RICOH Industrial Solutions Inc.

Machine Vision

- Lenses
- Accessories
- Technical Information

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MACHINE VISION LENSES
Keen eyes for manufacturing

On the production floor, companies continue to seek ever greater safety, security, and product quality. RICOH's latest “keen eyes” were created to support such advances in reliable manufacturing.

These series of high-quality factory automation (FA) lenses bring together all the advanced optical design and technology that RICOH has developed over many years.

Moving forward, we will support even higher production-line efficiency and reliability by continuing to develop the best high quality lenses optimised for FA cameras and by combining an extensive range of lenses in a way that ensures a dependable image solution.

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Machine Vision Lenses

Pictures not true to scale

- VGA Lenses
- 2 Megapixel Lenses
- 5 Megapixel Lenses
- 9 Megapixel Lenses
- Line-scan Lenses
- UV Cameras Lenses

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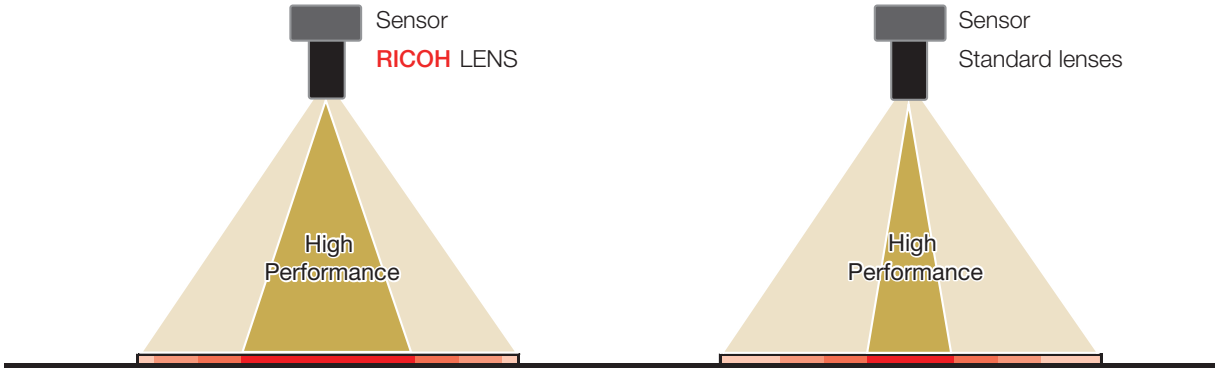
RICOH'S ADVANTAGE

RICOH technology has developed excellent optical characteristics even at the periphery, despite the problems with resolution, contrast, distortion and vignetting that competitor's lenses suffer from.

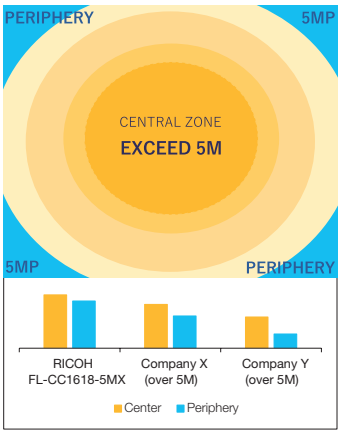


- You can obtain high quality images over a wider viewing area.
- Inspection systems have improved performance due to RICOH lenses high performing peripheral imagery.

REPORT 1 : RICOH'S OPTICAL DESIGH, BASED ON MACHINE VISION'S DEMAND.

Clear images to the periphery

2/3" format 5 Mega-pixel lens



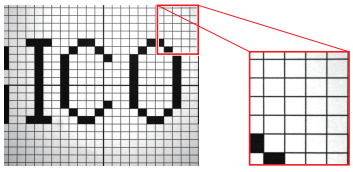
- 5MP at all distances, maintains 5MP even at the periphery.

WD : 250 mm
investigated by RICOH

- The quality is better than competitor's higher resolution lenses.

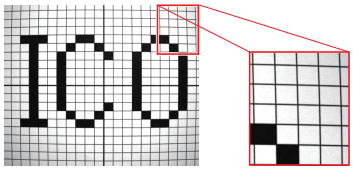
[Extremely low distortion]

FL-CC1218-5MX (w.d.100 f1.8)



- Low distortion achieves low image degradation at the corners.

Sensor Standard lenses (w.d.100 f1.8)



- Larger distortion at the corner.

REPORT 2: PROVIDING THE MARKET WITH HIGH PERFORMANCE LENSES

1. Optical simulation technology supported by actual results

To realise this product, we shared information on our vital optical design technology with other products in the Ricoh Group and are always introducing new technology. We introduced Ricoh original algorithms for resolution and ghost analysis, and in post-design trials, we confirmed the characteristics on actual equipment were the same as in our simulations. These results are fed back into the simulations, which in turn helps us improve our technology to ensure performance and build on pre-existing technology.

2. Tolerance accumulating technology with due attention to variations during mass production

Ricoh has created a parts tolerance accumulation system that is replete with our inherent knowledge of optical units, maintaining part processing precision and yield. We establish the required precision at part level in accordance with Ricoh's original algorithms and verify them.

3. Precision adjustment technology during mass production

We have introduced adjustment technology to precision lens processing and assembly to our production process, concentrating the precision adjustment technology created by the Ricoh Group to produce lenses that are even more advanced.

VGA LENSES
MANUAL IRIS

An extensive line of general-use lenses boasting high-performance lens technology featuring vibration-control measures, these lenses are a superior choice for installation in machine vision systems.

Built for a wide variety of uses, including pattern matching, component positioning, missing-part inspection, board mounting and inspection of pharmaceuticals, produce, and grains.

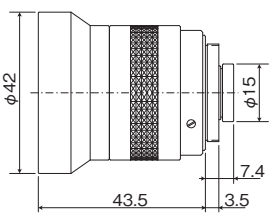
- Standard lenses for machine vision use
- Compatible with VGA-class cameras
- Production line handling cameras from 1/2" to 1" formats
- Lock screws as standard vibration-control measures

VGA LENSES, FIXED FOCAL LENGTH
Manual Iris, with Locking Screws

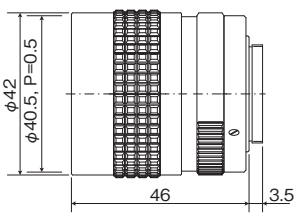
	Part No.	Format size	Mount	Focal length (mm)	Iris range	Min. Pixel Pitch (µm)*	M. O. D. (m)	Horizontal angle of view	Filter size (mm)	Dimensions (mm)
❶	FL-HC0416X-VG	1/2"	C	4.2	1.6 - C	8.75	0.2	86.8°	-	Ø42.0 × 43.5
	FL-HC0612A-VG	1/2"	C	6.0	1.2 - C	8.75	0.2	56.9°	40.5	Ø42.0 × 46.0
	FL-HC1212B-VG	1/2"	C	12.0	1.2 - 22	8.75	0.2	30.2°	27.0	Ø30.0 × 35.5
❶	FL-CC0418DX-VG	2/3"	C	4.8	1.8 - C	11.67	0.3	96.4°	-	Ø40.5 × 35.5
	FL-CC0815B-VG	2/3"	C	8.5	1.5 - C	11.67	0.2	56.5°	40.5	Ø42.0 × 40.0
	FL-CC1614A-VG	2/3"	C	16.0	1.4 - 22	11.67	0.3	30.7°	27.0	Ø30.0 × 33.0
	FL-BC1214D-VG	1"	C	12.5	1.4 - C	17.50	0.3	54.0°	40.5	Ø42.0 × 50.0
	FL-BC1218A-VG	1"	C	12.5	1.8 - C	17.50	0.3	55.5°	40.5	Ø42.0 × 40.0
	FL-BC2514D-VG	1"	C	25.0	1.4 - 22	17.50	0.3	30.0°	27.0	Ø30.0 × 37.3
	FL-BC2518-VG	1"	C	25.0	1.8 - C	17.50	0.6	28.2°	40.5	Ø42.0 × 40.0
	FL-BC5014A-VG	1"	C	50.0	1.4 - C	17.50	1.0	14.4°	46.0	Ø48.0 × 48.0

* Min. Pixel Pitch at 30% contrast (measuring on the edge of the Optic), ❶ fixed focus

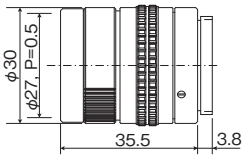
Unit: mm



FL-HC0416X-VG



FL-HC0612A-VG



FL-HC1212B-VG

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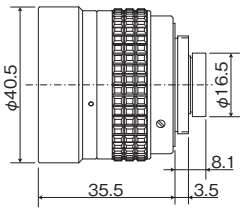
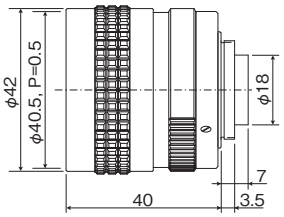
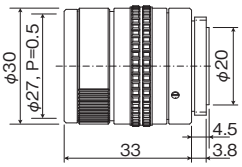


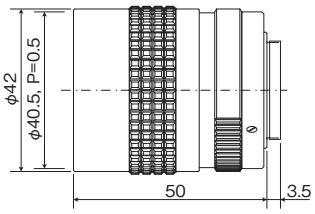
FL-CC0418DX-VG



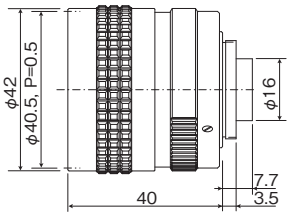
FL-CC0815B-VG



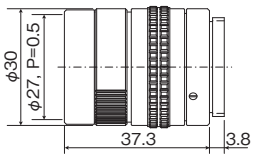
FL-CC1614A-VG



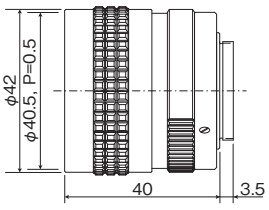
FL-BC1214D-VG



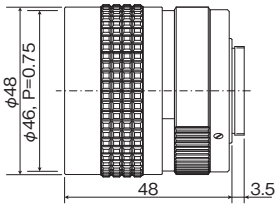
FL-BC1218A-VG



FL-BC2514D-VG



FL-BC2518-VG



FL-BC5014A-VG

2 MEGAPIXEL LENSES 1/2" AND 2/3"

2 megapixel type lenses for a wide range of applications: Select the optimum lens for your focal length and format size requirements.

These manual-iris lenses are an optimal choice for image processing data capture at 2 megapixels. With their compact size and high performance, they deliver great results for high-precision manufacturing inspection (chip mounters, wafers, electronic substrates, etc.).

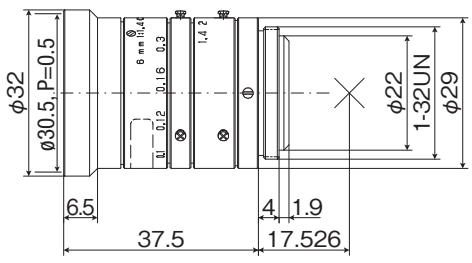
- High-performance lenses for close-up imaging with 2 megapixel CCD and CMOS sensors
- Sharp high resolution, high contrast images, that limit resolution loss from the center to periphery
- With compact size, light weight, and durability, these are excellent lenses for FA and machine vision use
- They greatly reduce distortion that causes problems in image measurement and recognition
- Built to handle environments with vibration, etc.
- Easy to use, reliable focus and iris locking mechanisms as standard features

2 MEGAPIXEL LENSES, FIXED FOCAL LENGTH
Manual Iris, with Locking Screws

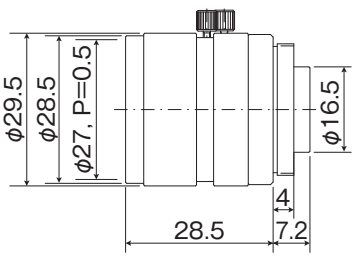
Part No.	Format size	Mount	Focal length (mm)	Iris range	Min. Pixel Pitch (µm)*	M. O. D. (m)	Horizontal angle of view	Filter size (mm)	Dimensions (mm)
HIGH-RESOLUTION, FOR STANDARD, IP AND MEGAPIXEL CAMERAS									
FL-HC0614-2M	1/2"	C	6	1.4 - 16	5.39	0.10	57.4°	30.5	Ø32.0 × 37.5
FL-HC1214-2M	1/2"	C	12	1.4 - 16	5.39	0.25	28.9°	27.0	Ø29.5 × 28.5
FL-CC1614-2M	2/3"	C	16	1.4 - 16	5.39	0.25	31.0°	27.0	Ø29.5 × 33.2
FL-CC2514-2M	2/3"	C	25	1.4 - 16	5.39	0.25	20.0°	27.0	Ø29.5 × 32.0
FL-CC3516-2M	2/3"	C	35	1.6 - 16	5.39	0.40	14.8°	27.0	Ø29.5 × 35.4
FL-CC5028-2M	2/3"	C	50	2.8 - 22	5.39	0.90	10.1°	27.0	Ø29.5 × 34.0
FL-CC7528-2M	2/3"	C	75	2.8 - 32	5.39	0.70	6.9°	30.5	Ø34.0 × 59.6

* Min. Pixel Pitch at 30% contrast (measuring on the edge of the Optic)

Unit: mm



FL-HC0614-2M



FL-HC1214-2M

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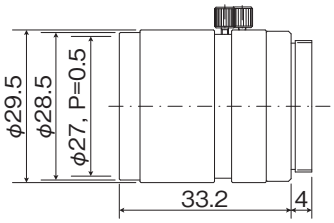
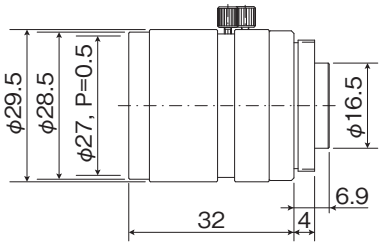
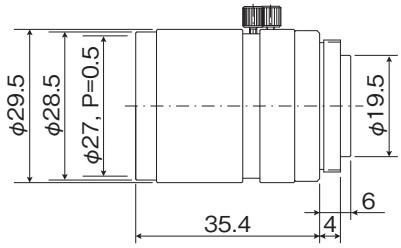


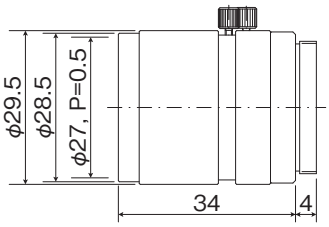
FL-CC1614-2M



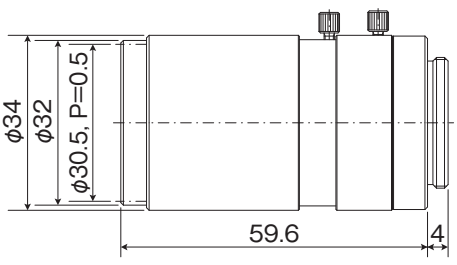
FL-CC2514-2M



FL-CC3516-2M



FL-CC5028-2M



FL-CC7528-2M

2 MEGAPIXEL LENSES ALL 2/3"

The new lenses following customer's requests now consistently have a 2/3" format, expanding the line-up next to the existing and very successful 2 Megapixel series. With the new lens design, all values are again improved, so the lenses are ideal for a wide range of applications.

