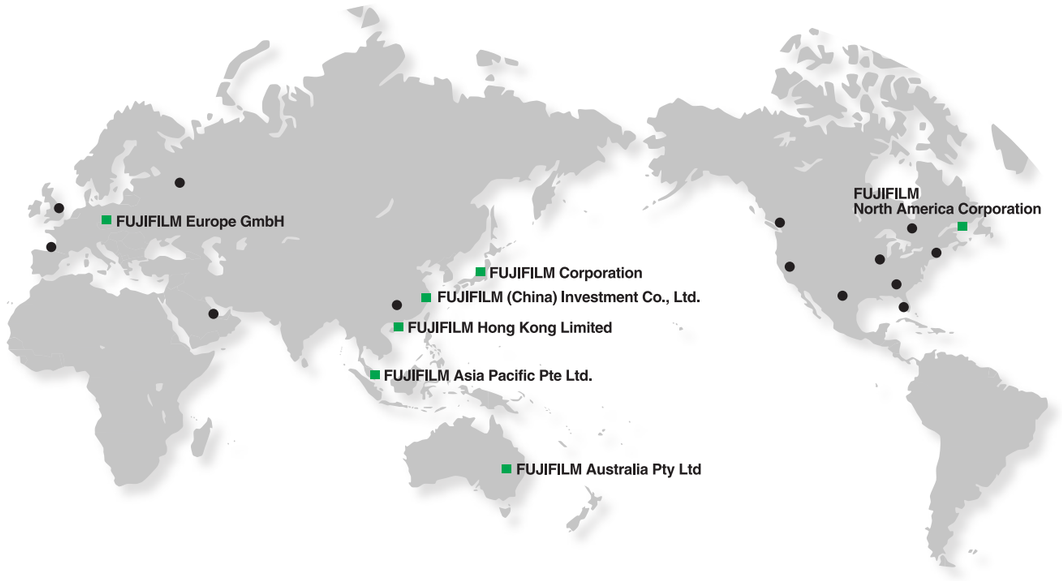

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⚠ Be certain to read the instructions for use before using any equipment.

FUJIFILM
Value from Innovation

FUJINON

Machine Vision Lenses

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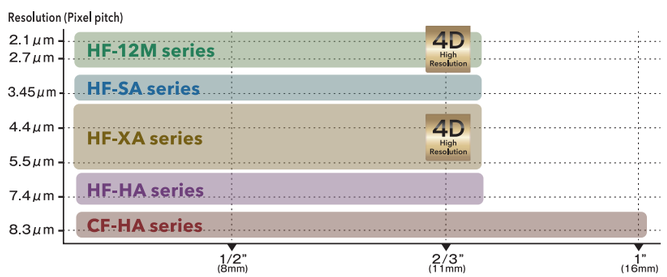
Lens Selection Guide



4D High Resolution

The “4D High Resolution” is the FUJINON lenses’unique performance. It maintains a high level of consistent image sharpness at the center as well as around the edges, while mitigating resolution degradation that typically occurs when changing a working distance or aperture value.

NEW

HF-12M series 12 Megapixel, 2/3" 4D High Resolution

<Main features>

■Advanced optical performance suitable for the top-of-the-range series

- When the iris (aperture) is set at the orange F4 marker on the lens barrel, the HF-12M series delivers the resolving power greater than 2.1μm pixel pitch on a 2/3-inch sensor (equivalent to 12 megapixels) *1.
- The HF-12M series is capable of maintaining ultra-high definition with a 2.7 μm pixel pitch within the whole frame area. Each pixel with high optical performance enables stable checking of product dimensions and appearance.
- The HF-12M series bring out maximum performance of the image sensor with 3.45μm pixel pitch(IMX250).

Orange-colored F4 marker on the lens barrel

■FUJINON lenses' unique "4D High Resolution" performance. 4D High Resolution

General machine vision lenses share the issue of resolution degradation when the working distance or aperture is changed. The HF-12M features FUJINON lenses' unique "4D High Resolution" performance. It maintains a high level of consitent image sharpness at the center as well as around the edges, while mitigating resolution degradation that typically occurs when changing a working distance or aperture value. This enables the consistent delivery of high-resolution images under a wide variety of installation and shooting conditions.

■Ease of installation and high reliability

- Despite being high-resolution lenses with 2.7μm pixel pitch, all the five models come in a compact form factor with the external dimension of just φ33mm. This allows installation flexibility even in manufacturing facilities with space constraints.
- General machine vision lenses use iris and focus locking screws with a head protruding out from the lens body, potentially causing interference within the machine vision system. The HF-12M series come with regular locking screws as well as headless compact screws, which can be countersunk into the lens body to minimize interference with the machine vision system, thereby increasing flexibility in system installation and design.
- The lenses are built with a metal barrel for durability and robustness.

When locked with a head-less compact screw. No head protruding from the lens body.

■Industry-leading low distortion design of no more than 0.05%

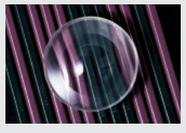
- The lenses' unique optical design minimizes troublesome distortion. in industrial applications requiring accuracy such as dimension measurement. The series boasts an industry-leading low distortion rate of no more than 0.05%*2.
- The aspherical glass*3 mold lens enabled the smallest body and low distortion.

*1: At the working distance of 50cm *2: In the case of HF1618-12M *3: Installed to HF818-12M and HF1218-12M

Technology Supporting the "HF-12M Series"

High-precision glass mold aspherical lens technology —Achieving both miniaturization and low distortion—

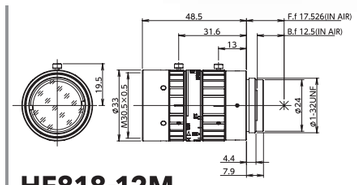
- In lens design, reducing the number of lenses and forming an image by abruptly bending light that enters the lens achieves miniaturization. Distortion cannot be controlled if the lenses are only composed of the commonly used spherical lens. However, the aspherical lens can yield the same results of using multiple spherical lenses, enabling the control of distortion with far fewer lenses.
- Aspherical lenses require precision processing. Fujifilm can design and manufacture aspherical lens within its own group. The precision processing required in the design stage and its mass production is realized by accurate die machining technology.
- The HF-12M series realizes both miniaturization and low distortion by implementing the high-precision glass mold aspherical lenses.


Aspherical lens


General MV lens only with spherical lenses

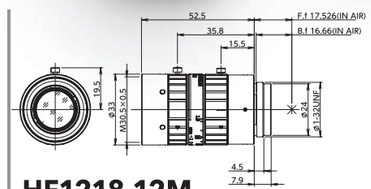
MV lens with an aspherical lens

Please download the specification sheet and the drawing data.



