle that an object makes on the entrance pupil is u, and refractive index is n, n x sin u is called object side numerical aperture, NA. When the half angle that an image makes on exit pupil is u', and refractive index is n', n' x sin u' is called image side numerical aperture, NA'. NAs in this catalog indicate object side numerical apertures. Numerical aperture is an important value that expresses lens resolution and brightness. $NA=n \times \sin u$ $NA'=n' \times \sin u'$ The higher the NA, the greater the resolution and brightness are of the lens.							
	F Number F No	The value indicates lens brightness. It is calculated by dividing the focal distance of the lens by its effective diameter (entrance pupil diameter D mm) looking from its object side. It can also be calculated by NA and the lens' optical magnification ( $\beta$ ). The smaller the number the brighter the lens is. $F \text{ No}=f/D$							
	Effective F No	The value indicates lens brightness when an object is located in finite distance, the value which indicates the brightness when actually operated. The higher the optical magnification ( $\beta$ ), the darker the lens is. $Effective \ F \ No=\beta / (2 \times NA)=1/(2 \times NA')$ $Effective \ F \ No= (1+\beta) \times F \ No^*$ <span style="float: right;">*Approximation for Thin-Walled Systems</span>							
Magnification	Optical Magnification $\beta$	Image size ratio against the object size. $\beta = y'/y$ $=b/a$ $=NA/NA'$ $=\text{Camera Element Size} / \text{Actual Size of Diel of View}$							
	Electronic Magnification	Electronic magnification is the magnification of an image on a camera when it is displayed on a monitor screen.							
	Monitor Magnification	Monitor magnification is the magnification of an object displayed on a monitor screen through a lens. <b>Monitor Magnification = (Optical Magnification <math>\beta</math>) x (Electronic Magnification)</b> (Calculation Example) Optical Magnification $\beta=0.2x$ , camera Size 1/2" (Diagonal Line 8mm), Monitor 14" : Electronic Magnification =14 x 25.4 $\beta$ 8 = 44.45 (Times) Monitor Magnification = 0.2 x 44.45= 8.89 (Times)      (1 Inch = 25.4mm)							
	Field of View	Field of view is the size of an object that can be shot when the lens is attached to a camera. The size of field of view is (sensor size) $\div$ (optical magnification $\beta$ ). (Calculation Example) Optical Magnification $\beta=0.2x$ , camera Size 1/2" (4.8mm Long, 6.4mm Wide) : Size of Field of View    Length =4.8/0.2=24 (mm) Width =6.4/0.2=32 (mm)							



### Size of Camera Elements



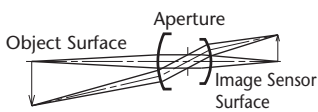
Type	Aspect Ratio	Length mm	Width mm	Diagonal mm
1/6"	4:3	1.73	2.3	2.878
1/4"	4:3	2.4	3.2	4
1/3"	4:3	3.6	4.8	6
1/2"	4:3	4.8	6.4	8
1/1.8"	4:3	5.3	7.2	8.9
2/3"	4:3	6.6	8.8	11
1"	4:3	9.6	12.8	16
4/3"	4:3	13.5	18	22.5

### Formula

- Resolution ( $\mu\text{m}$ )** =  $0.61(\text{Fixed Number}) \times 0.55(\text{Design Wavelength}) \div \text{NA}$
- Effective F No** =  $\text{Magnification} / 2\text{NA}$
- Depth of Field (mm)** =  $2(\text{Permissible Circle of Confusion Diameter} \times \text{Effective F No} \div \text{Magnifications}^2)$
- Light Flux Diameter ( $\theta$ )** =  $2\text{NA} \times \text{Height from Object} + \text{Size of Field of View (Angle)}$

### Features of Telecentric Optical System

Non-Telecentric Lens



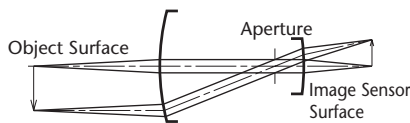
**Advantages**

Smaller size.  
Cost-saving because the number of lenses is fewer.

**Disadvantages**

Object size or position varies as the object surface moves up and down.

Object Side Telecentric Lens



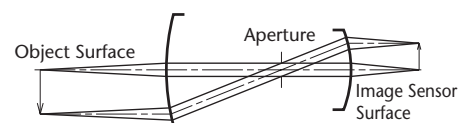
**Advantages**

Object size does not change even when the object surface moves up and down.  
Smaller size is possible when coaxial illumination is used.

**Disadvantages**

Larger than regular lenses when coaxial illumination is not used.

Double-Sided Telecentric Lens



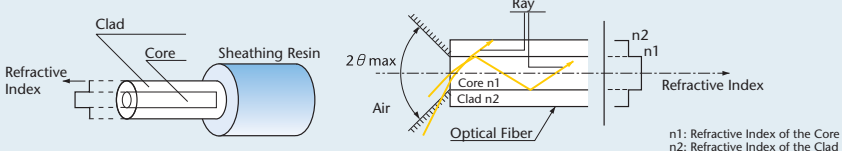
**Advantages**

Similar to MML. However, accuracy improves when the size of camera flange back differs greatly.