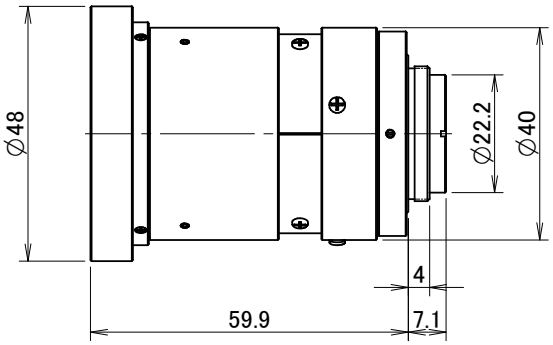
- **Bright images from the center to the edges:** Degradation of light transmission at the periphery has been kept to an absolute minimum enabling the new lenses to reproduce bright, high resolution images from the center to the periphery.
- **High Resolution and High Contrast even at the periphery:** Minimal degradation of resolution and contrast right through to the periphery. Therefore, even images right on the periphery are suitable for measurement and inspections.
- **Shortened MOD (Minimum Objective Distance):** Thanks to the newly developed optics, MODs have been shortened to 0.1m (except FL-CC5024A-2M), enabling further close-up imaging without the need for distance rings.
- **Low distortion:** Troublesome distortion for measurement and recognition applications has been reduced (0.02% to max. 0.56%).

2 MEGAPIXEL LENSES, FIXED FOCAL LENGTH
Manual Iris, with Locking Screws

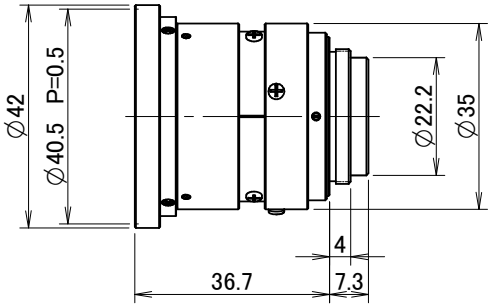
Part No.	Format size	Mount	Focal length (mm)	Iris Range	Min. Pixel Pitch (µm)*	M. O. D. (m)	Horizontal angle of biew	Filter size (mm)	Dimensions (mm)
HIGH-RESOLUTION, FOR STANDARD, IP AND MEGAPIXEL CAMERAS									
FL-CC0614A-2M	2/3"	C	6	1.4-16	5.39	0.1	71.2°	-	Ø 48.0 x 59.9
FL-CC0814A-2M	2/3"	C	8	1.4-16	5.39	0.1	56.3°	40.5 P=0.5	Ø 42.0 x 36.7
FL-CC1214A-2M	2/3"	C	12	1.4-16	5.39	0.1	39.4°	27.0 P=0.5	Ø 29.5 x 45.7
FL-CC1614A-2M	2/3"	C	16	1.4-16	5.39	0.1	30.7°	27.0 P=0.5	Ø 29.5 x 32.2
FL-CC2514A-2M	2/3"	C	25	1.4-16	5.39	0.1	19.5°	30.5 P=0.5	Ø 32.0 x 38.0
FL-CC5024A-2M	2/3"	C	50	2.4-22	5.39	0.3	10.3°	30.5 P=0.5	Ø 32.0 x 46.5

* Min. Pixel Pitch at 30% contrast (measuring on the edge of the Optic)

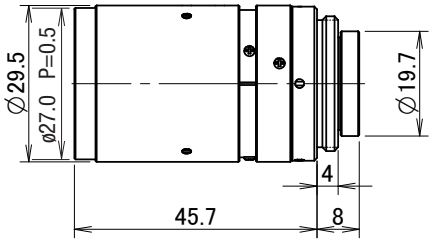
Unit: mm



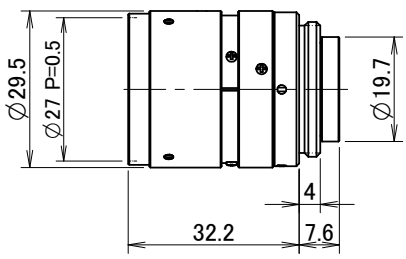
FL-CC0614A-2M



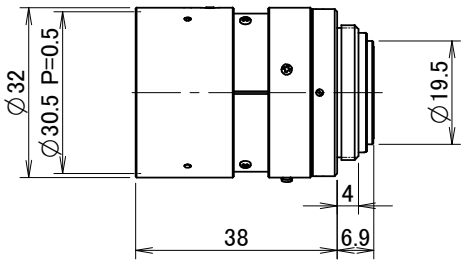
FL-CC0814A-2M



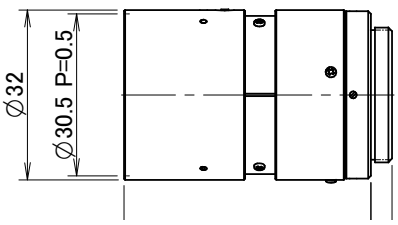
FL-CC1214A-2M



FL-CC1614A-2M



FL-CC2514A-2M



FL-CC5024A-2M

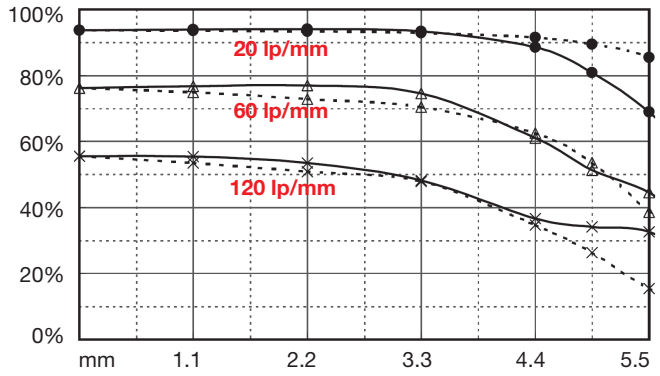
5 MEGAPIXEL LENSES

This series of high-res lenses are designed to match the requirements of highly developed machine vision systems. The lens isn't only optimized for highest image quality, but also for heavy duty industrial operation.

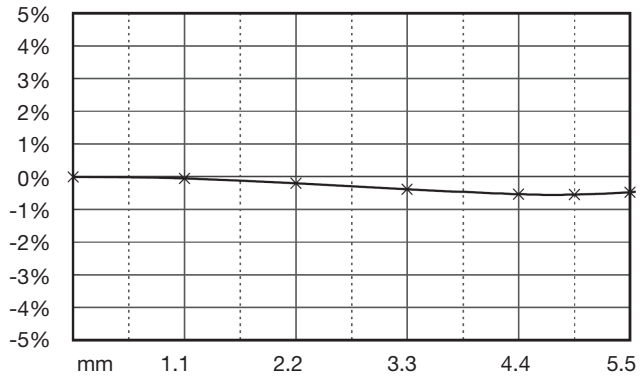
They are perfect for inspection, pattern matching, and alignment uses in which images with high definition from edge to edge definition are needed for large subjects such as wafers, chip mounters, board mounting, etc.

- Compatible with pixel size 3.45µm, 5 megapixel on 2/3" cameras
- High resolving power of 140 lp/mm from centre to corners of the image
- FL-CC1614-5M, FL-C2514-5M: 1% or less distortion, suitable for image measurement
- 40% increased light distribution
- Fast aperture F1.4
- Ideal for integration in highly developed machine vision systems
- Stable design, robust and durable
- With locking and thumb screws

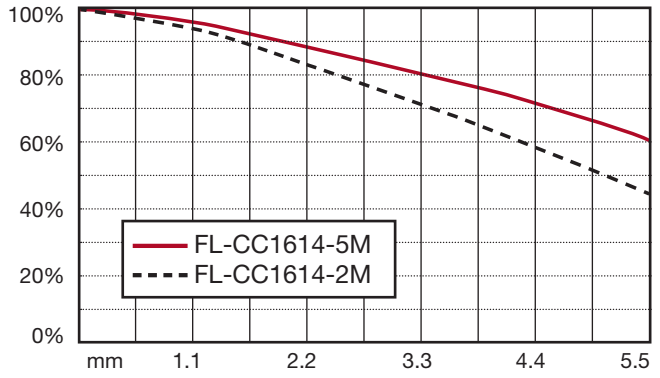
FL-CC1614-5M Optical transfer function



FL-CC1614-5M Distortion



Peripheral light intensity (Working distance 250 mm)



High resolution and high contrast

Supports 2/3" format, 5 megapixel CCD camera with 3.45µm pixel pitch. Achieves 140 lp/mm high resolution from center to periphery. Produces sharp, high-clarity images with high-contrast and low resolution loss all the way to the edge.

Ø 43 mm / 60 mm compact design

Consistent with the 44 mm-square cases used by many 5 megapixel cameras, we have achieved a size reduction to 43 mm for the outer diameter. These lenses are an excellent choice for installation on high-performance devices..

Extremely small level of optical distortion

For both the FL-CC2514-5M and the FL-CC1614-5M, optical distortion on the diagonals is less than 1%. TV distortion is held to less than 0.2%. The resulting extremely low-distortion images are also excellent for use in the image measurement field.

Bright to the periphery

Despite the F43 mm diameter, the optics accommodate 5 megapixels with F1.4 brightness. With peripheral-light-intensity falloff held to an absolute minimum, it is possible to obtain bright and high-resolution images. Although they are wide-angle lenses, with the iris open we were able to raise the peripheral light level to 70% (diagonals) and thereby achieve images that are bright and clear all the way to the periphery.

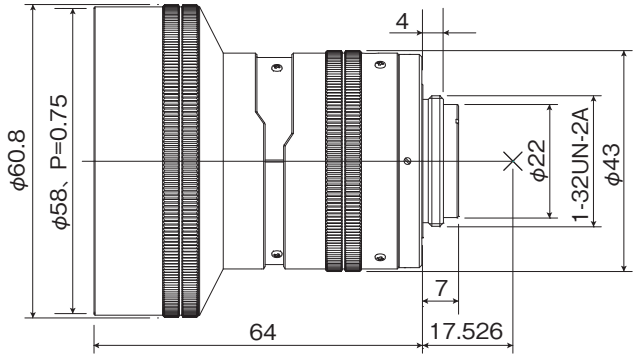
5 MEGAPIXEL LENSES, FIXED FOCAL LENGTH

Manual Iris, with Locking Screws

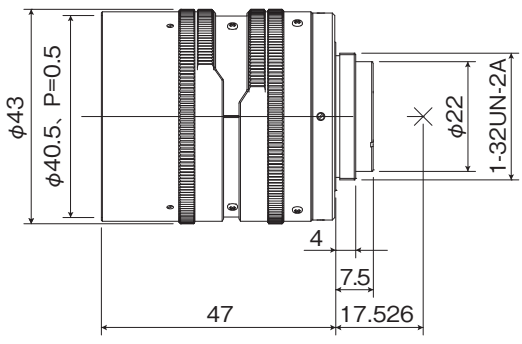
Part No.	Format size	Mount	Focal length (mm)	Iris range	Min. Pixel Pitch (µm)*	M. O. D. (m)	Horizontal angle of view	Filter size (mm)	Dimensions (mm)
HIGH-RESOLUTION, FOR STANDARD, IP AND MEGAPIXEL CAMERAS									
FL-CC0814-5M	2/3"	C	8	1.4 - 16	3.45	0.1	57.8°	58.0	Ø60.8 × 64.0
FL-CC1614-5M	2/3"	C	16	1.4 - 16	3.45	0.1	30.8°	40.5	Ø43.0 × 47.0
FL-CC2514-5M	2/3"	C	25	1.4 - 16	3.45	0.1	19.9°	40.5	Ø43.0 × 44.0

* Min. Pixel Pitch at 30% contrast (measuring on the edge of the Optic)

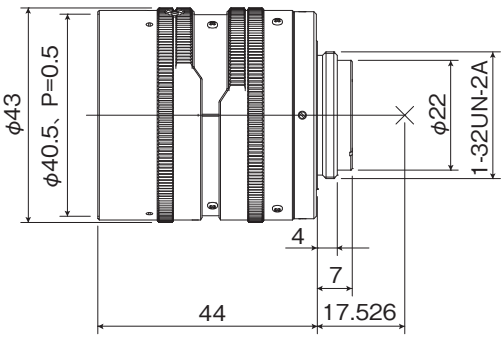
Unit: mm



FL-CC0814-5M



FL-CC1614-5M



FL-CC2514-5M

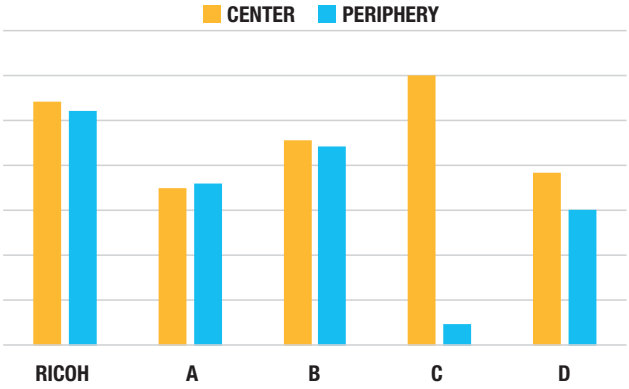
EXCEEDING 5 MEGAPIXEL LENSES

This series of 5 megapixel lenses are developed to be used with 2/3" format cameras and are not only optimised for high image quality, but also for use in harsh environments and durable industrial systems.
The lens's focusing uses a floating mechanism design, reducing aberrations from an infinite to close working distance. Therefore, the lenses can also be used at distance in intelligent traffic technology.

A floating focusing mechanism focuses whilst changing the spacing of some of its optical systems in order to minimize changes in aberrations due to object distance. The lens's construction is divided into a focus group that moves when focusing and a fixed group that remains stationary.