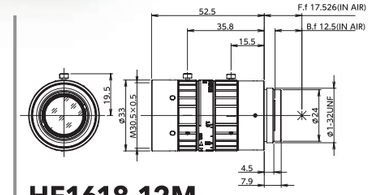
HF818-12M

Focal length [mm]	8
Iris range (F. no)	F1.8-F22
Angle of view	56.9°×43.9° (2/3")
Working Distance (*) [mm]	∞-100
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M30.5 x 0.5
Mount	C-mount
Weight (approx.) [g]	95
Sensor size (max.)	2/3"
TV distortion [%]	-1.03
Dimension [mm]	φ33×48.5



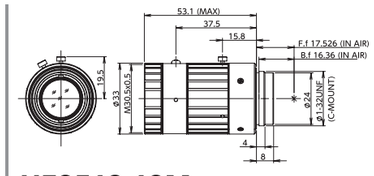
HF1218-12M

Focal length [mm]	12
Iris range (F. no)	F1.8-F22
Angle of view	39.3°×30.0° (2/3")
Working Distance (*) [mm]	∞-100
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M30.5 x 0.5
Mount	C-mount
Weight (approx.) [g]	85
Sensor size (max.)	2/3"
TV distortion [%]	0.18
Dimension [mm]	φ33×52.5



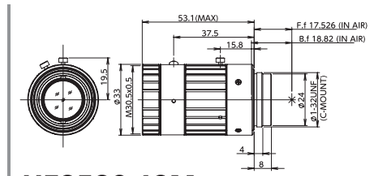
HF1618-12M

Focal length [mm]	16
Iris range (F. no)	F1.8-F22
Angle of view	30.8°×23.3° (2/3")
Working Distance (*) [mm]	∞-100
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M30.5 x 0.5
Mount	C-mount
Weight (approx.) [g]	90
Sensor size (max.)	2/3"
TV distortion [%]	-0.03
Dimension [mm]	φ33×52.5



HF2518-12M

Focal length [mm]	25
Iris range (F. no)	F1.8-F22
Angle of view	20.0°×15.1°(2/3")
Working Distance (*) [mm]	∞-100
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M30.5 x 0.5
Mount	C-mount
Weight (approx.) [g]	85
Sensor size (max.)	2/3"
TV distortion [%]	0.02
Dimension [mm]	φ33×53.1



HF3520-12M

Focal length [mm]	35
Iris range (F. no)	F2.0-F22
Angle of view	14.7°×11.0° (2/3")
Working Distance (*) [mm]	∞-200
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M30.5 x 0.5
Mount	C-mount
Weight (approx.) [g]	85
Sensor size (max.)	2/3"
TV distortion [%]	0.01
Dimension [mm]	φ33×53.1

* From front of lens barrel

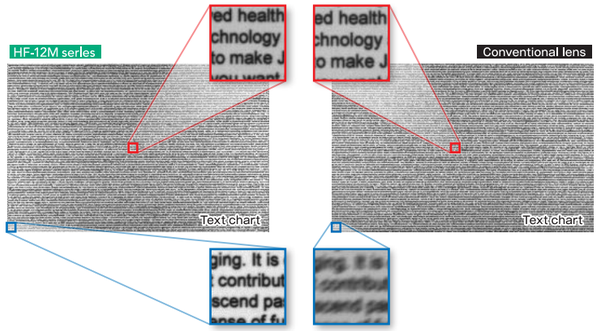
4D High Resolution Maintaining High-Resolution is about Controlling Aberration.

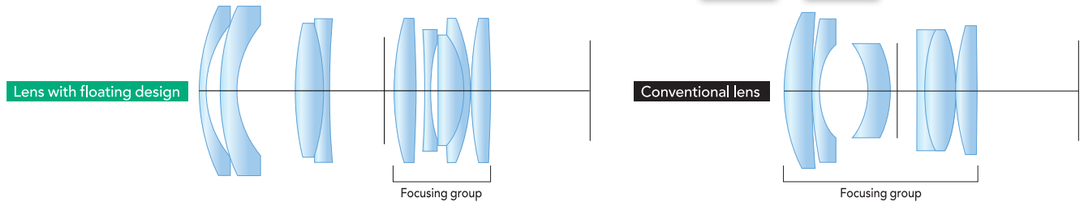
3 Technologies Supporting “4D High-Resolution”

1 Floating design technology

–Controls the drop in resolution caused by changing shooting distances–

- The lenses are designed to show the best resolution at the shooting distance most commonly used (designed distance). At this distance, the aberrations (color fringe/peripheral blur/distortion) are ideally corrected.
- Although conventional lens design technology optimally controlled aberration at the designed distance, aberration occurred at other distances and lowered resolution. The wide angle lens in particular had issues with its tendency for curvature of field (peripheral blur).
- The HF-12M series has implemented “floating design technology”. “Floating lens elements” behind the iris move to focus and enable the HF-12M series to retain its highest resolution regardless of the shooting distance.





2 Eccentricity adjustment technology

–Retaining consistent resolution to the periphery of the image–

- Misalignment of the axis of the lenses during the manufacturing process prevents the intended performance from being exhibited. It is crucial to align the axis of the lenses to the micrometer level during its manufacturing process.
- The HF-12M series realized high-resolution consistent all the way to the periphery of the image. This is accomplished by detecting all lens core misalignment using proprietary inspection equipment of Fujifilm manufacturing technology and aligning the whole lens constructions with micrometer level adjustments.
- Fujifilm’s proprietary manufacturing technology is utilized by applying the precision technology needed for manufacturing broadcast lenses that require high-dimensional and consistent qualities, to the manufacture of miniature lenses such as camera modules for mobile phones.

No misalignments　　Lenses are misaligned

3 Glass matching technology (Fujifilm original optical design software “FOCUS”)

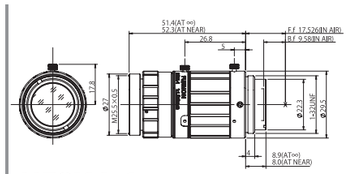
–Controls the drop in resolution caused by changing aperture value–

- “Lateral chromatic aberration (color fringe)” is the main cause for the drop in resolution when changing the aperture value. Due to the different refractive index of the wavelength, imaging position sometimes differs by colors. This leads to the color fringing at the edge of the frame. To control of this aberration combination of the glass materials matters. While general glass materials can correct only the 2 colors of RGB(Red, Green, Blue), Extra-low Dispersion glass material enables the correction of all three colors at high level.
- By implementing glass with Extra-low Dispersion characteristics to control lateral chromatic aberration, the HF-12M series have succeeded to maintain the high resolution even when changing the aperture value.
- Fujifilm’s has developed its original lens design software “FOCUS (Fujifilm Optical Class Library and Utilities System)”, which enables to decide the best glass materials from the infinite combination of possibilities.

Please download the specification sheet and the drawing data.

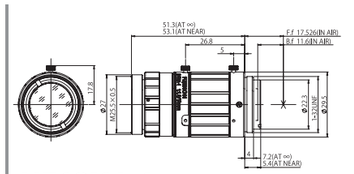
NEW

HF-XA series 3 Megapixel, 2/3” 4D High Resolution



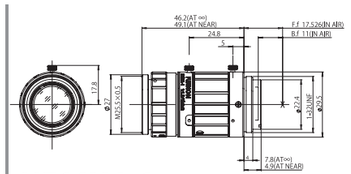
HF8XA-1

Focal length [mm]	8
Iris range (F. no)	F1.6-F16
Angle of view	58.4°×44.6° (2/3")
Working Distance (*) [mm]	∞-100
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M25.5 x 0.5
Mount	C-mount
Weight (approx.) [g]	79
Sensor size (max.)	2/3"
TV distortion [%]	-1.99
Dimension [mm]	φ29.5×51.5