**Disadvantages**

Similar to MML. However, higher cost than MML.

# Glossary

Measured Light Quantity	Light Flux (lumen)	The quantity of light emitted from a light source. The unit is lumen (lm) $1\text{lm}=1\text{cd}\times\text{sr}$
	Luminous Intensity (candela)	Light source quantity representing the quantity of light emitted from a light source per unit solid angle. The unit is candela (cd)
	Intensity (lux)	Brightness on an object surface irradiated by light emitted from a light source. The unit is lux (lx) $1\text{lx}=1\text{lm}/\text{m}^2$ where $\text{m}^2$ is the area of the object surface
	Illuminance (nit)	Light source quantity representing the luminous intensity of light emitted from a light source per unit area. The unit is nit (nt) $1\text{nt}=1\text{cd}/\text{m}^2$ or $1\text{sb}=1\text{cd}/\text{cm}^2$
Filter	Color Temperature K	Color temperature representing the spectral energy distribution of light emitted from a light source. The unit is kelvin (K). A light source of a low value is reddish and one of a high value is bluish. To change the color temperature of a light source, use a color temperature conversion filter.
	Polarizing Filter	A filter to block light being reflected from glass, metal, or liquid surfaces that is too strong and detrimental.
	ND Filter	A filter to reduce the light quantity only, without affecting color reproduction. Also known as a gray filter.
	Color Temperature Conversion Filter	A filter to change the color temperature. The wavelength can be selected.
	Diffusion Filter	A filter to diffuse light from a light source and suppress illumination irregularity.
	IR Cut Filter	This filter can be classified into two types: heat-ray absorbing filters (or, catathermic filters), which absorb infrared rays, and cold filters, which reflect infrared rays by a multilayer film.
	Light Control Film	By laminating a micro-louver film with PET or other types of film, diffused light becomes more parallel.
Lamp	Halogen Lamp	An incandescent lamp with a trace of halogen gas added to the sealed gas. The halogen cycle prevents the blackening of the bulb wall. The optical output and color temperature are stable with less attenuation compared with that of an ordinary incandescent.
	Metal Halide Lamp	A lamp of great color rendering and high intensity using illumination by various metal halogen compounds and mercury.
	LED	A Light Emitting Diode (LED) is a semi-conductor element that applies a fixed-direction current to a crystalline substance with a semi-conductor PN junction, generating energy in the substance and emitting the energy as light. The basic theory was found early in the 20th century and silicon carbide was confirmed, experimentally, to emit light if a current was applied. Following this research, the current technology was established in the 1960's. Red and green were developed first, yellow in the 1970's, blue in 1993 and white in 1996.
	Constant-Current Power Supply	A power supply that can supply a fixed current even if infinite impedance and load voltage change.
	Constant-Voltage Power Supply	A power supply that can supply a fixed voltage even if 0 impedance and load voltage change.
	Resistance	Resistance (R) represents the difficulty of a current to pass: $R = V/I$ . The unit is ohm ( $\Omega$ ). If the potential of a current drops by 1 volt (V) per ampere (A), the resistance is $1\Omega$ .
Fiber	Optical Fiber	
	Numerical Aperture NA	The characteristic of receiving rays transmitted through the end face of an optical fiber. This is determined by the refractive indexes of the core and clad of the optical fiber. $NA = \sqrt{n_1^2 - n_2^2}$
	Light-Reception Angle $\theta$	An angle where the optical fiber can receive light. $\theta = 2\sin^{-1}(NA)$
	Transmittance	The amount of incident light that passes through an optical fiber, typically at a given wavelength, represented as a fraction or rate. The higher the transmission rate or transmittance, the better.
	Attenuation	The reduction or loss in intensity of light as it travels through an optical fiber, also known as transmission loss. Lower attenuation means better performance. Unit is dB/km.



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## Lens

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## Catalog Icon Key



The CE marking (CE mark) is a mandatory conformity mark on many products placed on the single market in the European Economic Area (EEA). The CE marking certifies that a product has met EU consumer safety, health or environmental requirements.



IP (Ingress Protection) is a set of standard measurements related to the protection of products from solid foreign objects and water. IP is prescribed by the Japanese Industrial Standards Committee (JISC0920) and the International Organization for Standardization (IEC60529). IP67 is a level of protection that can withstand being submerged in water at a depth of 1 meter for 30 minutes.



Indicates Wattage i.e. 50 W = 50 Watt



External intensity control type - Analog = 0-5 V, Digital = 8 bit or 10 bit



The number of channels for output power  
i.e. 1 ch = 1 channel output, 2 ch = 2 channel output



LED color  
W = White, R = Red, G = Green, B = Blue, ( R/G/B ) = Made-to-order

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