NEW 5 MEGAPIXEL LENSES

- Focal Length 12 mm, 16 mm, 25mm
- Pixel Pitch 3.45 µm
- Ø 33mm compact design, robust and durable with locking screws
- JIIA S-Rank*1 Performance, 147 lp/mm from center to corners
- Even light distribution, bright and clear to the periphery
- Floating Focusing Mechanism produces high resolution images at all working distances
- Distortion less than 0.1%



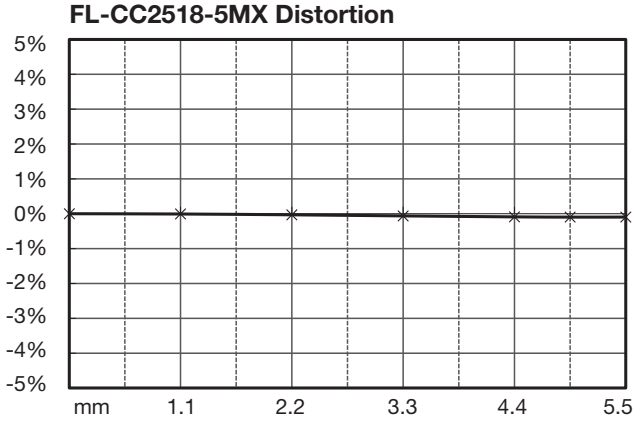
FL-CC1218-5MX f12 MTF Comparison

[A] Competitor's 5 MP Lens: Large distorion caused lower MTF result

[B] Competitor's 12 MP Lens

[C] Competitor's 5 MP Lens: High central MTF, very low peripheral MTF

[D] Competitor's 10 MP Lens



Extremely low distortion

The optical distortion of this series is < 0.1%. The resulting extremely low distortion images are excellent for use in the image measurement field.

Compact design, Ø 33 mm

These lenses have a 33 mm compact design, ideal for installation with high performance equipment.

Bright and clear to the periphery

Despite the small diameter of 33 mm, the vignetting has been reduced to the minimum. Combined with the 5 megapixel resolution, bright, high contrast images are achieved all the way to the edges.

High resolution and high contrast

Supports 2/3" format, 3.45µm pixel pitch cameras, producing sharp 147 lp/mm high resolution, high contrast images from the center to the periphery.

*1 JIIA Technical Report LER-007:Recommended specifications for high definition camera lenses
- Applications (S-Rank): For applications requiring higher resolution over the entire image
- Evaluation Criteria (S-Rank): Resolving spatial frequency corresponding to the Nyquist frequency over the entire image

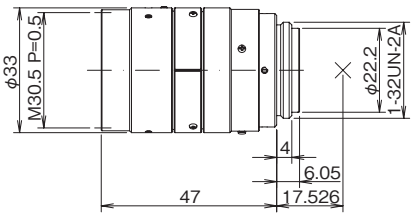
EXCEEDING 5 MEGAPIXEL LENSES, FIXED FOCAL LENGTH

Manual Iris, with Locking Screws

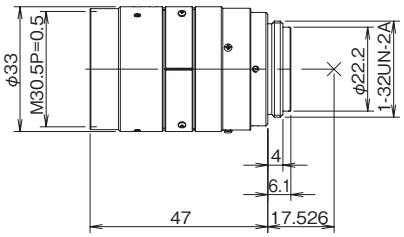
Part No.	Format size	Mount	Focal length (mm)	Iris range	Min. Pixel Pitch (µm)*	M. O. D. (m)	Horizontal angle of view	Filter size (mm)	Dimensions (mm)
HIGH-RESOLUTION, FOR STANDARD, IP AND MEGAPIXEL CAMERAS									
FL-CC1218-5MX	2/3"	C	12	1.8 - 16	3.45	0.1	40.5°	30.5	Ø33.0 × 47.0
FL-CC1618-5MX	2/3"	C	16	1.8 - 16	3.45	0.1	30.9°	30.5	Ø33.0 × 47.0
FL-CC2518-5MX	2/3"	C	25	1.8 - 16	3.45	0.1	20.0°	30.5	Ø33.0 × 50.0

* Min. Pixel Pitch at 30% contrast (measuring on the edge of the Optic)

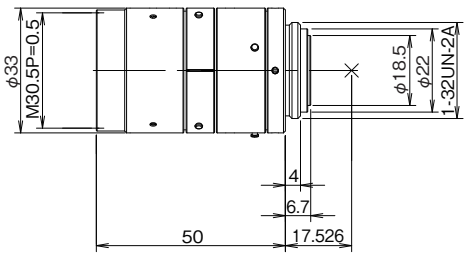
Unit: mm



FL-CC1218-5MX



FL-CC1618-5MX

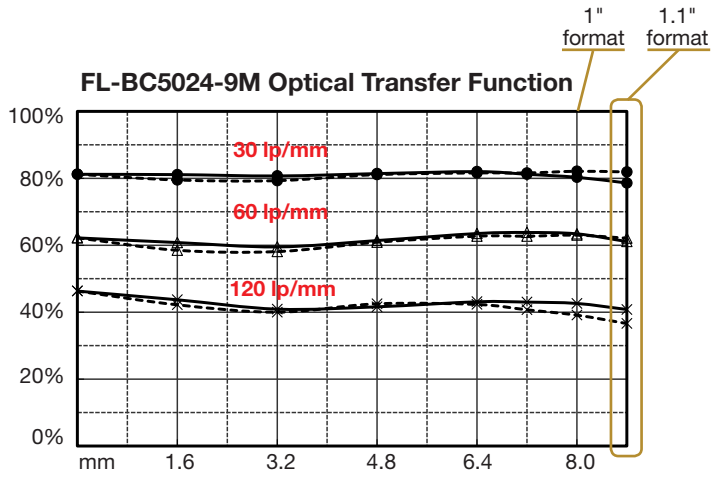


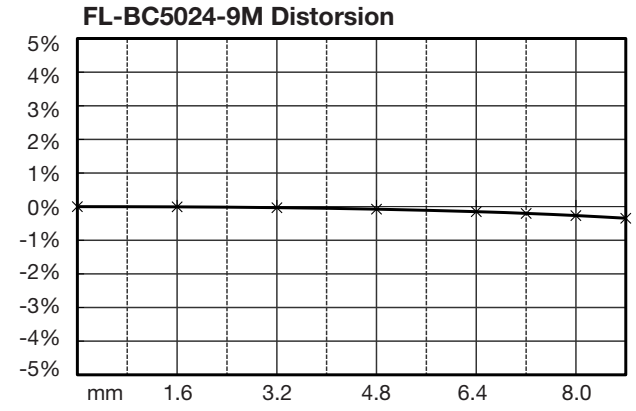
FL-CC2518-5MX

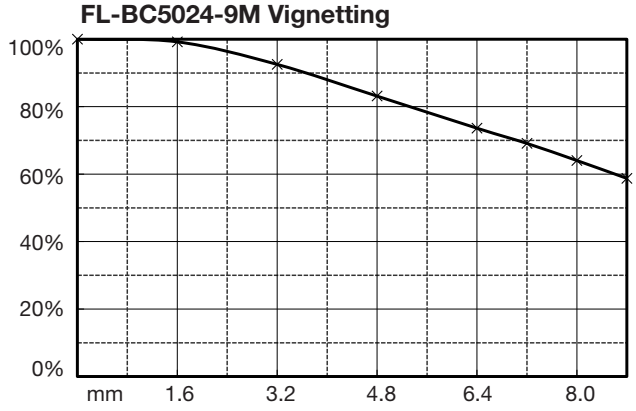
9 MEGAPIXEL LENSES (1") / 12 MEGAPIXEL LENSES (1.1")

This series of high resolution lenses are developed to be installed in machine vision systems with cameras with sensors up to 9 megapixel for 1 inch format / 12 megapixel for 1.1 inch format.

- Focal Lengths 12 mm, 16 mm, 25 mm, 35 mm, 50 mm, 75 mm
- Pixel pitch 3.45 µm
- 147 lp/mm from center to corners of image
- Extremely low distortion, suitable for image measurement
- Even light distribution
- Locking Screws
- Ideal for integration in systems with large sensors
- Compact design, robust and durable







High resolution and high contrast

Supports 1" format, 9 megapixel / 1.1" format, 12 megapixel cameras. Achieves 147 lp/mm high resolution from center to periphery.

Compact design, Ø 42 mm

To suit 44 mm housings used for most 12 megapixel cameras, these lenses have a 42 mm compact design ideal for installation with high performance equipment.

Extremely low distortion

The optical distortion of this series is generally ~ 2%, (wide angle lens FL-BC1220-9M) or less, partially even < 0.1 %. The resulting extremely low-distortion images are excellent for use in the image measurement field.

Bright and clear to the periphery

Despite the small diameter of 42 mm, the vignetting has been reduced to the minimum. Combined with the 12 megapixel resolution, bright, high contrast images are achieved all the way to the edges.

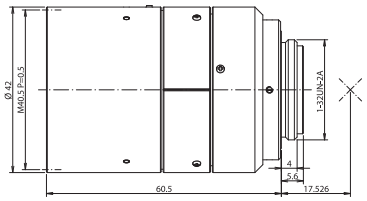
9 MEGAPIXEL LENSES, FIXED FOCAL LENGTH

Manual Iris, with Locking Screws

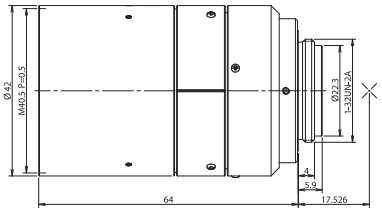
Part No.	Format size	Mount	Focal length (mm)	Iris range	Min. Pixel Pitch (µm)*	M. O. D. (m)	Horizontal angle of view	Filter size (mm)	Dimensions (mm)
HIGH-RESOLUTION, FOR STANDARD, IP AND MEGAPIXEL CAMERAS									
FL-BC1220-9M	1" (1.1")	C	12	2.0 - 16	3.45	0.08	57.0°/ 61.8°	40.5	Ø42.0 × 60.5
FL-BC1618-9M	1" (1.1")	C	16	1.8 - 16	3.45	0.08	43.8°/ 47.7°	40.5	Ø42.0 × 64.0
FL-BC2518-9M	1" (1.1")	C	25	1.8 - 16	3.45	0.1	28.8°/ 31.5°	40.5	Ø42.0 × 57.5
FL-BC3518-9M	1" (1.1")	C	35	1.8 - 22	3.45	0.15	20.7°/ 22.7°	40.5	Ø42.0 × 60.0
FL-BC5024-9M	1" (1.1")	C	50	2.4 - 22	3.45	0.2	14.6°/ 16.0°	40.5	Ø42.0 × 69.0
FL-BC7528-9M	1" (1.1")	C	75	2.8 - 32	3.45	0.25	9.8°/ 10.7°	40.5	Ø42.0 × 81.0

* Min. Pixel Pitch at 30% contrast (measuring on the edge of the Optic)

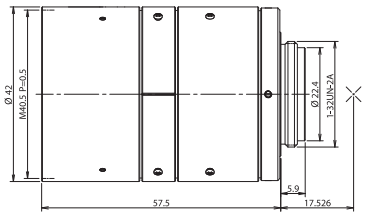
Unit: mm



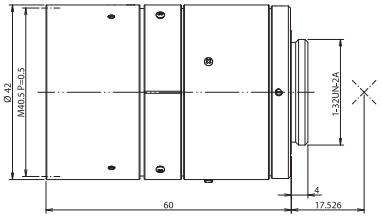
FL-BC1220-9M



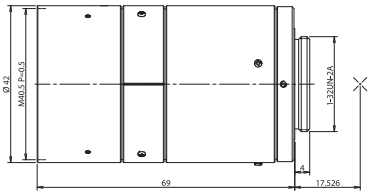
FL-BC1618-9M



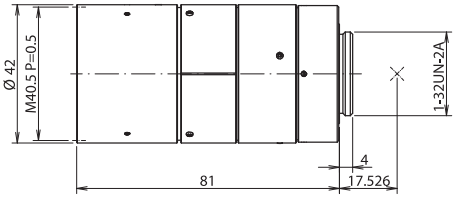
FL-BC2518-9M



FL-BC3518-9M



FL-BC5024-9M



FL-BC7528-9M

LINE-SCAN LENSES
Format 45 mm, Locking Screw for Focus

Part No.	Format size	Mount	Focal length (mm)	Iris range	Min. Pixel Pitch (µm)*	Working distance (m)	Horizontal angle of view	Filter size (mm)	Dimensions (mm)
FL-YFL3528	45mm	F	35	2.8 - 22	5.83	0.19 - ∞	64.40°	62	Ø72.0 × 56.8
FL-YFL5028	45mm	F	50	2.8 - 22	5.83	0.25 - ∞	47.60°	62	Ø72.0 × 57.8
FL-YKL3528	45mm	K	35	2.8 - 22	5.83	0.19 - ∞	64.40°	62	Ø72.0 × 56.8
FL-YKL5028	45mm	K	50	2.8 - 22	5.83	0.25 - ∞	47.60°	62	Ø72.0 × 57.8

* Min. Pixel Pitch at 30% contrast (measuring on the edge of the Optic)

Unit: mm

FL-YFL3528 | FL-YKL3528

FL-YFL5028 | FL-YKL5028

6X ZOOM LENSES MANUAL

Manual zoom

	Part No.	Format size	Mount	Focal length (mm)	Iris range	Min. Pixel Pitch (µm)*	M. O. D. (m)	Horizontal angle of view	Filter size (mm)	Dimensions (mm)
❶	**FL-HC6Z0810-VG**	1/2''	C	8.0 - 48	1.0 - 22	11.67	0.75	43.3° - 7.7°	55	Ø57 × 95
	FL-CC6Z1218-VG	2/3''	C	12.5 - 75	1.8 - 22	12.25	1.00	38.8° - 6.7°	49	Ø51 × 90
❶	**FL-CC6Z1218A-VG**	2/3''	C	12.5 - 75	1.8 - 22	12.25	1.00	38.8° - 6.7°	49	Ø51 × 90

* Min. Pixel Pitch at 30% contrast (measuring on the edge of the Optic), ❶ Locking Screws

Unit: mm

FL-HC6Z0810-VG

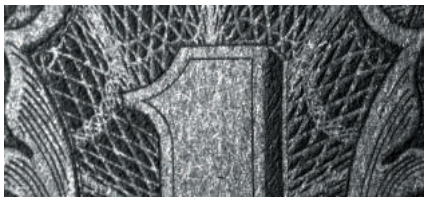
FL-CC6Z1218-VG

FL-CC6Z1218A-VG

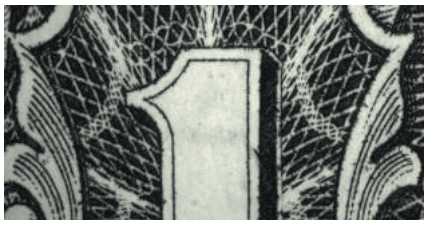
HIGH PERFORMANCE UV LENSES

An optical system that employs optical-grade quartz glass for imaging in the near-ultraviolet region. This lens is optimized for application in the inspection of minute surfaces. Used for detection of counterfeit banknotes; falsified documents and credit cards, surface inspection of circuit boards for soldering defects.