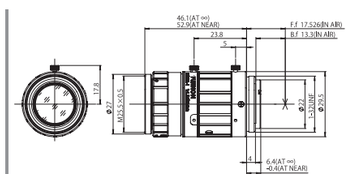
HF12XA-1

Focal length [mm]	12
Iris range (F. no)	F1.6-F16
Angle of view	40.1°×30.3° (2/3")
Working Distance (*) [mm]	∞-100
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M25.5 x 0.5
Mount	C-mount
Weight (approx.) [g]	79
Sensor size (max.)	2/3"
TV distortion [%]	-1.26
Dimension [mm]	φ29.5×51.5



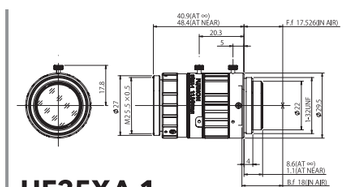
HF16XA-1

Focal length [mm]	16
Iris range (F. no)	F1.6-F16
Angle of view	31.4°×23.7° (2/3")
Working Distance (*) [mm]	∞-100
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M25.5 x 0.5
Mount	C-mount
Weight (approx.) [g]	71
Sensor size (max.)	2/3"
TV distortion [%]	-0.60
Dimension [mm]	φ29.5×46.0



HF25XA-1

Focal length [mm]	25
Iris range (F. no)	F1.6-F16
Angle of view	20.0°×15.0°(2/3")
Working Distance (*) [mm]	∞-100
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M25.5 x 0.5
Mount	C-mount
Weight (approx.) [g]	72
Sensor size (max.)	2/3"
TV distortion [%]	-0.07
Dimension [mm]	φ29.5×46.5



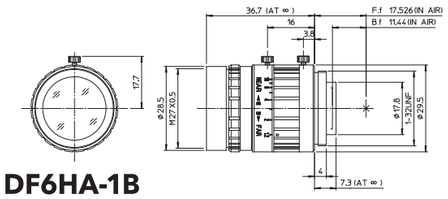
HF35XA-1

Focal length [mm]	35
Iris range (F. no)	F1.9-F16
Angle of view	14.2°×10.7° (2/3")
Working Distance (*) [mm]	∞-200
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M25.5 x 0.5
Mount	C-mount
Weight (approx.) [g]	60
Sensor size (max.)	2/3"
TV distortion [%]	0.10
Dimension [mm]	φ29.5×41.5

* From front of lens barrel

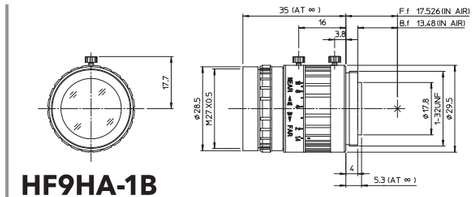
HF-HA series 1.5 Megapixel, 2/3“

Please download the specification sheet and the drawing data.



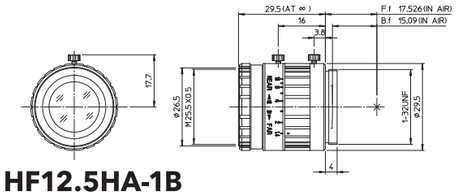
DF6HA-1B

Focal length [mm]	6
Iris range (F. no)	F1.2-F16
Angle of view	57.3°x 43.8°(1/2")
Working Distance (*) [mm]	∞-100
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M27 x 0.5
Mount	C-mount
Weight (approx.) [g]	55
Sensor size (max.)	1/2"
TV distortion [%]	-1.84
Dimension [mm]	ϕ29.5×36.8



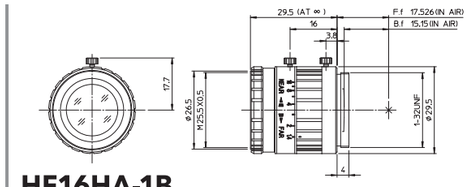
HF9HA-1B

Focal length [mm]	9
Iris range (F. no)	F1.4-F16
Angle of view	53.3°x 40.5°(2/3")
Working Distance (*) [mm]	∞-100
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M27 x 0.5
Mount	C-mount
Weight (approx.) [g]	55
Sensor size (max.)	2/3"
TV distortion [%]	-2.00
Dimension [mm]	ϕ29.5×35



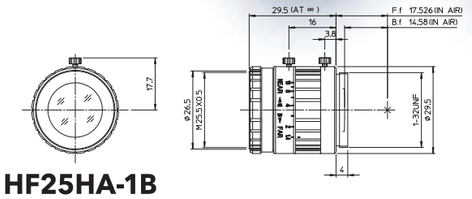
HF12.5HA-1B

Focal length [mm]	12.5
Iris range (F. no)	F1.4-F16
Angle of view	39.2°x 29.4°(2/3")
Working Distance (*) [mm]	∞-100
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M25.5 x 0.5
Mount	C-mount
Weight (approx.) [g]	45
Sensor size (max.)	2/3"
TV distortion [%]	-1.95
Dimension [mm]	ϕ29.5×29.5



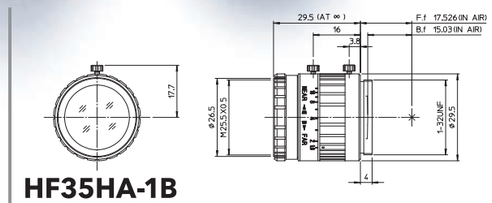
HF16HA-1B

Focal length [mm]	16
Iris range (F. no)	F1.4-F16
Angle of view	30.5°x 22.9°(2/3")
Working Distance (*) [mm]	∞-100
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M25.5 x 0.5
Mount	C-mount
Weight (approx.) [g]	45
Sensor size (max.)	2/3"
TV distortion [%]	-0.87
Dimension [mm]	ϕ29.5×29.5



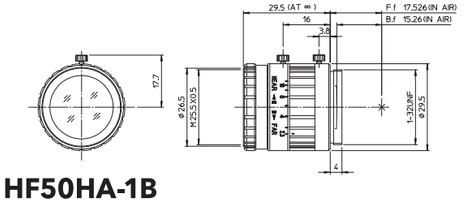
HF25HA-1B

Focal length [mm]	25
Iris range (F. no)	F1.4-F16
Angle of view	19.4°x 14.6°(2/3")
Working Distance (*) [mm]	∞-150
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M25.5 x 0.5
Mount	C-mount
Weight (approx.) [g]	45
Sensor size (max.)	2/3"
TV distortion [%]	-0.19
Dimension [mm]	ϕ29.5×29.5



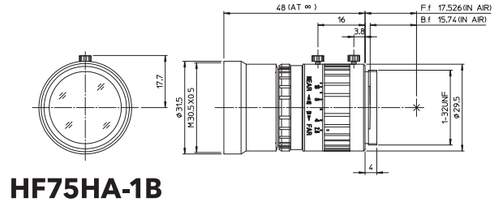
HF35HA-1B

Focal length [mm]	35
Iris range (F. no)	F1.6-F22
Angle of view	14.3°x 10.8°(2/3")
Working Distance (*) [mm]	∞-250
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M25.5 x 0.5
Mount	C-mount
Weight (approx.) [g]	45
Sensor size (max.)	2/3"
TV distortion [%]	0.10
Dimension [mm]	ϕ29.5×29.5



HF50HA-1B

Focal length [mm]	50
Iris range (F. no)	F2.3-F22
Working Distance (*) [mm]	10.1°x 7.6°(2/3")
Operation of focus	∞-500
Operation of iris	Manual
Filter thread [mm]	Manual
Mount	M25.5 x 0.5
Weight (approx.) [g]	C-mount
Sensor size (max.)	45
TV distortion [%]	2/3"
Dimension [mm]	0.06
	ϕ29.5×29.5



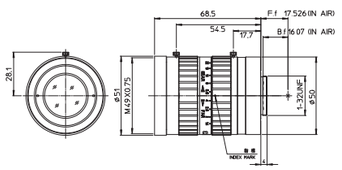
HF75HA-1B

Focal length [mm]	75
Iris range (F. no)	F2.8-F22
Angle of view	6.7°x 5.0°(2/3")
Working Distance (*) [mm]	∞-1,100
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M30.5 x 0.5
Mount	C-mount
Weight (approx.) [g]	55
Sensor size (max.)	2/3"
TV distortion [%]	0.36
Dimension [mm]	ϕ29.5×48

* From front of lens barrel

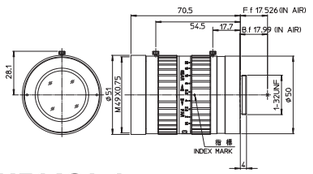
Please download the specification sheet and the drawing data.