- High performance quartz glass, enabling the capture of sharp images in the near-ultraviolet region
- Extended wavelength range (230 nm to 800 nm), with peak performance at 365 nm
- Compact design, ideal for integration into machine vision systems
- Optimised for use with band pass filters and UV illumination to provide falsified documents detection



UV Lens with near UV light. The texture of material and unevenness of ink can be recognized

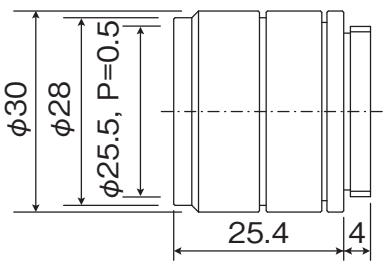


Ordinary Lens with visible light

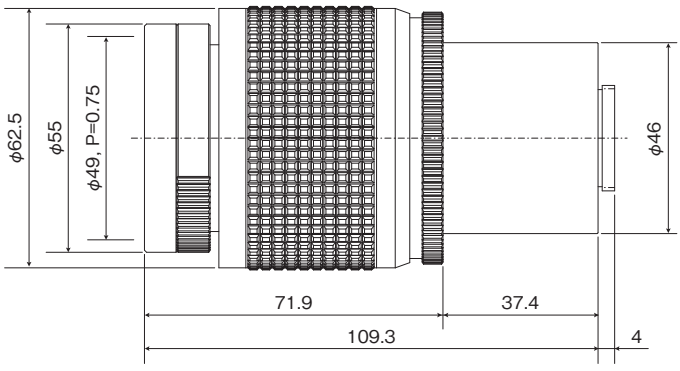
Part No.	Format size	Mount	Focal length (mm)	Iris range	Min. Pixel Pitch (µm)*	M. O. D. (m)	Horizontal angle of view	Filter size (mm)	Dimensions (mm)
FL-BC2528-VGUV	1"	C	25	2.8 - 16	35.00	0.23	29.7°	25.5	Ø30.0 × 25.4
FL-BC7838-VGUV	1"	C	78	3.8 - 16	17.50	0.44	9.5°	49.0	Ø62.5 × 109.3

* Min. Pixel Pitch at 30% contrast (measuring on the edge of the Optic)

Unit: mm



FL-BC2528-VGUV



FL-BC7838-VGUV

ACCESSORIES
Focal Length Extender, Adaptors, Tools

Part No.	Description	Specials
FOCAL LENGTH EXTENDER		
FP-EX2	2x, for C-Mount lenses ø 30.5 mm	compact

for close-up applications

Part No.	Description	Filter size (mm)	Specials
MACRO REVERSING RING			
FP-RR27	Macro reversing ring	27.0	

FP-EX2

FP-RR27

Part No.	Description	Specials
MACRO FOCUS MOUNT		
FP-MUVG	Macro Focus Mount - 2mm for FL-HC1212B-VG, FL-CC1614A-VG, FL-BC2514D-VG	
FP-MU2M	Macro Focus Mount - 2mm for FL-HC1214-2M, FL-CC1614-2M, FL-CC2514-2M, FL-CC3516-2M, FL-CC5028-2M	

The Macro Focus Mount is a special camera mount with a 2 mm tube extension. The C-Mount flange focal distance will then be extended by 2 mm to 19.526 mm which will in turn reduce the lenses minimum object distance (M.O.D.).

FP-MUVG

In order to use our Macro Focus Mount, remove the standard C-mount on the lens and replace them with the appropriate mount above.

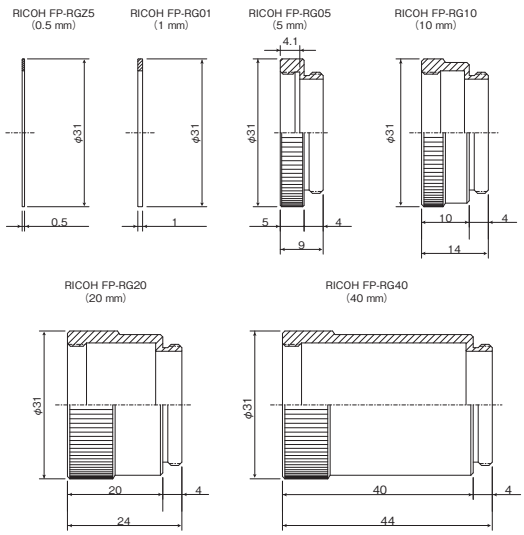
Please ensure you use the correct mount to lens as per the above chart. The FP-MU2M is designed for all the machine vision lenses except the FL-HC0614-2M and FL-CC7528-2M. In order to achieve even higher magnifications you can also use the close up adaptors and extension tubes.

FP-MU2M

ACCESSORIES
for close-up applications

Part No.	Description			Specials
EXTENSION TUBES				
FP-RGZ5	Extension tube Min. order quantity = 10 pcs	0.5 mm	matt black (antireflex)	Price per Item
FP-RG01	Extension tube Min. order quantity = 10 pcs	1.0 mm	matt black (antireflex)	Price per Item
FP-MA	Extension tube	5.0 mm		
FP-RG05	Extension tube	5.0 mm	matt black (antireflex)	
FP-RG10	Extension tube	10.0 mm	matt black (antireflex)	
FP-RG20	Extension tube	20.0 mm	matt black (antireflex)	
FP-RG40	Extension tube	40.0 mm	matt black (antireflex)	
FP-RGST	Extension tube set (6 pieces) Contents: 0.5 mm / 1.0 mm / 5.0 mm / 10.0 mm / 20.0 mm / 40.0 mm			

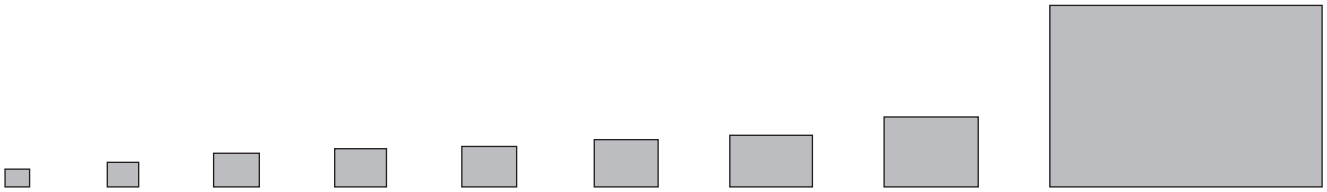
FP-RGST



TECHNICAL INFORMATION

CONVERSION TABLE FOR HORIZONTAL ANGLE OF VIEW

Lenses can be used on cameras with a smaller sensor, but not vice versa. By doing this, the viewing angle will change according to the table below.



1/4 1/3 1/2 1/1.8 1/1.7 2/3 1/1.2 1/1 35mm 24x36

Horizontal Angle Of View

Format	1/4	1/3	1/2	1/1.8	1/1.7	2/3	1/1.2	1/1	35mm 24x36
Sensor (mm)									
horizontal	3.6	4.8	6.4	7.2	7.6	8.8	11.3	12.8	36.0
vertical	2.7	3.6	4.8	5.4	5.7	6.6	7.1	9.6	24.0
diagonal	4.5	6.0	8.0	9.0	9.5	11.0	13.4	16.0	43.3
Focal Length (mm)									
2.2	78.6 °								
2.6	69.4 °	81.7 °							
2.8	65.5 °	77.6 °							
2.9	63.7 °	75.6 °							
3.0	61.9 °	73.7 °							
3.5	54.4 °	65.5 °	84.9 °						
3.7	51.9 °	62.6 °	81.7 °	88.4 °	91.5 °				
4.0	48.5 °	58.7 °	77.3 °	84.0 °	87.1 °				
4.2	46.4 °	56.4 °	74.6 °	81.2 °	84.3 °	92.7 °			
4.8	41.1 °	50.2 °	67.4 °	73.7 °	76.7 °	85.0 °	99.3 °	106.3 °	
5.8	34.5 °	42.4 °	57.8 °	63.7 °	66.5 °	74.4 °	88.5 °	95.6 °	
6.0	33.4 °	41.1 °	56.1 °	61.9 °	64.7 °	72.5 °	86.6 °	93.7 °	
6.2	32.4 °	39.9 °	54.6 °	60.3 °	63.0 °	70.7 °	84.7 °	91.8 °	
6.5	31.0 °	38.2 °	52.4 °	58.0 °	60.6 °	68.2 °	82.0 °	89.1 °	
7.5	27.0 °	33.4 °	46.2 °	51.3 °	53.7 °	60.8 °	74.0 °	81.0 °	134.8 °
8.0	25.4 °	31.4 °	43.6 °	48.5 °	50.8 °	57.6 °	70.5 °	77.3 °	132.1 °
8.5	23.9 °	29.7 °	41.3 °	45.9 °	48.2 °	54.7 °	67.2 °	74.0 °	129.4 °
9.0	22.6 °	28.1 °	39.1 °	43.6 °	45.8 °	52.1 °	64.2 °	70.8 °	126.9 °
10.0	20.4 °	25.4 °	35.5 °	39.6 °	41.6 °	47.5 °	58.9 °	65.2 °	121.9 °
10.5	19.5 °	24.2 °	33.9 °	37.8 °	39.8 °	45.5 °	56.6 °	62.7 °	119.5 °
12.0	17.1 °	21.2 °	29.9 °	33.4 °	35.1 °	40.3 °	50.4 °	56.1 °	112.6 °
12.5	16.4 °	20.4 °	28.7 °	32.1 °	33.8 °	38.8 °	48.6 °	54.2 °	110.4 °
16.0	12.8 °	16.0 °	22.6 °	25.4 °	26.7 °	30.8 °	38.9 °	43.6 °	96.7 °
25.0	8.2 °	10.3 °	14.6 °	16.4 °	17.3 °	20.0 °	25.5 °	28.7 °	71.5 °
35.0	5.9 °	7.4 °	10.4 °	11.7 °	12.4 °	14.3 °	18.3 °	20.7 °	54.4 °
38.0	5.4 °	6.8 °	9.6 °	10.8 °	11.4 °	13.2 °	16.9 °	19.1 °	50.7 °
40.0	5.2 °	6.4 °	9.1 °	10.3 °	10.9 °	12.6 °	16.1 °	18.2 °	48.5 °
48.0	4.3 °	5.4 °	7.6 °	8.6 °	9.1 °	10.5 °	13.4 °	15.2 °	41.1 °
50.0	4.1 °	5.2 °	7.3 °	8.2 °	8.7 °	10.1 °	12.9 °	14.6 °	39.6 °
58.0	3.6 °	4.4 °	6.3 °	7.1 °	7.5 °	8.7 °	11.1 °	12.6 °	34.5 °
75.0	2.7 °	3.4 °	4.9 °	5.5 °	5.8 °	6.7 °	8.6 °	9.8 °	27.0 °

Angles of view in this table are calculated. Individual lens angles of view may vary according to optical design.

OPTICAL CALCULATIONS FOR CLOSE-UP APPLICATIONS

When viewing an object measuring 20 mm per side from a working distance (WD) of 100 mm with a 1/2" format camera (6.4 × 4.8 mm, 1.5 mega pixels)

First, calculate the magnification, M, by the following formula:

M = −B/A M = −4.8/20=−0.24×

(The horizontal screen dimension is automatically decided when the vertical dimension is decided. Therefore, the vertical screen dimension is used here). Obtain a rough idea of the focal length required for your application with the object distance and magnification between the object size and image size by using the following formula:

f = −M×O f = −((−0.24)×100)=24 mm

According to the calculation a 24 mm lens is required. Then, select one of the closest RICOH lenses to 24 mm: FL-BC2514D-VG, FL-BC2518-VG, FL-CC2514-2M. Since the camera is 1.5 mega pixel, substitute the true focal length of FL-CC2514-2M into the following formula to calculate the overall distance L, by adding up the figures indicated in the attached table.

L = −f/M+f+f+⊿H−f×M

L = −(25.00/(−0.24))+25.00+25.00+(−10.51)−(25.00×(−0.24))

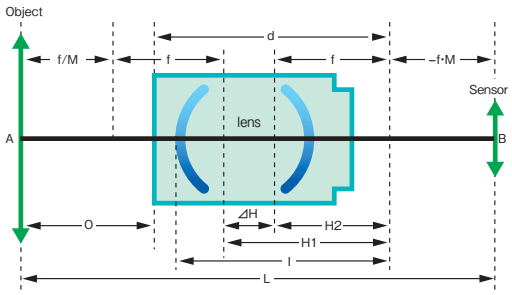
L = 104.17+25.00+25.00−10.51+6.00=149.66

Finally, you can get an exact objective distance, O by the following formula:
(f×M is the length of the extension tube)

O = L−d+f×M

O = 149.66−49.53+(25.00×(−0.24))=94.13

Therefore, when viewing an object measuring 20 mm per side on a 1/2" format camera, use the FL-CC2514-2M and extension tube of 6 mm in length with a WD of 94.13 (about 94 mm). Use a lens with a longer f (focal length) if you want a longer WD, or a lens with a shorter focal length if you want a shorter WD.



A	Object size (Vertical or Horizontal)
B	Imager format size (Vertical or Horizontal)
M	Magnification (B/A)
f	Focal length
H1	1st principal position
H2	2nd principal position
⊿H	Distance between 1st and 2nd principal point
d	Distance between the front end of lens barrel and the focal point
I	Distance between the 1st lens element and the focal point
f-M	Length of the extension tube
O	Object distance (Distance between the front end of lens barrel and the object)

Optical Data

Model name	Focal length (f)	1st principal positon (H1)	2nd principal positon (H2)	Distance between H1 and H2 (⊿H)	Optical path length (I)	Total length (d)	Entrance pupil position	Diameter of entrance pupil	Exit pupil position	Diameter of Exit pupil position	Distortion in %		Back focus length (in air)	Remarks
											1"	1.1"		
9 Mega-Pixel Lens (1") / 12 Mega-Pixel Lens (1.1") (Manual Iris Lens, compatible with 5 mega-pixel cameras)														
FL-BC1220-9M	12.0	-49.8	-12.0	37.7	75.3	78.0	-59.5	5.8	-61.5	30.8	-2.1	-2.1	14.1	W.D. =250 mm*1
FL-BC1618-9M	16.0	-47.0	-16.0	31.0	78.2	81.5	-58.0	8.7	-51.0	28.7	-0.5	-0.5	14.1	W.D. =250 mm*1
FL-BC2518-9M	25.0	-32.0	-25.0	7.0	61.5	75.0	-42.5	13.5	-43.0	24.2	-0.5	-0.5	14.1	W.D. =250 mm*1
FL-BC3518-9M	35.0	-29.2	-35.0	-5.8	57.9	77.5	-38.6	19.0	-47.9	27.0	0.1	0.1	16.8	W.D. =250 mm*1
FL-BC5024-9M	50.0	-36.9	-50.0	-13.1	71.2	86.5	-44.2	20.4	-58.4	24.4	-0.3	-0.3	18.8	W.D. =300 mm*1
FL-BC7528-9M	75.0	-47.3	-75.0	-27.7	82.6	98.5	-24.7	26.1	-57.6	20.3	-0.1	-0.2	21.3	W.D. =500 mm*1
5 Mega-Pixel Lens (Manual Iris Lens, compatible with 5 mega-pixel cameras)														
FL-CC0814-5M	8.2	-49.9	-8.2	41.7	77.7	81.5	-57.1	5.8	-64.2	48.0	-4.9		11.5	W.D. =250 mm
FL-CC1218-5MX	12.0	-35.4	-12.0	23.4	59.3	64.5	-44.6	6.5	-52.3	29.6	-0.5		13.2	W.D. =250 mm*1
FL-CC1618-5MX	16.0	-29.3	-16.0	13.3	59.7	64.5	-40.1	8.7	-48.7	27.6	-0.5		13.4	W.D. =250 mm*1
FL-CC1614-5M	16.0	-29.6	-16.0	13.6	58.9	64.5	-40.9	11.2	-54.3	40.5	-0.5		11.5	W.D. =250 mm
FL-CC2518-5MX	25.0	-19.6	-25.2	-5.6	40.4	67.5	-26.0	13.5	-33.9	18.2	-0.1		13.7	W.D. =250 mm*1
FL-CC2514-5M	25.0	-9.8	-25.0	-15.2	47.6	61.5	-22.4	17.5	-50.2	37.6	-1.0		12.3	W.D. =250 mm
2 Mega-Pixel Lens (Manual Iris Lens, compatible with 2 mega-pixel cameras)														
FL-HC0514-2M	5.1	-41.1	-5.1	36.0	61.3	63.0	-46.4	3.6	147.4	103.0	-0.7		10.8	W.D. =Inf.
FL-HC0614-2M	6.0	-35.2	-6.0	29.2	42.0	55.0	-39.5	4.3	-21.8	30.7	-2.9		12.4	W.D. =225 mm
FL-HC1214-2M	12.4	-17.8	-12.4	5.4	41.0	46.0	-25.8	8.6	-34.5	25.7	-0.7		11.5	W.D. =250 mm
FL-CC0614A-2M	6.2	-51.7	-6.2	45.5	73.9	77.4	-57.6	4.3	-123.5	92.4	-1.3		10.9	W.D. =250 mm
FL-CC0814A-2M	8.2	-30.3	-8.2	22.0	51.5	54.2	-38.1	5.7	-171.7	127.6	-1.0		11.1	W.D. =250 mm
FL-CC0814-2M	8.3	-24.4	-8.3	16.1	43.9	45.7	-31.5	5.8	-57.8	40.4	-0.1		13.1	W.D. =Inf.
FL-CC1214A-2M	12.3	-32.4	-12.3	20.1	58.8	63.2	-42.9	8.4	-86.9	63.5	-0.5		10.7	W.D. =250 mm
FL-CC1214-2M	12.0	-17.1	-12.0	5.1	41.8	45.7	-24.2	8.4	-72.6	50.8	0.1		13.1	W.D. =Inf.
FL-CC1614A-2M	16.0	-16.2	-16.0	0.2	43.4	49.7	-29.4	11.2	-90.3	67.3	-0.5		10.7	W.D. =250 mm
FL-CC1614-2M	16.0	-18.0	-16.0	2.0	46.6	50.7	-30.2	11.2	-68.0	50.7	-2.0		14.6	W.D. =250 mm
FL-CC2514A-2M	25.6	-12.9	-25.6	-12.7	39.9	55.5	-17.0	17.9	-30.4	22.7	-1.1		12.1	W.D. =250 mm
FL-CC2514-2M	25.0	-14.5	-25.0	-10.5	39.5	49.5	-19.6	17.5	-31.4	23.5	-1.2		11.5	W.D. =250 mm
FL-CC3516-2M	34.0	-10.9	-34.0	-23.0	47.1	52.9	-11.3	20.6	-34.3	22.0	-0.9		11.9	W.D. =250 mm
FL-CC5024A-2M	48.8	-39.5	-48.8	-9.3	51.8	64.0	-4.2	19.9	-28.3	11.9	0.1		22.3	W.D. =300 mm
FL-CC5028-2M	50.0	-47.4	-50.0	-2.6	46.5	51.5	-3.2	17.9	-26.5	9.7	-0.1		21.0	W.D. =250 mm
FL-CC7528-2M	72.8	-57.4	-72.8	-15.4	72.8	77.1	16.1	25.2	-36.2	12.8	0.0		30.9	W.D. =250 mm
VGA Lens (Manual Iris Lens 1/2" format)														
FL-HC0416X-VG	4.3	-42.2	-4.3	37.8	59.5	61.0	-46.1	2.7	-43.5	27.7	-35.8		10.4	W.D. =Inf.
FL-HC0612A-VG	6.2	-39.0	-6.2	32.8	58.3	63.5	-44.9	5.0	-111.4	97.8	-5.8		14.3	W.D. =Inf.
FL-HC1212B-VG	12.2	-26.7	-12.2	14.5	47.6	53.0	-38.5	10.0	-322.6	289.7	-4.3		13.9	W.D. =Inf.
VGA Lens (Manual Iris Lens 2/3" format)														
FL-CC0418DX-VG	4.9	-37.0	-4.9	32.1	51.6	53.0	-41.5	2.8	-54.9	31.8	-28.8		9.7	W.D. =Inf.
FL-CC0815B-VG	8.5	-31.2	-8.5	22.6	53.6	57.5	-39.1	5.7	-115.2	80.8	-4.2		10.9	W.D. =Inf.
FL-CC1614A-VG	16.2	-20.1	-16.2	3.9	41.0	50.5	-30.5	11.6	-45.7	34.9	-1.9		13.2	W.D. =Inf.
VGA Lens (Manual Iris Lens 1" format)														
FL-BC1214D-VG	12.7	-34.3	-12.7	21.7	63.5	67.5	-42.9	8.6	-39.5	28.5	-1.7		14.4	W.D. =Inf.
FL-BC1218A-VG	12.4	-24.6	-12.4	12.2	39.5	57.5	-31.8	6.8	-29.8	16.9	-3.9		10.4	W.D. =Inf.
FL-BC2514D-VG	25.1	-25.6	-25.1	0.5	51.4	54.8	-30.3	17.5	-30.8	22.7	-2.8		15.0	W.D. =Inf.
FL-BC2518-VG	25.0	-22.1	-25.0	-2.9	31.1	57.5	-15.6	13.9	-19.9	11.4	1.4		14.9	W.D. =Inf.
FL-BC5014A-VG	49.9	-47.3	-49.9	-2.6	57.4	65.5	1.7	35.7	-25.2	19.3	0.9		18.1	W.D. =Inf.
Line Scan Lens														
FL-YFL3528	36.3	-61.8	-36.3	25.5	89.9	103.3	-72.3	13.0	-51.0	18.5	-0.5		33.2	M=-0.2*1
FL-YFL5028	52.0	-54.8	-52.0	2.8	71.1	103.3	-57.1	18.6	-54.5	19.8	0.2		37.0	M=-0.2*1
UV Lens														
FL-BC2528-VGUV	25.0	-24.9	-25.0	-0.2	34.9	42.9	-25.9	8.9	-26.1	9.3	-4.1		12.8	266 nm
FL-BC7838-VGUV	77.5	-77.6	-77.5	0.1	96.8	126.8	-78.8	20.4	-78.8	20.7	-0.2		71.3	250 nm

*1 These models adopt a floating mechanism and are not covered by the calculation above. Please contact us for details.

Unit: mm

2 MEGAPIXEL LENS + MACRO RING – 2/3" FORMAT

W.D. (Working Distance): Object~L1 vertex

2/3" FORMAT			FL-CC0614A-2M		FL-CC0814A-2M		FL-CC1214A-2M		FL-CC1614-2M		FL-CC1614A-2M		FL-CC2514-2M	
V: 6.6 H: 8.8		Position of Focus Ring	f=6mm F1.4		f=8mm F1.4		f=12mm F1.4		f=16mm F1.4		f=16mm F1.4		f=25mm F1.4	
			V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.
Extension Tube Set (Macro Ring) EX-C6 (0.5mm, 1mm, 5mm, 10mm, 20mm and 40mm)	0.5mm	maximum	81.8 x 109.1	61	108.8 x 145.1	123	162.3 x 216.4	288	211.2 x 281.6	499	211.3 x 281.7	501	330.0 x 440.1	1250
		minimum	49.2 x 65.6	30	49.4 x 65.8	49	44.5 x 59.3	69	71.6 x 95.5	161	37.7 x 50.2	80	55.0 x 73.3	208
	1.0mm	maximum	40.9 x 54.5	22	54.4 x 72.5	55	81.1 x 108.2	137	105.6 x 140.8	243	105.6 x 140.9	245	165.0 x 220.0	625
		minimum	30.7 x 41.0	13	34.0 x 45.3	29	34.9 x 46.5	51	53.5 x 71.3	117	32.0 x 42.6	66	47.1 x 62.9	179
	1.5mm (1+0.5)	maximum	x	-	36.3 x 48.4	32	54.1 x 72.1	87	70.4 x 93.9	158	70.4 x 93.9	160	110.0 x 146.7	417
		minimum	x	-	25.9 x 34.5	19	28.7 x 38.3	39	42.7 x 56.9	91	27.8 x 37.0	56	41.2 x 55.0	156
	5mm	maximum	x	-	x	-	16.2 x 21.6	16	21.1 x 28.2	39	21.1 x 28.2	40	33.0 x 44.0	125
		minimum	x	-	x	-	12.8 x 17.1	10	17.7 x 23.6	30	14.5 x 19.3	24	22.0 x 29.3	83
	10mm	maximum	x	-	x	-	x	-	10.6 x 14.1	13	10.6 x 14.1	14	16.5 x 22.0	63
		minimum	x	-	x	-	x	-	9.6 x 12.8	11	8.6 x 11.4	10	13.2 x 17.6	50
	15mm (10+5)	maximum	x	-	x	-	x	-	x	-	x	-	11.0 x 14.7	42
		minimum	x	-	x	-	x	-	x	-	x	-	9.4 x 12.6	36
	20mm	maximum	x	-	x	-	x	-	x	-	x	-	8.3 x 11.0	31
		minimum	x	-	x	-	x	-	x	-	x	-	7.3 x 9.8	28
	25mm (20+5)	maximum	x	-	x	-	x	-	x	-	x	-	6.6 x 8.8	25
		minimum	x	-	x	-	x	-	x	-	x	-	6.0 x 8.0	23
	30mm (20+10)	maximum	x	-	x	-	x	-	x	-	x	-	5.5 x 7.3	21
		minimum	x	-	x	-	x	-	x	-	x	-	5.1 x 6.8	19
	35mm (20+10+5)	maximum	x	-	x	-	x	-	x	-	x	-	4.7 x 6.3	18
		minimum	x	-	x	-	x	-	x	-	x	-	4.4 x 5.9	17
	40mm	maximum	x	-	x	-	x	-	x	-	x	-	4.1 x 5.5	16
		minimum	x	-	x	-	x	-	x	-	x	-	3.9 x 5.2	15
	45mm (40+5)	maximum	x	-	x	-	x	-	x	-	x	-	3.7 x 4.9	14
		minimum	x	-	x	-	x	-	x	-	x	-	3.5 x 4.6	13
	50mm (40+10)	maximum	x	-	x	-	x	-	x	-	x	-	3.3 x 4.4	13
		minimum	x	-	x	-	x	-	x	-	x	-	3.1 x 4.2	12