HF-SA series 5 Megapixel, 2/3"



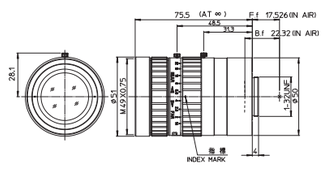
HF12.5SA-1

Focal length [mm]	12.5
Iris range (F. no)	F1.4-F22
Angle of view	38.0°x 29.0°(2/3")
Working Distance (*) [mm]	∞-100
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M49 x 0.75
Mount	C-mount
Weight (approx.) [g]	295
Sensor size (max.)	2/3"
TV distortion [%]	-0.08
Dimension [mm]	ϕ51×68.5



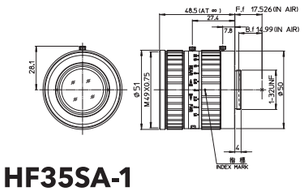
HF16SA-1

Focal length [mm]	16
Iris range (F. no)	F1.4-F22
Angle of view	30.2°x 22.9°(2/3")
Working Distance (*) [mm]	∞-100
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M49 x 0.75
Mount	C-mount
Weight (approx.) [g]	285
Sensor size (max.)	2/3"
TV distortion [%]	0.11
Dimension [mm]	ϕ51×70.5



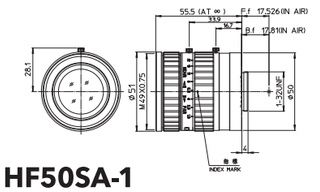
HF25SA-1

Focal length [mm]	25
Iris range (F. no)	F1.4-F22
Angle of view	20.8°x 15.7°(2/3")
Working Distance (*) [mm]	∞-100
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M49 x 0.75
Mount	C-mount
Weight (approx.) [g]	315
Sensor size (max.)	2/3"
TV distortion [%]	-0.06
Dimension [mm]	ϕ51×75.5



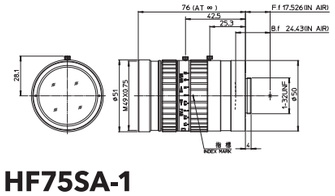
HF35SA-1

Focal length [mm]	35
Iris range (F. no)	F1.4-F22
Angle of view	14.0°x 10.5°(2/3")
Working Distance (*) [mm]	∞-200
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M49 x 0.75
Mount	C-mount
Weight (approx.) [g]	185
Sensor size (max.)	2/3"
TV distortion [%]	0.07
Dimension [mm]	ϕ51×48.5



HF50SA-1

Focal length [mm]	50
Iris range (F. no)	F1.8-F22
Angle of view	9.7°x 7.3°(2/3")
Working Distance (*) [mm]	∞-400
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M49 x 0.75
Mount	C-mount
Weight (approx.) [g]	240
Sensor size (max.)	2/3"
TV distortion [%]	0.08
Dimension [mm]	ϕ51×55.5



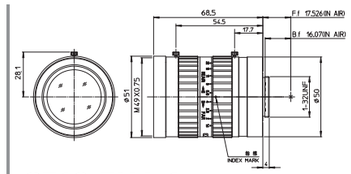
HF75SA-1

Focal length [mm]	75
Iris range (F. no)	F1.8-F22
Angle of view	6.7°x 5.0°(2/3")
Working Distance (*) [mm]	∞-900
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M49 x 0.75
Mount	C-mount
Weight (approx.) [g]	305
Sensor size (max.)	2/3"
TV distortion [%]	0.01
Dimension [mm]	ϕ51×76

* From front of lens barrel

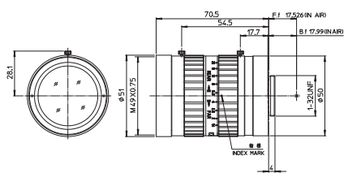
Please download the specification sheet and the drawing data.

CF-HA series 1.5 Megapixel, 1"



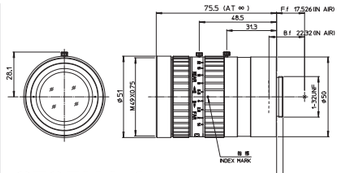
CF12.5HA-1

Focal length [mm]	12.5
Iris range (F. no)	F1.4-F22
Angle of view	53.1°x 41.2°(1")
Working Distance (*) [mm]	∞-100
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M49 x 0.75
Mount	C-mount
Weight (approx.) [g]	290
Sensor size (max.)	1"
TV distortion [%]	0.86
Dimension [mm]	ϕ51×68.5



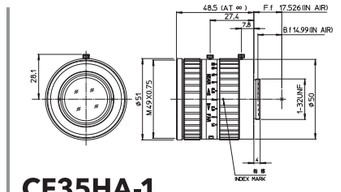
CF16HA-1

Focal length [mm]	16
Iris range (F. no)	F1.4-F22
Angle of view	42.6°x 32.8°(1")
Working Distance (*) [mm]	∞-100
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M49 x 0.75
Mount	C-mount
Weight (approx.) [g]	280
Sensor size (max.)	1"
TV distortion [%]	0.79
Dimension [mm]	ϕ51×70.5



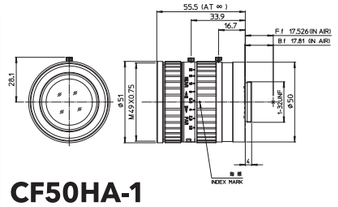
CF25HA-1

Focal length [mm]	25
Iris range (F. no)	F1.4-F22
Angle of view	29.9°x 22.7° (1")
Working Distance (*) [mm]	∞-100
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M49 x 0.75
Mount	C-mount
Weight (approx.) [g]	310
Sensor size (max.)	1"
TV distortion [%]	0.36
Dimension [mm]	ϕ51×75.5



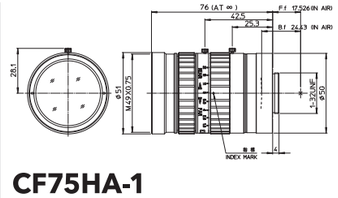
CF35HA-1

Focal length [mm]	35
Iris range (F. no)	F1.4-F22
Angle of view	20.3°x 15.3°(1")
Working Distance (*) [mm]	∞-200
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M49 x 0.75
Mount	C-mount
Weight (approx.) [g]	180
Sensor size (max.)	1"
TV distortion [%]	0.18
Dimension [mm]	ϕ51×48.5