2 MEGAPIXEL LENS + MACRO RING – 2/3" FORMAT

W.D. (Working Distance): Object~L1 vertex

2/3" FORMAT			FL-CC2514A-2M		FL-CC3516-2M		FL-CC5028-2M		FL-CC5024A-2M		FL-CC7528-2M	
V: 6.6 H: 8.8		Position of Focus Ring	f=25mm F1.4		f=35mm F1.6		f=50mm F2.8		f=50mm F2.4		f=75mm F2.8	
			V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.
Extension Tube Set (Macro Ring) EX-C6 (0.5mm, 1mm, 5mm, 10mm, 20mm and 40mm)	0.5mm	maximum	338.2 x 451.0	1312	448.1 x 597.5	2303	659.8 x 879.7	5048	643.5 x 858.0	4790	960.8 x 1281.0	10652
		minimum	24.2 x 32.3	93	66.6 x 88.8	340	95.8 x 127.8	777	33.8 x 45.1	286	54.9 x 73.3	663
	1.0mm	maximum	169.1 x 225.5	655	224.1 x 298.8	1150	329.9 x 439.9	2549	321.8 x 429.0	2413	480.4 x 640.5	5355
		minimum	22.6 x 30.1	86	58.0 x 77.3	296	83.7 x 111.6	685	32.1 x 42.8	274	52.0 x 69.3	630
	1.5mm (1+0.5)	maximum	112.7 x 150.3	436	149.4 x 199.2	766	219.9 x 293.2	1716	214.5 x 286.0	1621	320.3 x 427.0	3589
		minimum	21.2 x 28.3	81	51.3 x 68.4	262	74.3 x 99.0	613	30.6 x 40.8	262	49.3 x 65.7	601
	5mm	maximum	33.8 x 45.1	130	44.8 x 59.8	228	66.0 x 88.0	551	64.4 x 85.8	512	96.1 x 128.1	1117
		minimum	14.7 x 19.6	56	28.5 x 38.0	144	41.5 x 55.4	365	23.0 x 30.6	206	36.3 x 48.4	457
	10mm	maximum	16.9 x 22.5	64	22.4 x 29.9	113	33.0 x 44.0	301	32.2 x 42.9	274	48.0 x 64.1	587
		minimum	10.3 x 13.7	39	17.4 x 23.2	87	25.5 x 34.0	244	16.9 x 22.6	161	26.3 x 35.1	348
	15mm (10+5)	maximum	11.3 x 15.0	42	14.9 x 19.9	75	22.0 x 29.3	217	21.5 x 28.6	195	32.0 x 42.7	411
		minimum	7.9 x 10.5	29	12.5 x 16.7	62	18.4 x 24.5	190	13.4 x 17.9	135	20.7 x 27.6	285
	20mm	maximum	8.5 x 11.3	32	11.2 x 14.9	55	16.5 x 22.0	176	16.1 x 21.5	155	24.0 x 32.0	322
		minimum	6.4 x 8.5	23	9.8 x 13.1	48	14.4 x 19.2	160	11.1 x 14.8	118	17.0 x 22.7	245
	25mm (20+5)	maximum	6.8 x 9.0	25	9.0 x 12.0	44	13.2 x 17.6	151	12.9 x 17.2	132	19.2 x 25.6	269
		minimum	5.4 x 7.2	20	8.0 x 10.7	39	11.8 x 15.7	140	9.5 x 12.6	106	14.5 x 19.3	217
	30mm (20+10)	maximum	5.6 x 7.5	21	7.5 x 10.0	36	11.0 x 14.7	134	10.7 x 14.3	116	16.0 x 21.4	234
		minimum	4.6 x 6.2	17	6.8 x 9.1	33	10.0 x 13.4	127	8.2 x 11.0	97	12.6 x 16.7	196
	35mm (20+10+5)	maximum	4.8 x 6.4	17	6.4 x 8.5	31	9.4 x 12.6	122	9.2 x 12.3	104	13.7 x 18.3	209
		minimum	4.1 x 5.4	15	5.9 x 7.9	28	8.7 x 11.6	117	7.3 x 9.7	90	11.1 x 14.8	180
	40mm	maximum	4.2 x 5.6	15	5.6 x 7.5	27	8.2 x 11.0	113	8.0 x 10.7	96	12.0 x 16.0	190
		minimum	3.6 x 4.9	13	5.2 x 7.0	25	7.7 x 10.2	109	6.6 x 8.8	85	10.0 x 13.3	167
	45mm (40+5)	maximum	3.8 x 5.0	13	5.0 x 6.6	23	7.3 x 9.8	106	7.2 x 9.5	89	10.7 x 14.2	175
		minimum	3.3 x 4.4	11	4.7 x 6.2	22	6.9 x 9.2	103	6.0 x 7.9	80	9.0 x 12.0	157
	50mm (40+10)	maximum	3.4 x 4.5	12	4.5 x 6.0	21	6.6 x 8.8	101	6.4 x 8.6	84	9.6 x 12.8	163
		minimum	3.0 x 4.0	10	4.2 x 5.7	20	6.2 x 8.3	98	5.5 x 7.3	77	8.2 x 11.0	148

2 MEGAPIXEL LENS + MACRO RING – 1/1.8" FORMAT

W.D. (Working Distance): Object~L1 vertex

1/1.8" FORMAT			FL-CC0614A-2M		FL-CC0814A-2M		FL-CC1214A-2M		FL-CC1614-2M		FL-CC1614A-2M		FL-CC2514-2M	
V: 5.4 H: 7.2		Position of Focus Ring	f=6mm F1.4		f=8mm F1.4		f=12mm F1.4		f=16mm F1.4		f=16mm F1.4		f=25mm F1.4	
			V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.
Extension Tube Set (Macro Ring) EX-C6 (0,5mm, 1mm, 5mm, 10mm, 20mm and 40mm)	0.5mm	maximum	66.9 x 89.3	61	89.0 x 118.7	123	132.8 x 177.0	288	172.8 x 230.4	499	172.9 x 230.5	501	270.0 x 360.0	1250
		minimum	40.3 x 53.7	30	40.4 x 53.9	49	36.4 x 48.5	69	58.6 x 78.1	161	30.8 x 41.1	80	45.0 x 60.0	208
	1.0mm	maximum	33.5 x 44.6	22	44.5 x 59.3	55	66.4 x 88.5	137	86.4 x 115.2	243	86.4 x 115.3	245	135.0 x 180.0	625
		minimum	25.1 x 33.5	13	27.8 x 37.1	29	28.6 x 38.1	51	43.8 x 58.3	117	26.1 x 34.9	66	38.6 x 51.4	179
	1.5mm (1+0.5)	maximum	x	-	29.7 x 39.6	32	44.3 x 59.0	87	57.6 x 76.8	158	57.6 x 76.8	160	90.0 x 120.0	417
		minimum	x	-	21.2 x 28.2	19	23.5 x 31.3	39	34.9 x 46.5	91	22.7 x 30.3	56	33.7 x 45.0	156
	5mm	maximum	x	-	x	-	13.3 x 17.7	16	17.3 x 23.0	39	17.3 x 23.1	40	27.0 x 36.0	125
		minimum	x	-	x	-	10.5 x 14.0	10	14.5 x 19.3	30	11.8 x 15.8	24	18.0 x 24.0	83
	10mm	maximum	x	-	x	-	x	-	8.6 x 11.5	13	8.6 x 11.5	14	13.5 x 18.0	63
		minimum	x	-	x	-	x	-	7.9 x 10.5	11	7.0 x 9.4	10	10.8 x 14.4	50
	15mm (10+5)	maximum	x	-	x	-	x	-	x	-	x	-	9.0 x 12.0	42
		minimum	x	-	x	-	x	-	x	-	x	-	7.7 x 10.3	36
	20mm	maximum	x	-	x	-	x	-	x	-	x	-	6.8 x 9.0	31
		minimum	x	-	x	-	x	-	x	-	x	-	6.0 x 8.0	28
	25mm (20+5)	maximum	x	-	x	-	x	-	x	-	x	-	5.4 x 7.2	25
		minimum	x	-	x	-	x	-	x	-	x	-	4.9 x 6.5	23
	30mm (20+10)	maximum	x	-	x	-	x	-	x	-	x	-	4.5 x 6.0	21
		minimum	x	-	x	-	x	-	x	-	x	-	4.2 x 5.5	19
	35mm (20+10+5)	maximum	x	-	x	-	x	-	x	-	x	-	3.9 x 5.1	18
		minimum	x	-	x	-	x	-	x	-	x	-	3.6 x 4.8	17
	40mm	maximum	x	-	x	-	x	-	x	-	x	-	3.4 x 4.5	16
		minimum	x	-	x	-	x	-	x	-	x	-	3.2 x 4.2	15
	45mm (40+5)	maximum	x	-	x	-	x	-	x	-	x	-	3.0 x 4.0	14
		minimum	x	-	x	-	x	-	x	-	x	-	2.8 x 3.8	13
	50mm (40+10)	maximum	x	-	x	-	x	-	x	-	x	-	2.7 x 3.6	13
		minimum	x	-	x	-	x	-	x	-	x	-	2.6 x 3.4	12

2 MEGAPIXEL LENS + MACRO RING – 1/1.8" FORMAT

W.D. (Working Distance): Object~L1 vertex

1/1.8" FORMAT			FL-CC2514A-2M		FL-CC3516-2M		FL-CC5028-2M		FL-CC5024A-2M		FL-CC7528-2M	
V: 5.4 H: 7.2		Position of Focus Ring	f=25mm F1.4		f=35mm F1.6		f=50mm F2.8		f=50mm F2.4		f=75mm F2.8	
			V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.
Extension Tube Set (Macro Ring) EX-C6 (0,5mm, 1mm, 5mm, 10mm, 20mm and 40mm)	0.5mm	maximum	276.7 x 369.0	1312	366.7 x 488.9	2303	539.8 x 719.8	5048	526.5 x 702.0	4790	786.1 x 1048.1	10652
		minimum	19.8 x 26.4	93	54.5 x 72.6	340	78.4 x 104.6	777	27.7 x 36.9	286	45.0 x 59.9	663
	1.0mm	maximum	138.4 x 184.5	655	183.3 x 244.4	1150	269.9 x 359.9	2549	263.3 x 351.0	2413	393.0 x 524.0	5355
		minimum	18.5 x 24.7	86	47.4 x 63.2	296	68.5 x 91.3	685	26.3 x 35.0	274	42.5 x 56.7	630
	1.5mm (1+0.5)	maximum	92.2 x 123.0	436	122.2 x 163.0	766	179.9 x 239.9	1716	175.5 x 234.0	1621	262.0 x 349.4	3589
		minimum	17.3 x 23.1	81	42.0 x 56.0	262	60.8 x 81.0	613	25.0 x 33.4	262	40.3 x 53.8	601
	5mm	maximum	27.7 x 36.9	130	36.7 x 48.9	228	54.0 x 72.0	551	52.7 x 70.2	512	78.6 x 104.8	1117
		minimum	12.1 x 16.1	56	23.3 x 31.1	144	34.0 x 45.3	365	18.8 x 25.0	206	29.7 x 39.6	457
	10mm	maximum	13.8 x 18.4	64	18.3 x 24.4	113	27.0 x 36.0	301	26.3 x 35.1	274	39.3 x 52.4	587
		minimum	8.4 x 11.2	39	14.2 x 19.0	87	20.9 x 27.8	244	13.8 x 18.5	161	21.5 x 28.7	348
	15mm (10+5)	maximum	9.2 x 12.3	42	12.2 x 16.3	75	18.0 x 24.0	217	17.6 x 23.4	195	26.2 x 34.9	411
		minimum	6.4 x 8.6	29	10.3 x 13.7	62	15.0 x 20.1	190	11.0 x 14.6	135	16.9 x 22.5	285
	20mm	maximum	6.9 x 9.2	32	9.2 x 12.2	55	13.5 x 18.0	176	13.2 x 17.6	155	19.7 x 26.2	322
		minimum	5.2 x 7.0	23	8.0 x 10.7	48	11.8 x 15.7	160	9.1 x 12.1	118	13.9 x 18.6	245
	25mm (20+5)	maximum	5.5 x 7.4	25	7.3 x 9.8	44	10.8 x 14.4	151	10.5 x 14.0	132	15.7 x 21.0	269
		minimum	4.4 x 5.9	20	6.6 x 8.8	39	9.7 x 12.9	140	7.7 x 10.3	106	11.8 x 15.8	217
	30mm (20+10)	maximum	4.6 x 6.1	21	6.1 x 8.1	36	9.0 x 12.0	134	8.8 x 11.7	116	13.1 x 17.5	234
		minimum	3.8 x 5.1	17	5.6 x 7.4	33	8.2 x 10.9	127	6.7 x 9.0	97	10.3 x 13.7	196
	35mm (20+10+5)	maximum	4.0 x 5.3	17	5.2 x 7.0	31	7.7 x 10.3	122	7.5 x 10.0	104	11.2 x 15.0	209
		minimum	3.3 x 4.4	15	4.8 x 6.5	28	7.1 x 9.5	117	6.0 x 8.0	90	9.1 x 12.1	180
	40mm	maximum	3.5 x 4.6	15	4.6 x 6.1	27	6.7 x 9.0	113	6.6 x 8.8	96	9.8 x 13.1	190
		minimum	3.0 x 4.0	13	4.3 x 5.7	25	6.3 x 8.4	109	5.4 x 7.2	85	8.1 x 10.9	167
	45mm (40+5)	maximum	3.1 x 4.1	13	4.1 x 5.4	23	6.0 x 8.0	106	5.9 x 7.8	89	8.7 x 11.6	175
		minimum	2.7 x 3.6	11	3.8 x 5.1	22	5.6 x 7.5	103	4.9 x 6.5	80	7.4 x 9.8	157
	50mm (40+10)	maximum	2.8 x 3.7	12	3.7 x 4.9	21	5.4 x 7.2	101	5.3 x 7.0	84	7.9 x 10.5	163
		minimum	2.4 x 3.3	10	3.5 x 4.6	20	5.1 x 6.8	98	4.5 x 5.9	77	6.7 x 9.0	148

2 MEGAPIXEL LENS + MACRO RING – 1/2" FORMAT

W.D. (Working Distance): Object~L1 vertex

1/2" FORMAT			FL-CC0614A-2M		FL-CC0814A-2M		FL-CC1214A-2M		FL-CC1614-2M		FL-CC1614A-2M		FL-CC2514-2M	
V: 4.8 H: 6.4		Position of Focus Ring	f=6mm F1.4		f=8mm F1.4		f=12mm F1.4		f=16mm F1.4		f=16mm F1.4		f=25mm F1.4	
			V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.
Extension Tube Set (Macro Ring) EX-C6 (0,5mm, 1mm, 5mm, 10mm, 20mm and 40mm)	0.5mm	maximum	59.5 x 79.3	61	79.1 x 105.5	123	118.0 x 157.4	288	153.6 x 204.8	499	153.7 x 204.9	501	240.0 x 320.0	1250
		minimum	35.8 x 47.7	30	35.9 x 47.9	49	32.3 x 43.1	69	52.1 x 69.4	161	27.4 x 36.5	80	40.0 x 53.3	208
	1.0mm	maximum	29.8 x 39.7	22	39.6 x 52.7	55	59.0 x 78.7	137	76.8 x 102.4	243	76.8 x 102.4	245	120.0 x 160.0	625
		minimum	22.4 x 29.8	13	24.7 x 32.9	29	25.4 x 33.8	51	38.9 x 51.9	117	23.2 x 31.0	66	34.3 x 45.7	179
	1.5mm (1+0.5)	maximum	x	-	26.4 x 35.2	32	39.3 x 52.5	87	51.2 x 68.3	158	51.2 x 68.3	160	80.0 x 106.7	417
		minimum	x	-	18.8 x 25.1	19	20.9 x 27.9	39	31.0 x 41.4	91	20.2 x 26.9	56	30.0 x 40.0	156
	5mm	maximum	x	-	x	-	11.8 x 15.7	16	15.4 x 20.5	39	15.4 x 20.5	40	24.0 x 32.0	125
		minimum	x	-	x	-	9.3 x 12.4	10	12.9 x 17.1	30	10.5 x 14.0	24	16.0 x 21.3	83
	10mm	maximum	x	-	x	-	x	-	7.7 x 10.2	13	7.7 x 10.2	14	12.0 x 16.0	63
		minimum	x	-	x	-	x	-	7.0 x 9.3	11	6.2 x 8.3	10	9.6 x 12.8	50
	15mm (10+5)	maximum	x	-	x	-	x	-	x	-	x	-	8.0 x 10.7	42
		minimum	x	-	x	-	x	-	x	-	x	-	6.9 x 9.1	36
	20mm	maximum	x	-	x	-	x	-	x	-	x	-	6.0 x 8.0	31
		minimum	x	-	x	-	x	-	x	-	x	-	5.3 x 7.1	28
	25mm (20+5)	maximum	x	-	x	-	x	-	x	-	x	-	4.8 x 6.4	25
		minimum	x	-	x	-	x	-	x	-	x	-	4.4 x 5.8	23
	30mm (20+10)	maximum	x	-	x	-	x	-	x	-	x	-	4.0 x 5.3	21
		minimum	x	-	x	-	x	-	x	-	x	-	3.7 x 4.9	19
	35mm (20+10+5)	maximum	x	-	x	-	x	-	x	-	x	-	3.4 x 4.6	18
		minimum	x	-	x	-	x	-	x	-	x	-	3.2 x 4.3	17
	40mm	maximum	x	-	x	-	x	-	x	-	x	-	3.0 x 4.0	16
		minimum	x	-	x	-	x	-	x	-	x	-	2.8 x 3.8	15
	45mm (40+5)	maximum	x	-	x	-	x	-	x	-	x	-	2.7 x 3.6	14
		minimum	x	-	x	-	x	-	x	-	x	-	2.5 x 3.4	13
	50mm (40+10)	maximum	x	-	x	-	x	-	x	-	x	-	2.4 x 3.2	13
		minimum	x	-	x	-	x	-	x	-	x	-	2.3 x 3.0	12