CF50HA-1

Focal length [mm]	50
Iris range (F. no)	F1.8-F22
Angle of view	14.1°x 10.6°(1")
Working Distance (*) [mm]	∞-400
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M49 x 0.75
Mount	C-mount
Weight (approx.) [g]	235
Sensor size (max.)	1"
TV distortion [%]	0.20
Dimension [mm]	ϕ51×55.5



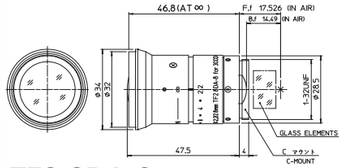
CF75HA-1

Focal length [mm]	75
Iris range (F. no)	F1.8-F22
Angle of view	9.8°x 7.3°(1")
Working Distance (*) [mm]	∞-900
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M49 x 0.75
Mount	C-mount
Weight (approx.) [g]	300
Sensor size (max.)	1"
TV distortion [%]	0.01
Dimension [mm]	ϕ51×76

* From front of lens barrel

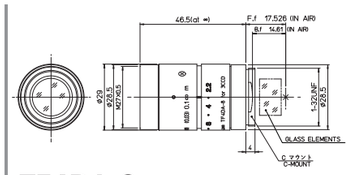
Please download the specification sheet and the drawing data.

TF series 3CCD, 1/3"



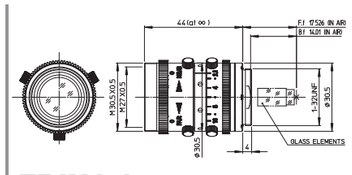
TF2.8DA-8

Focal length [mm]	2.8
Iris range (F. no)	F2.2-F16・Close
Angle of view	89.1°x 69.3°(1/3")
Working Distance (*) [mm]	∞-100
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	-
Mount	C-mount
Weight (approx.) [g]	75
Sensor size (max.)	1/3"
TV distortion [%]	-6.25
Dimension [mm]	φ34×47.5



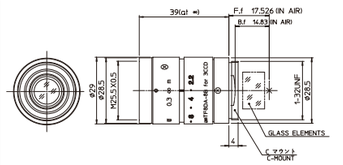
TF4DA-8

Focal length [mm]	4
Iris range (F. no)	F2.2-F16・Close
Angle of view	64.5°x 49.0°(1/3")
Working Distance (*) [mm]	∞-100
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M27 x 0.5
Mount	C-mount
Weight (approx.) [g]	70
Sensor size (max.)	1/3"
TV distortion [%]	-3.77
Dimension [mm]	φ29×46.5



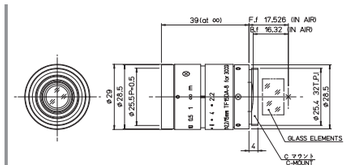
TF4XA-1 2MP

Focal length [mm]	4
Iris range (F. no)	F2.2
Angle of view	64.5°x 49.1°(1/3")
Working Distance (*) [mm]	∞-100
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M27 x 0.5 (INSIDE) M30.5×0.5 (OUTSIDE)
Mount	C-mount
Weight (approx.) [g]	100
Sensor size (max.)	1/3"
TV distortion [%]	-4.27
Dimension [mm]	φ30.5×44



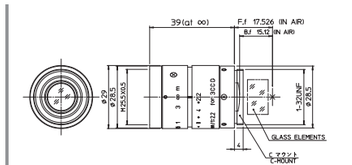
TF8DA-8B

Focal length [mm]	8
Iris range (F. no)	F2.2-F16・Close
Angle of view	33.4°x 25.1°(1/3")
Working Distance (*) [mm]	∞-100
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M25.5 x 0.5
Mount	C-mount
Weight (approx.) [g]	60
Sensor size (max.)	1/3"
TV distortion [%]	-1.30
Dimension [mm]	φ29×39



TF15DA-8

Focal length [mm]	15
Iris range (F. no)	F2.2-F16・Close
Angle of view	18.0°x 13.5°(1/3")
Working Distance (*) [mm]	∞-100
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M25.5 x 0.5
Mount	C-mount
Weight (approx.) [g]	60
Sensor size (max.)	1/3"
TV distortion [%]	-0.31
Dimension [mm]	φ29×39



TF25DA-8B ※This product is for sale while stock lasts.

Focal length [mm]	25
Iris range (F. no)	F2.2-F16・Close
Angle of view	11.0°x 8.3°(1/3")
Working Distance (*) [mm]	∞-200
Operation of focus	Manual
Operation of iris	Manual
Filter thread [mm]	M25.5 x 0.5
Mount	C-mount
Weight (approx.) [g]	60
Sensor size (max.)	1/3"
TV distortion [%]	-0.06
Dimension [mm]	φ29×39

* From front of lens barrel

Optical Magnification Ratio Chart [Reference data]

■SAMPLE [mm]

Extension tube [mm]	Product name	HF9HA-1B
	Focal Length	f9
	Focus	Shooting range (HxV)
		NEAR / FAR
5	WD※	2 / 4
	2/3"	15.4x11.1 / 17.7x12.8
	1/2"	10.7x7.9 / 12.3x9.1
	1/3"	7.9x5.9 / 9.1x6.7
	mag	0.624x / 0.542x

※Working distance
←Lens magnification
↑Sensor size

■Sensor size

1""	12.8x9.6
2/3"	8.8x6.6
1/2"	6.4x4.8
1/3"	4.8x3.6

■HF-12M series

Extension tube [mm]	Focus	HF818-12M f8 NEAR	HF818-12M f8 FAR	HF1218-12M f12 NEAR	HF1218-12M f12 FAR	HF1618-12M f16 NEAR	HF1618-12M f16 FAR	HF2518-12M f25 NEAR	HF2518-12M f25 FAR	HF3520-12M f35 NEAR	HF3520-12M f35 FAR
		Shooting range (HxV)		Shooting range (HxV)		Shooting range (HxV)		Shooting range (HxV)		Shooting range (HxV)	
0	WD	100	INF	100	INF	100	INF	100	INF	200	INF
	2/3"	123.7x92.0	-x-	84.8x63.5	-x-	66.6x49.8	-x-	42.3x31.7	-x-	53.2x39.8	-x-
	1/2"	89.1x66.6	-x-	61.6x46.2	-x-	48.3x36.1	-x-	30.7x23.0	-x-	38.6x29.0	-x-
	1/3"	66.6x49.8	-x-	46.2x34.6	-x-	36.1x27.1	-x-	23.0x17.2	-x-	29.0x21.7	-x-
	mag	0.072x	0.000x	0.104x	0.000x	0.133x	0.000x	0.209x	0.000x	0.166x	0.000x
0.5	WD	48	120	67	284	77	495	90	1215	183	2322
	2/3"	67.5x50.1	146.3x108.	61.1x45.7	216.4x162.3	53.7x40.2	282.6x211.8	38.6x28.9	439.5x329.	48.9x36.6	602.0x451.
	1/2"	48.6x36.2	105.4x78.8	44.3x33.2	157.4x118.1	38.9x29.2	205.4x154.0	28.0x21.0	319.5x239.	35.5x26.6	437.8x328.
	1/3"	36.2x27.1	78.8x59.0	33.2x24.9	118.1x88.5	29.2x21.8	154.0x115.4	21.0x15.7	239.6x179.	26.6x20.0	328.3x246.
	mag	0.133x	0.061x	0.145x	0.041x	0.165x	0.031x	0.229x	0.020x	0.180x	0.015x
1	WD	28	53	48	133	62	238	81	593	169	1153
	2/3"	46.5x34.5	73.4x54.5	47.8x35.7	108.4x81.3	45.0x33.7	141.4x105.9	35.5x26.6	219.9x164.	45.2x33.9	301.1x225.
	1/2"	33.4x24.9	52.8x39.5	34.6x25.9	78.8x59.1	32.6x24.4	102.7x77.0	25.8x19.3	159.8x119.	32.8x24.6	218.9x164.
	1/3"	24.9x18.6	39.5x29.5	25.9x19.4	59.1x44.3	24.4x18.3	77.0x57.7	19.3x14.5	119.8x89.8	24.6x18.5	164.2x123.
	mag	0.193x	0.122x	0.185x	0.081x	0.197x	0.062x	0.249x	0.040x	0.195x	0.029x
1.5	WD	18	30	36	82	51	152	73	385	157	763
	2/3"	35.5x26.3	49.1x36.4	39.2x29.3	72.4x54.2	38.7x29.0	94.3x70.6	32.9x24.6	146.7x109.	42.1x31.5	200.8x150.
	1/2"	25.5x19.0	35.3x26.3	28.4x21.3	52.6x39.4	28.1x21.0	68.5x51.3	23.9x17.9	106.6x79.9	30.6x22.9	146.0x109.
	1/3"	19.0x14.2	26.3x19.7	21.3x15.9	39.4x29.5	21.0x15.8	51.3x38.5	17.9x13.4	79.9x59.9	22.9x17.2	109.5x82.1
	mag	0.254x	0.183x	0.226x	0.122x	0.229x	0.094x	0.269x	0.060x	0.210x	0.044x
2	WD	12	19	28	57	42	110	67	281	146	568
	2/3"	28.7x21.3	36.9x27.4	33.3x24.9	54.4x40.7	34.0x25.4	70.7x53.0	30.6x22.9	110.1x82.5	39.3x29.5	150.6x112.
	1/2"	20.6x15.4	26.5x19.8	24.1x18.0	39.5x29.6	24.6x18.5	51.4x38.5	22.2x16.6	80.0x59.9	28.6x21.4	109.5x82.1
	1/3"	15.4x11.5	19.8x14.8	18.0x13.5	29.6x22.2	18.5x13.8	38.5x28.9	16.6x12.5	59.9x44.9	21.4x16.1	82.1x61.6
	mag	0.314x	0.244x	0.267x	0.163x	0.261x	0.125x	0.289x	0.080x	0.224x	0.058x
5	WD			6	12	17	33	42	95	103	217
	2/3"			17.5x13.0	22.0x16.4	19.6x14.7	28.3x21.2	21.7x16.2	44.2x33.0	28.3x21.2	60.3x45.2
	1/2"			12.6x9.4	15.9x11.9	14.2x10.6	20.6x15.4	15.7x11.7	32.0x24.0	20.5x15.4	43.8x32.9
	1/3"			9.4x7.1	11.9x8.9	10.6x8.0	15.4x11.5	11.7x8.8	24.0x18.0	15.4x11.5	32.9x24.6
	mag			0.511x	0.407x	0.452x	0.312x	0.410x	0.200x	0.312x	0.146x
10	WD					3	7	22	33	68	100
	2/3"					11.5x8.6	14.2x10.6	14.6x10.9	22.1x16.5	19.3x14.4	30.2x22.6
	1/2"					8.3x6.2	10.3x7.7	10.5x7.9	16.0x12.0	14.0x10.5	21.9x16.4
	1/3"					6.2x4.7	7.7x5.8	7.9x5.9	12.0x9.0	10.5x7.9	16.4x12.3
	mag					0.771x	0.624x	0.610x	0.401x	0.458x	0.292x
15	WD							12	12	50	61
	2/3"							11.0x8.2	14.8x11.0	14.6x10.9	20.1x15.1
	1/2"							7.9x5.9	10.7x8.0	10.6x8.0	14.6x11.0
	1/3"							5.9x4.4	8.0x6.0	8.0x6.0	11.0x8.2
	mag							0.811x	0.601x	0.604x	0.439x
20	WD							5	1	39	41
	2/3"							8.8x6.6	11.1x8.3	11.8x8.8	15.1x11.3
	1/2"							6.4x4.8	8.0x6.0	8.5x6.4	11.0x8.2
	1/3"							4.8x3.6	6.0x4.5	6.4x4.8	8.2x6.2
	mag							1.011x	0.802x	0.751x	0.585x
25	WD									32	30
	2/3"									9.8x7.4	12.1x9.0
	1/2"									7.1x5.4	8.8x6.6
	1/3"									5.4x4.0	6.6x4.9
	mag									0.897x	0.731x
30	WD									27	22
	2/3"									8.5x6.3	10.1x7.5
	1/2"									6.1x4.6	7.3x5.5
	1/3"									4.6x3.5	5.5x4.1
	mag									1.043x	0.877x
35	WD									23	16
	2/3"									7.4x5.6	8.6x6.5
	1/2"									5.4x4.0	6.3x4.7
	1/3"									4.0x3.0	4.7x3.5
	mag									1.189x	1.023x
40	WD									19	12
	2/3"									6.6x5.0	7.5x5.7
	1/2"									4.8x3.6	5.5x4.1
	1/3"									3.6x2.7	4.1x3.1
	mag									1.335x	1.170x
45	WD									17	9
	2/3"									6.0x4.5	6.7x5.0
	1/2"									4.3x3.2	4.9x3.7
	1/3"									3.2x2.4	3.7x2.7
	mag									1.482x	1.316x
50	WD									15	6
	2/3"									5.4x4.1	6.0x4.5
	1/2"									3.9x3.0	4.4x3.3
	1/3"									3.0x2.2	3.3x2.5
	mag									1.628x	1.462x
70	WD									9	0
	2/3"									4.0x3.0	4.3x3.2
	1/2"									2.9x2.2	3.1x2.3
	1/3"									2.2x1.6	2.3x1.8
	mag									2.213x	2.047x

■SAMPLE

[mm]

Extension tube [mm]	Product name	HF9HA-1B	
	Focal Length	f9	
	Focus	Shooting range (HxV)	
		NEAR	FAR
5	WD※	2	4
	2/3"	15.4x11.1	17.7x12.8
	1/2"	10.7x7.9	12.3x9.1
	1/3"	7.9x5.9	9.1x6.7
	mag	0.624x	0.542x