2 MEGAPIXEL LENS + MACRO RING – 1/2" FORMAT

W.D. (Working Distance): Object~L1 vertex

1/2" FORMAT			FL-CC2514A-2M		FL-CC3516-2M		FL-CC5028-2M		FL-CC5024A-2M		FL-CC7528-2M	
V: 4.8 H: 6.4		Position of Focus Ring	f=25mm F1.4		f=35mm F1.6		f=50mm F2.8		f=50mm F2.4		f=75mm F2.8	
			V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.
Extension Tube Set (Macro Ring) EX-C6 (0,5mm, 1mm, 5mm, 10mm, 20mm and 40mm)	0.5mm	maximum	246.0 x 328.0	1312	325.9 x 434.6	2303	479.8 x 639.8	5048	468.0 x 624.0	4790	698.7 x 931.6	10652
		minimum	17.6 x 23.5	93	48.4 x 64.5	340	69.7 x 92.9	777	24.6 x 32.8	286	40.0 x 53.3	663
	1.0mm	maximum	123.0 x 164.0	655	163.0 x 217.3	1150	239.9 x 319.9	2549	234.0 x 312.0	2413	349.4 x 465.8	5355
		minimum	16.4 x 21.9	86	42.2 x 56.2	296	60.9 x 81.1	685	23.4 x 31.1	274	37.8 x 50.4	630
	1.5mm (1+0.5)	maximum	82.0 x 109.3	436	108.6 x 144.9	766	159.9 x 213.3	1716	156.0 x 208.0	1621	232.9 x 310.5	3589
		minimum	15.4 x 20.5	81	37.3 x 49.8	262	54.0 x 72.0	613	22.2 x 29.7	262	35.9 x 47.8	601
	5mm	maximum	24.6 x 32.8	130	32.6 x 43.5	228	48.0 x 64.0	551	46.8 x 62.4	512	69.9 x 93.2	1117
		minimum	10.7 x 14.3	56	20.7 x 27.6	144	30.2 x 40.3	365	16.7 x 22.3	206	26.4 x 35.2	457
	10mm	maximum	12.3 x 16.4	64	16.3 x 21.7	113	24.0 x 32.0	301	23.4 x 31.2	274	34.9 x 46.6	587
		minimum	7.5 x 10.0	39	12.7 x 16.9	87	18.5 x 24.7	244	12.3 x 16.4	161	19.2 x 25.5	348
	15mm (10+5)	maximum	8.2 x 10.9	42	10.9 x 14.5	75	16.0 x 21.3	217	15.6 x 20.8	195	23.3 x 31.1	411
		minimum	5.7 x 7.6	29	9.1 x 12.2	62	13.4 x 17.8	190	9.7 x 13.0	135	15.0 x 20.0	285
	20mm	maximum	6.1 x 8.2	32	8.1 x 10.9	55	12.0 x 16.0	176	11.7 x 15.6	155	17.5 x 23.3	322
		minimum	4.6 x 6.2	23	7.1 x 9.5	48	10.5 x 13.9	160	8.1 x 10.8	118	12.4 x 16.5	245
	25mm (20+5)	maximum	4.9 x 6.6	25	6.5 x 8.7	44	9.6 x 12.8	151	9.4 x 12.5	132	14.0 x 18.6	269
		minimum	3.9 x 5.2	20	5.8 x 7.8	39	8.6 x 11.4	140	6.9 x 9.2	106	10.5 x 14.0	217
	30mm (20+10)	maximum	4.1 x 5.5	21	5.4 x 7.2	36	8.0 x 10.7	134	7.8 x 10.4	116	11.6 x 15.5	234
		minimum	3.4 x 4.5	17	5.0 x 6.6	33	7.3 x 9.7	127	6.0 x 8.0	97	9.1 x 12.2	196
	35mm (20+10+5)	maximum	3.5 x 4.7	17	4.7 x 6.2	31	6.9 x 9.1	122	6.7 x 8.9	104	10.0 x 13.3	209
		minimum	3.0 x 4.0	15	4.3 x 5.7	28	6.3 x 8.4	117	5.3 x 7.1	90	8.1 x 10.8	180
	40mm	maximum	3.1 x 4.1	15	4.1 x 5.4	27	6.0 x 8.0	113	5.9 x 7.8	96	8.7 x 11.6	190
		minimum	2.6 x 3.5	13	3.8 x 5.1	25	5.6 x 7.4	109	4.8 x 6.4	85	7.2 x 9.7	167
	45mm (40+5)	maximum	2.7 x 3.6	13	3.6 x 4.8	23	5.3 x 7.1	106	5.2 x 6.9	89	7.8 x 10.4	175
		minimum	2.4 x 3.2	11	3.4 x 4.5	22	5.0 x 6.7	103	4.3 x 5.8	80	6.6 x 8.7	157
	50mm (40+10)	maximum	2.5 x 3.3	12	3.3 x 4.3	21	4.8 x 6.4	101	4.7 x 6.2	84	7.0 x 9.3	163
		minimum	2.2 x 2.9	10	3.1 x 4.1	20	4.5 x 6.0	98	4.0 x 5.3	77	6.0 x 8.0	148

5 MEGAPIXEL LENS + MACRO RING – 2/3" FORMAT

W.D. (Working Distance): Object~L1 vertex

2/3" FORMAT			FL-CC0814-5M		FL-CC1614-5M		FL-CC2514-5M		FL-CC1218-5MX		FL-CC1618-5MX		FL-CC2518-5MX	
V: 6.6 H: 8.8		Position of Focus Ring	f=8mm F1.4		f=16mm F1.4		f=25mm F1.4		f=12mm F1.8		f=16mm F1.8		f=25mm F1.8	
			V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.
Extension Tube Set (Macro Ring) FP-RGST (0,5mm, 1mm, 5mm, 10mm, 20mm and 40mm)	0.5mm	maximum	108.8 x 145.0	116	211.1 x 281.4	498	330.0 x 440.0	1237	158.3 x 211.1	276	211.1 x 281.5	497	330.0 x 440.0	1254
		minimum	50.9 x 67.9	44	38.3 x 51.1	79	27.3 x 36.4	91	44.0 x 58.7	69	38.5 x 51.3	79	22.4 x 29.9	94
	1.0mm	maximum	54.4 x 72.5	48	105.5 x 140.7	242	165.0 x 220.0	612	79.2 x 105.5	132	105.5 x 140.7	241	165.0 x 220.0	629
		minimum	34.7 x 46.2	24	32.4 x 43.2	65	25.2 x 33.6	83	34.5 x 46.0	52	32.5 x 43.3	65	21.1 x 28.1	88
	1.5mm (1+0.5)	maximum	36.3 x 48.3	26	70.4 x 93.8	157	110.0 x 146.7	404	52.8 x 70.4	84	70.4 x 93.8	156	110.0 x 146.7	420
		minimum	26.3 x 35.1	13	28.1 x 37.5	55	23.4 x 31.2	76	28.3 x 37.8	41	28.1 x 37.4	54	19.9 x 26.5	84
	5mm	maximum	x	-	21.1 x 28.1	38	33.0 x 44.0	112	15.8 x 21.1	17	21.1 x 28.1	37	33.0 x 44.0	129
		minimum	x	-	14.5 x 19.4	22	15.7 x 20.9	46	12.6 x 16.8	12	14.4 x 19.2	22	14.2 x 19.0	61
	10mm	maximum	x	-	10.6 x 14.1	12	16.5 x 22.0	50	x	-	10.6 x 14.1	11	16.5 x 22.0	66
		minimum	x	-	8.6 x 11.5	8	10.6 x 14.2	27	x	-	8.5 x 11.3	8	10.1 x 13.5	44
	15mm (10+5)	maximum	x	-	x	-	11.0 x 14.7	29	x	-	x	-	11.0 x 14.7	46
		minimum	x	-	x	-	8.0 x 10.7	18	x	-	x	-	7.9 x 10.5	35
	20mm	maximum	x	-	x	-	8.3 x 11.0	18	x	-	x	-	8.2 x 11.0	35
		minimum	x	-	x	-	6.5 x 8.6	12	x	-	x	-	6.4 x 8.6	29
	25mm (20+5)	maximum	x	-	x	-	6.6 x 8.8	12	x	-	x	-	6.6 x 8.8	29
		minimum	x	-	x	-	5.4 x 7.2	8	x	-	x	-	5.4 x 7.2	25
	30mm (20+10)	maximum	x	-	x	-	x	-	x	-	x	-	x	-
		minimum	x	-	x	-	x	-	x	-	x	-	x	-
	35mm (20+10+5)	maximum	x	-	x	-	x	-	x	-	x	-	x	-
		minimum	x	-	x	-	x	-	x	-	x	-	x	-
	40mm	maximum	x	-	x	-	x	-	x	-	x	-	x	-
		minimum	x	-	x	-	x	-	x	-	x	-	x	-
	45mm (40+5)	maximum	x	-	x	-	x	-	x	-	x	-	x	-
		minimum	x	-	x	-	x	-	x	-	x	-	x	-
	50mm (40+10)	maximum	x	-	x	-	x	-	x	-	x	-	x	-
		minimum	x	-	x	-	x	-	x	-	x	-	x	-

5 MEGAPIXEL LENS + MACRO RING – 1/1.8" FORMAT

W.D. (Working Distance): Object~L1 vertex

1/1.8" FORMAT			FL-CC0814-5M		FL-CC1614-5M		FL-CC2514-5M		FL-CC1218-5MX		FL-CC1618-5MX		FL-CC2518-5MX	
V: 5.4 H: 7.2		Position of Focus Ring	f=8mm F1.4		f=16mm F1.4		f=25mm F1.4		f=12mm F1.8		f=16mm F1.8		f=25mm F1.8	
			V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.
Extension Tube Set (Macro Ring) FP-RGST (0,5mm, 1mm, 5mm, 10mm, 20mm and 40mm)	0.5mm	maximum	89.0 x 118.6	116	172.7 x 230.2	498	270.0 x 360.0	1237	129.5 x 172.7	276	172.7 x 230.3	497	270.0 x 360.0	1254
		minimum	41.7 x 55.5	44	31.3 x 41.8	79	22.3 x 29.8	91	36.0 x 48.0	69	31.5 x 42.0	79	18.3 x 24.5	94
	1.0mm	maximum	44.5 x 59.3	48	86.3 x 115.1	242	135.0 x 180.0	612	64.8 x 86.4	132	86.4 x 115.1	241	135.0 x 180.0	629
		minimum	28.4 x 37.8	24	26.5 x 35.4	65	20.6 x 27.5	83	28.2 x 37.6	52	26.6 x 35.4	65	17.2 x 23.0	88
	1.5mm (1+0.5)	maximum	29.7 x 39.5	26	57.6 x 76.7	157	90.0 x 120.0	404	43.2 x 57.6	84	57.6 x 76.8	156	90.0 x 120.0	420
		minimum	21.5 x 28.7	13	23.0 x 30.7	55	19.2 x 25.6	76	23.2 x 30.9	41	23.0 x 30.6	54	16.3 x 21.7	84
	5mm	maximum	x	-	17.3 x 23.0	38	27.0 x 36.0	112	13.0 x 17.3	17	17.3 x 23.0	37	27.0 x 36.0	129
		minimum	x	-	11.9 x 15.9	22	12.8 x 17.1	46	10.3 x 13.8	12	11.8 x 15.7	22	11.6 x 15.5	61
	10mm	maximum	x	-	8.6 x 11.5	12	13.5 x 18.0	50	x	-	8.6 x 11.5	11	13.5 x 18.0	66
		minimum	x	-	7.0 x 9.4	8	8.7 x 11.6	27	x	-	7.0 x 9.3	8	8.3 x 11.0	44
	15mm (10+5)	maximum	x	-	x	-	9.0 x 12.0	29	x	-	x	-	9.0 x 12.0	46
		minimum	x	-	x	-	6.6 x 8.8	18	x	-	x	-	6.4 x 8.6	35
	20mm	maximum	x	-	x	-	6.8 x 9.0	18	x	-	x	-	6.7 x 9.0	35
		minimum	x	-	x	-	5.3 x 7.0	12	x	-	x	-	5.3 x 7.0	29
	25mm (20+5)	maximum	x	-	x	-	5.4 x 7.2	12	x	-	x	-	5.4 x 7.2	29
		minimum	x	-	x	-	4.4 x 5.9	8	x	-	x	-	4.4 x 5.9	25
	30mm (20+10)	maximum	x	-	x	-	x	-	x	-	x	-	x	-
		minimum	x	-	x	-	x	-	x	-	x	-	x	-
	35mm (20+10+5)	maximum	x	-	x	-	x	-	x	-	x	-	x	-
		minimum	x	-	x	-	x	-	x	-	x	-	x	-
	40mm	maximum	x	-	x	-	x	-	x	-	x	-	x	-
		minimum	x	-	x	-	x	-	x	-	x	-	x	-
	45mm (40+5)	maximum	x	-	x	-	x	-	x	-	x	-	x	-
		minimum	x	-	x	-	x	-	x	-	x	-	x	-
	50mm (40+10)	maximum	x	-	x	-	x	-	x	-	x	-	x	-
		minimum	x	-	x	-	x	-	x	-	x	-	x	-

5 MEGAPIXEL LENS + MACRO RING – 1/2" FORMAT

W.D. (Working Distance): Object~L1 vertex

1/2" FORMAT			FL-CC0814-5M		FL-CC1614-5M		FL-CC2514-5M		FL-CC1218-5MX		FL-CC1618-5MX		FL-CC2518-5MX	
V: 4.8 H: 6.4		Position of Focus Ring	f=8mm F1.4		f=16mm F1.4		f=25mm F1.4		f=12mm F1.8		f=16mm F1.8		f=25mm F1.8	
			V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.
Extension Tube Set (Macro Ring) FP-RGST (0,5mm, 1mm, 5mm, 10mm, 20mm and 40mm)	0.5mm	maximum	79.1 x 105.5	116	153.5 x 204.7	498	240.0 x 320.0	1237	115.1 x 153.5	276	153.5 x 204.7	497	240.0 x 320.0	1254
		minimum	37.0 x 49.4	44	27.9 x 37.1	79	19.9 x 26.5	91	32.0 x 42.7	69	28.0 x 37.3	79	16.3 x 21.7	94
	1.0mm	maximum	39.5 x 52.7	48	76.7 x 102.3	242	120.0 x 160.0	612	57.6 x 76.8	132	76.8 x 102.4	241	120.0 x 160.0	629
		minimum	25.2 x 33.6	24	23.6 x 31.4	65	18.3 x 24.5	83	25.1 x 33.4	52	23.6 x 31.5	65	15.3 x 20.4	88
	1.5mm (1+0.5)	maximum	26.4 x 35.2	26	51.2 x 68.2	157	80.0 x 106.7	404	38.4 x 51.2	84	51.2 x 68.2	156	80.0 x 106.7	420
		minimum	19.1 x 25.5	13	20.4 x 27.2	55	17.0 x 22.7	76	20.6 x 27.5	41	20.4 x 27.2	54	14.5 x 19.3	84
	5mm	maximum	x	-	15.3 x 20.5	38	24.0 x 32.0	112	11.5 x 15.4	17	15.4 x 20.5	37	24.0 x 32.0	129
		minimum	x	-	10.6 x 14.1	22	11.4 x 15.2	46	9.2 x 12.2	12	10.5 x 14.0	22	10.4 x 13.8	61
	10mm	maximum	x	-	7.7 x 10.2	12	12.0 x 16.0	50	x	-	7.7 x 10.2	11	12.0 x 16.0	66
		minimum	x	-	6.3 x 8.3	8	7.7 x 10.3	27	x	-	6.2 x 8.3	8	7.4 x 9.8	44
	15mm (10+5)	maximum	x	-	x	-	8.0 x 10.7	29	x	-	x	-	8.0 x 10.7	46
		minimum	x	-	x	-	5.8 x 7.8	18	x	-	x	-	5.7 x 7.6	35
	20mm	maximum	x	-	x	-	6.0 x 8.0	18	x	-	x	-	6.0 x 8.0	35
		minimum	x	-	x	-	4.7 x 6.3	12	x	-	x	-	4.7 x 6.2	29
	25mm (20+5)	maximum	x	-	x	-	4.8 x 6.4	12	x	-	x	-	4.8 x 6.4	29
		minimum	x	-	x	-	3.9 x 5.2	8	x	-	x	-	3.9 x 5.3	25
	30mm (20+10)	maximum	x	-	x	-	x	-	x	-	x	-	x	-
		minimum	x	-	x	-	x	-	x	-	x	-	x	-
	35mm (20+10+5)	maximum	x	-	x	-	x	-	x	-	x	-	x	-
		minimum	x	-	x	-	x	-	x	-	x	-	x	-
	40mm	maximum	x	-	x	-	x	-	x	-	x	-	x	-
		minimum	x	-	x	-	x	-	x	-	x	-	x	-
	45mm (40+5)	maximum	x	-	x	-	x	-	x	-	x	-	x	-
		minimum	x	-	x	-	x	-	x	-	x	-	x	-
	50mm (40+10)	maximum	x	-	x	-	x	-	x	-	x	-	x	-
		minimum	x	-	x	-	x	-	x	-	x	-	x	-

9 MEGAPIXEL LENS + MACRO RING – 1" FORMAT

W.D. (Working Distance): Object~L1 vertex

1" FORMAT			FL-BC1220-9M		FL-BC1618-9M		FL-BC2518-9M		FL-BC3518-9M		FL-BC5024-9M		FL-BC7528-9M	
V: 9.6 H: 12.8		Position of Focus Ring	f=12mm F2.0		f=16mm F1.8		f=25mm F1.8		f=35mm F1.8		f=50mm F2.4		f=75mm F2.8	
			V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.
Extension Tube Set (Macro Ring) EX-C6 (0,5mm, 1mm, 5mm, 10mm, 20mm and 40mm)	0.5mm	∞	230.9 x 307.9	276	307.4 x 409.8	497	479.8 x 639.8	1244	671.9 x 895.8	2455	959.9 x 1279.9	5015	1439.9 x 1919.9	11288
		minimum	55.5 x 74.0	58	47.8 x 63.7	65	36.2 x 48.3	92	36.3 x 48.5	142	35.1 x 46.8	193	26.0 x 34.7	246
	1.0mm	∞	115.5 x 153.9	131	153.7 x 204.9	241	239.9 x 319.9	620	335.9 x 447.9	1231	479.9 x 639.9	2515	720.0 x 959.9	5664
		minimum	44.9 x 59.9	45	41.3 x 55.1	55	33.8 x 45.0	86	34.5 x 46.0	136	33.8 x 45.1	187	25.5 x 34.0	243
	1.5mm (1+0.5)	∞	77.0 x 102.6	83	102.5 x 136.6	156	159.9 x 213.3	412	224.0 x 298.6	823	320.0 x 426.6	1682	480.0 x 640.0	3789
		minimum	37.7 x 50.3	35	36.4 x 48.6	46	31.6 x 42.1	80	32.9 x 43.8	129	32.6 x 43.5	181	25.1 x 33.5	239
	5mm	∞	23.1 x 30.8	15	30.7 x 41.0	36	48.0 x 64.0	120	67.2 x 89.6	251	96.0 x 128.0	516	144.0 x 192.0	1165
		minimum	17.8 x 23.7	10	19.9 x 26.5	19	21.8 x 29.1	54	24.7 x 32.9	99	26.2 x 34.9	148	22.4 x 29.9	218
	10mm	∞	x	-	15.4 x 20.5	10	24.0 x 32.0	58	33.6 x 44.8	129	48.0 x 64.0	266	72.0 x 96.0	602
		minimum	x	-	12.1 x 16.1	6	15.1 x 20.2	36	18.2 x 24.2	74	20.5 x 27.3	119	19.4 x 25.9	194
	15mm (10+5)	∞	x	-	x	-	16.0 x 21.3	37	22.4 x 29.9	88	32.0 x 42.7	182	48.0 x 64.0	415
		minimum	x	-	x	-	11.6 x 15.4	26	14.4 x 19.2	60	16.8 x 22.4	100	17.2 x 22.9	176
	20mm	∞	x	-	x	-	12.0 x 16.0	27	16.8 x 22.4	68	24.0 x 32.0	141	36.0 x 48.0	321
		minimum	x	-	x	-	9.4 x 12.5	20	11.9 x 15.9	51	14.2 x 19.0	88	15.4 x 20.5	162
	25mm (20+5)	∞	x	-	x	-	9.6 x 12.8	20	13.4 x 17.9	55	19.2 x 25.6	116	28.8 x 38.4	265
		minimum	x	-	x	-	7.9 x 10.5	16	10.2 x 13.5	44	12.3 x 16.5	78	13.9 x 18.5	150
	30mm (20+10)	∞	x	-	x	-	8.0 x 10.7	16	11.2 x 14.9	47	16.0 x 21.3	99	24.0 x 32.0	227
		minimum	x	-	x	-	6.8 x 9.1	14	8.9 x 11.8	39	10.9 x 14.5	71	12.7 x 16.9	141
	35mm (20+10+5)	∞	x	-	x	-	6.9 x 9.1	13	9.6 x 12.8	41	13.7 x 18.3	87	20.6 x 27.4	200
		minimum	x	-	x	-	6.0 x 8.0	11	7.9 x 10.5	36	9.8 x 13.0	65	11.7 x 15.6	133
	40mm	∞	x	-	x	-	6.0 x 8.0	11	8.4 x 11.2	37	12.0 x 16.0	78	18.0 x 24.0	180
		minimum	x	-	x	-	5.3 x 7.1	10	7.1 x 9.4	33	8.8 x 11.8	60	10.8 x 14.4	126
	45mm (40+5)	∞	x	-	x	-	5.3 x 7.1	9	7.5 x 10.0	34	10.7 x 14.2	71	16.0 x 21.3	165
		minimum	x	-	x	-	4.8 x 6.4	8	6.4 x 8.5	30	8.1 x 10.8	56	10.1 x 13.4	120
	50mm (40+10)	∞	x	-	x	-	4.8 x 6.4	8	6.7 x 9.0	31	9.6 x 12.8	66	14.4 x 19.2	152
		minimum	x	-	x	-	4.4 x 5.8	7	5.9 x 7.8	28	7.4 x 9.9	53	9.4 x 12.6	115

9 MEGAPIXEL(1") / 12 MEGAPIXEL (1.1") LENS + MACRO RING 1.1" FORMAT

W.D. (Working Distance): Object–L1 vertex

1.1" FORMAT			FL-BC1220-9M		FL-BC1618-9M		FL-BC2518-9M		FL-BC3518-9M		FL-BC5024-9M		FL-BC7528-9M	
V: 10.37 H: 14.16		Position of Focus Ring	f=12mm F2.0		f=16mm F1.8		f=25mm F1.8		f=35mm F1.8		f=50mm F2.4		f=75mm F2.8	
			V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.	V x H (mm)	W.D.
Extension Tube Set (Macro Ring) FP-RGST (0.5mm, 1mm, 5mm, 10mm, 20mm and 40mm)	0.5mm	∞	249.5 x 340.6	276	332.1 x 453.3	497	518.3 x 707.7	1244	725.8 x 990.9	2455	1037.0 x 1415.7	5015	1555.5 x 2123.7	11288
		minimum	59.9 x 81.8	58	51.6 x 70.4	65	39.2 x 53.5	92	39.3 x 53.6	142	37.9 x 51.7	193	28.1 x 38.3	246
	1.0mm	∞	124.7 x 170.3	131	166.0 x 226.7	241	259.2 x 353.8	620	362.9 x 495.5	1231	518.5 x 707.9	2515	777.8 x 1061.8	5664
		minimum	48.5 x 66.2	45	44.6 x 61.0	55	36.5 x 49.8	86	37.3 x 50.9	136	36.5 x 49.9	187	27.6 x 37.7	243
	1.5mm (1+0.5)	∞	83.2 x 113.5	83	110.7 x 151.1	156	172.8 x 235.9	412	241.9 x 330.3	823	345.7 x 471.9	1682	518.5 x 707.9	3789
		minimum	40.7 x 55.6	35	39.4 x 53.7	46	34.1 x 46.6	80	35.5 x 48.5	129	35.2 x 48.1	181	27.1 x 37.0	239
	5mm	∞	24.9 x 34.1	15	33.2 x 45.3	36	51.8 x 70.8	120	72.6 x 99.1	251	103.7 x 141.6	516	155.6 x 212.4	1165
		minimum	19.2 x 26.2	10	21.5 x 29.4	19	23.6 x 32.2	54	26.6 x 36.4	99	28.3 x 38.7	148	24.2 x 33.1	218
	10mm	∞	x	-	16.6 x 22.7	10	25.9 x 35.4	58	36.3 x 49.5	129	51.8 x 70.8	266	77.8 x 106.2	602
		minimum	x	-	13.0 x 17.8	6	16.3 x 22.3	36	19.6 x 26.8	74	22.1 x 30.2	119	21.0 x 28.7	194
	15mm (10+5)	∞	x	-	x	-	17.3 x 23.6	37	24.2 x 33.0	88	34.6 x 47.2	182	51.9 x 70.8	415
		minimum	x	-	x	-	12.5 x 17.1	26	15.5 x 21.2	60	18.1 x 24.7	100	18.5 x 25.3	176
	20mm	∞	x	-	x	-	13.0 x 17.7	27	18.1 x 24.8	68	25.9 x 35.4	141	38.9 x 53.1	321
		minimum	x	-	x	-	10.1 x 13.8	20	12.9 x 17.6	51	15.4 x 21.0	88	16.6 x 22.7	162
	25mm (20+5)	∞	x	-	x	-	10.4 x 14.2	20	14.5 x 19.8	55	20.7 x 28.3	116	31.1 x 42.5	265
		minimum	x	-	x	-	8.5 x 11.6	16	11.0 x 15.0	44	13.3 x 18.2	78	15.0 x 20.5	150
	30mm (20+10)	∞	x	-	x	-	8.6 x 11.8	16	12.1 x 16.5	47	17.3 x 23.6	99	25.9 x 35.4	227
		minimum	x	-	x	-	7.3 x 10.0	14	9.6 x 13.1	39	11.8 x 16.1	71	13.7 x 18.7	141
	35mm (20+10+5)	∞	x	-	x	-	7.4 x 10.1	13	10.4 x 14.2	41	14.8 x 20.2	87	22.2 x 30.3	200
		minimum	x	-	x	-	6.4 x 8.8	11	8.5 x 11.6	36	10.5 x 14.4	65	12.6 x 17.2	133
	40mm	∞	x	-	x	-	6.5 x 8.8	11	9.1 x 12.4	37	13.0 x 17.7	78	19.4 x 26.5	180
		minimum	x	-	x	-	5.7 x 7.8	10	7.6 x 10.4	33	9.5 x 13.0	60	11.7 x 16.0	126
	45mm (40+5)	∞	x	-	x	-	5.8 x 7.9	9	8.1 x 11.0	34	11.5 x 15.7	71	17.3 x 23.6	165
		minimum	x	-	x	-	5.2 x 7.1	8	6.9 x 9.4	30	8.7 x 11.9	56	10.9 x 14.9	120
	50mm (40+10)	∞	x	-	x	-	5.2 x 7.1	8	7.3 x 9.9	31	10.4 x 14.2	66	15.6 x 21.2	152
		minimum	x	-	x	-	4.7 x 6.5	7	6.3 x 8.6	28	8.0 x 11.0	53	10.2 x 13.9	115

NOTES

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