※Working distance

←Lens magnification

↑ Sensor size

■Sensor size

1""	12.8x9.6
2/3"	8.8x6.6
1/2"	6.4x4.8
1/3"	4.8x3.6

HF-XA series

Extension tube [mm]	Product name	HF8XA-1		HF12XA-1		HF16XA-1		HF25XA-1		HF35XA-1	
	Focal Length	f8		f12		f16		f25		f35	
	Focus	Shooting range (HxV)		Shooting range (HxV)		Shooting range (HxV)		Shooting range (HxV)		Shooting range (HxV)	
		NEAR	FAR	NEAR	FAR	NEAR	FAR	NEAR	FAR	NEAR	FAR
0	WD	100	INF	100	INF	100	INF	100	INF	200	INF
	2/3"	124.6x91.5	-x-	82.7x61.3	-x-	65.6x48.8	-x-	38.8x29.0	-x-	48.5x36.3	-x-
	1/2"	88.6x65.6	-x-	59.4x44.2	-x-	47.3x35.3	-x-	28.1x21.1	-x-	35.2x26.4	-x-
	1/3"	65.6x48.8	-x-	44.2x33.1	-x-	35.3x26.4	-x-	21.1x15.8	-x-	26.4x19.8	-x-
	mag	0.074x	0.000x	0.109x	0.000x	0.137x	0.000x	0.228x	0.000x	0.182x	0.000x
0.5	WD	50	126	69	293	78	486	91	1241	186	2472
	2/3"	68.9x50.6	154.0x113.1	60.4x44.8	224.3x166.3	53.4x39.7	283.6x211.4	35.7x26.7	442.3x331.4	45.0x33.7	617.9x463.8
	1/2"	49.0x36.3	109.5x81.1	43.4x32.3	161.1x120.0	38.5x28.7	204.9x153.1	25.9x19.4	321.3x240.9	32.7x24.5	449.7x337.4
	1/3"	36.3x27.0	81.1x60.4	32.3x24.2	120.0x89.7	28.7x21.5	153.1x114.6	19.4x14.5	240.9x180.6	24.5x18.4	337.4x253.1
	mag	0.135x	0.060x	0.150x	0.040x	0.168x	0.032x	0.248x	0.020x	0.196x	0.014x
1	WD	31	57	52	139	63	234	84	612	174	1236
	2/3"	47.7x35.0	77.1x56.6	47.6x35.3	112.2x83.1	45.1x33.5	142.0x105.8	33.0x24.7	221.3x165.7	41.9x31.4	309.1x231.9
	1/2"	33.9x25.1	54.8x40.5	34.2x25.5	80.6x60.0	32.4x24.2	102.5x76.6	23.9x17.9	160.7x120.4	30.5x22.8	224.9x168.7
	1/3"	25.1x18.7	40.5x30.2	25.5x19.0	60.0x44.8	24.2x18.1	76.6x57.3	17.9x13.4	120.4x90.3	22.8x17.1	168.7x126.5
	mag	0.195x	0.120x	0.190x	0.081x	0.200x	0.063x	0.268x	0.040x	0.210x	0.028x
1.5	WD	21	34	41	88	53	150	77	403	163	824
	2/3"	36.5x26.7	51.4x37.7	39.3x29.1	74.8x55.4	39.0x28.9	94.8x70.6	30.8x23.0	147.6x110.5	39.3x29.4	206.1x154.6
	1/2"	25.9x19.1	36.5x27.0	28.2x21.0	53.7x40.0	28.0x20.9	68.4x51.1	22.3x16.7	107.2x80.3	28.5x21.4	150.0x112.5
	1/3"	19.1x14.3	27.0x20.1	21.0x15.7	40.0x29.9	20.9x15.6	51.1x38.2	16.7x12.5	80.3x60.2	21.4x16.0	112.5x84.4
	mag	0.255x	0.181x	0.230x	0.121x	0.231x	0.095x	0.288x	0.060x	0.224x	0.043x
2	WD	15	22	32	62	44	108	72	298	154	618
	2/3"	29.5x21.6	38.6x28.3	33.4x24.8	56.1x41.6	34.3x25.5	71.2x53.0	28.8x21.5	110.7x82.9	36.9x27.7	154.6x116.0
	1/2"	20.9x15.5	27.4x20.3	24.0x17.9	40.3x30.0	24.7x18.4	51.3x38.3	20.9x15.6	80.4x60.2	26.8x20.1	112.5x84.4
	1/3"	15.5x11.5	20.3x15.1	17.9x13.4	30.0x22.4	18.4x13.8	38.3x28.7	15.6x11.7	60.2x45.2	20.1x15.1	84.4x63.3
	mag	0.315x	0.241x	0.271x	0.161x	0.263x	0.126x	0.308x	0.080x	0.239x	0.057x
5	WD	1	2	11	16	19	32	49	110	115	247
	2/3"	13.8x10.1	15.5x11.3	17.7x13.1	22.5x16.6	20.1x14.9	28.7x21.3	20.8x15.5	44.4x33.2	27.2x20.4	61.9x46.4
	1/2"	9.8x7.2	11.0x8.1	12.7x9.4	16.1x12.0	14.4x10.7	20.6x15.4	15.0x11.2	32.2x24.1	19.8x14.8	45.0x33.8
	1/3"	7.2x5.4	8.1x6.0	9.4x7.1	12.0x9.0	10.7x8.0	15.4x11.5	11.2x8.4	24.1x18.1	14.8x11.1	33.8x25.3
	mag	0.677x	0.602x	0.513x	0.403x	0.452x	0.315x	0.428x	0.199x	0.324x	0.142x
10	WD					5	7	30	47	82	124
	2/3"					12.0x8.8	14.5x10.7	14.2x10.6	22.3x16.6	18.9x14.2	31.0x23.2
	1/2"					8.5x6.3	10.4x7.7	10.3x7.7	16.1x12.1	13.7x10.3	22.5x16.9
	1/3"					6.3x4.7	7.7x5.8	7.7x5.7	12.1x9.0	10.3x7.7	16.9x12.7
	mag					0.767x	0.630x	0.627x	0.399x	0.466x	0.284x
15	WD							21	26	64	82
	2/3"							10.8x8.0	14.9x11.1	14.5x10.9	20.7x15.5
	1/2"							7.8x5.8	10.8x8.0	10.5x7.9	15.0x11.3
	1/3"							5.8x4.4	8.0x6.0	7.9x5.9	11.3x8.4
	mag							0.827x	0.598x	0.608x	0.427x
20	WD							15	15	53	62
	2/3"							8.7x6.5	11.2x8.3	11.8x8.8	15.5x11.6
	1/2"							6.3x4.7	8.1x6.0	8.5x6.4	11.3x8.4
	1/3"							4.7x3.5	6.0x4.5	6.4x4.8	8.4x6.3
	mag							1.026x	0.798x	0.751x	0.569x
25	WD							11	9	46	49
	2/3"							7.3x5.4	8.9x6.7	9.9x7.4	12.4x9.3
	1/2"							5.3x3.9	6.5x4.8	7.2x5.4	9.0x6.8
	1/3"							3.9x2.9	4.8x3.6	5.4x4.0	6.8x5.1
	mag							1.226x	0.997x	0.893x	0.711x
30	WD							8	5	41	41
	2/3"							6.3x4.7	7.5x5.6	8.5x6.4	10.3x7.7
	1/2"							4.5x3.4	5.4x4.0	6.2x4.6	7.5x5.6
	1/3"							3.4x2.5	4.0x3.0	4.6x3.5	5.6x4.2
	mag							1.425x	1.197x	1.035x	0.853x
35	WD									37	35
	2/3"									7.5x5.6	8.9x6.6
	1/2"									5.4x4.1	6.4x4.8
	1/3"									4.1x3.1	4.8x3.6
	mag									1.177x	0.996x
40	WD									33	31
	2/3"									6.7x5.0	7.8x5.8
	1/2"									4.9x3.6	5.6x4.2
	1/3"									3.6x2.7	4.2x3.2
	mag									1.320x	1.138x
45	WD									31	27
	2/3"									6.0x4.5	6.9x5.2
	1/2"									4.4x3.3	5.0x3.8
	1/3"									3.3x2.5	3.8x2.8
	mag									1.462x	1.280x
50	WD									29	25
	2/3"									5.5x4.1	6.2x4.6
	1/2"									4.0x3.0	4.5x3.4
	1/3"									3.0x2.2	3.4x2.5
	mag									1.604x	1.422x
70	WD									23	18
	2/3"									4.1x3.0	4.4x3.3
	1/2"									2.9x2.2	3.2x2.4
	1/3"									2.2x1.7	2.4x1.8
	mag									2.173x	1.991x

HF-HA series

Extension tube [mm]	Product name	DF6HA-1B		HF9HA-1B		HF12.5HA		HF16HA-1B		HF25HA-1B		HF35HA-1B		HF50HA-1B		HF75HA-1B	
	Focal Length	f6		f9		f12.5		f16		f25		f35		f50		f75	
	Focus	Shooting range (HxV)		Shooting range (HxV)		Shooting range (HxV)		Shooting range (HxV)		Shooting range (HxV)		Shooting range (HxV)		Shooting range (HxV)		Shooting range (HxV)	
		NEAR	FAR	NEAR	FAR	NEAR	FAR	NEAR	FAR	NEAR	FAR	NEAR	FAR	NEAR	FAR	NEAR	FAR
0	WD	100	INF	100	INF	100	INF	100	INF	150	INF	250	INF	500	INF	1100	INF
	2/3"	-	-	114.4x83.6	-x-	81.5x59.8	-x-	63.8x47.2	-x-	53.6x40.0	-x-	59.3x44.4	-x-	77.6x58.2	-x-	113.5x85.3	-x-
	1/2"	126.0x92.3	-x-	80.9x59.8	-x-	57.9x43.0	-x-	45.7x34.1	-x-	38.8x29.0	-x-	43.1x32.3	-x-	56.4x42.3	-x-	82.7x62.1	-x-
	1/3"	92.3x68.2	-x-	59.8x44.5	-x-	43.0x32.0	-x-	34.1x25.5	-x-	29.0x21.7	-x-	32.3x24.2	-x-	42.3x31.8	-x-	62.1x46.6	-x-
	mag	0.054x	0.000x	0.082x	0.000x	0.113x	0.000x	0.142x	0.000x	0.166x	0.000x	0.149x	0.000x	0.113x	0.000x	0.077x	0.000x
0.5	WD	31	61	55	157	71	318	80	528	134	1327	229	2464	464	4977	1023	11380
	2/3"	-	-	69.1x50.4	172.1x126.0	60.8x44.6	237.1x174.4	52.6x38.9	297.4x220.8	48.0x35.8	456.6x341.7	54.1x40.5	614.8x461.4	71.3x53.5	870.7x653.5	104.5x78.5	1310.6x986.0
	1/2"	50.9x37.0	83.9x61.2	48.7x36.0	121.9x90.2	43.2x32.0	168.8x125.3	37.7x28.1	214.0x159.5	34.7x26.0	331.3x248.1	39.3x29.5	447.5x335.7	51.8x38.9	633.7x475.5	76.2x57.2	956.3x718.5
	1/3"	37.0x27.3	61.2x45.2	36.0x26.8	90.2x67.1	32.0x23.9	125.3x93.4	28.1x21.0	159.5x119.3	26.0x19.5	248.1x186.0	29.5x22.1	335.7x251.9	38.9x29.2	475.5x356.7	57.2x42.9	718.5x539.4
	mag	0.135x	0.081x	0.136x	0.054x	0.152x	0.039x	0.172x	0.030x	0.185x	0.019x	0.163x	0.014x	0.123x	0.010x	0.084x	0.007x
1	WD	14	24	36	72	54	152	65	256	121	660	212	1239	434	2520	957	5754
	2/3"	-	-	49.6x36.1	86.5x63.1	48.5x35.5	118.7x87.3	44.8x33.1	149.0x110.5	43.5x32.4	228.5x170.9	49.7x37.3	307.6x230.8	65.9x49.4	435.5x326.8	96.8x72.8	655.5x493.1
	1/2"	32.2x23.2	42.5x30.8	34.9x25.8	61.1x45.2	34.4x25.5	84.5x62.7	32.1x23.9	107.1x79.8	31.4x23.5	165.7x124.1	36.1x27.1	223.8x167.9	47.9x35.9	316.9x237.8	70.6x53.0	478.2x359.3
	1/3"	23.2x17.1	30.8x22.7	25.8x19.2	45.2x33.6	25.5x19.0	62.7x46.7	23.9x17.8	79.8x59.6	23.5x17.6	124.1x93.0	27.1x20.3	167.9x125.9	35.9x27.0	237.8x178.4	53.0x39.8	359.3x269.7
	mag	0.216x	0.163x	0.190x	0.108x	0.191x	0.078x	0.203x	0.061x	0.205x	0.039x	0.177x	0.029x	0.134x	0.020x	0.090x	0.013x
1.5	WD	6	11	25	44	42	97	55	165	110	438	197	831	408	1701	900	3879
	2/3"	-	-	38.8x28.1	57.9x42.2	40.3x29.5	79.3x58.2	39.0x28.8	99.5x73.7	39.7x29.6	152.5x114.0	46.0x34.5	205.1x153.9	61.3x45.9	290.4x217.9	90.2x67.8	437.1x328.8
	1/2"	23.7x17.0	28.7x20.7	27.2x20.1	40.8x30.1	28.6x21.2	56.4x41.8	27.9x20.8	71.4x53.2	28.7x21.5	110.5x82.8	33.5x25.1	149.2x111.9	44.6x33.4	211.3x158.5	65.7x49.3	318.9x239.5
	1/3"	17.0x12.4	20.7x15.2	20.1x14.9	30.1x22.4	21.2x15.8	41.8x31.2	20.8x15.5	53.2x39.8	21.5x16.1	82.8x62.0	25.1x18.8	111.9x84.0	33.4x25.1	158.5x118.9	49.3x37.0	239.5x179.8
	mag	0.298x	0.244x	0.244x	0.163x	0.230x	0.116x	0.233x	0.091x	0.224x	0.058x	0.191x	0.043x	0.144x	0.030x	0.097x	0.020x
2	WD	2	5	18	30	34	69	47	120	101	327	185	627	385	1291	850	2941
	2/3"	-	-	31.8x23.1	43.6x31.7	34.5x25.3	59.5x43.7	34.5x25.5	74.7x55.3	36.6x27.3	114.4x85.5	42.8x32.1	153.9x115.4	57.2x42.9	217.8x163.4	84.4x63.4	328.0x246.6
	1/2"	18.8x13.4	21.8x15.6	22.3x16.4	30.7x22.6	24.5x18.1	42.3x31.4	24.7x18.4	53.6x39.9	26.4x19.8	82.9x62.1	31.1x23.3	111.9x84.0	41.6x31.2	158.5x118.9	61.5x46.2	239.2x179.7
	1/3"	13.4x9.8	15.6x11.4	16.4x12.2	22.6x16.8	18.1x13.5	31.4x23.4	18.4x13.7	39.9x29.8	19.8x14.8	62.1x46.5	23.3x17.5	84.0x63.0	31.2x23.4	118.9x89.2	46.2x34.7	179.7x134.9
	mag	0.379x	0.325x	0.299x	0.217x	0.268x	0.155x	0.263x	0.121x	0.243x	0.077x	0.206x	0.057x	0.154x	0.040x	0.104x	0.027x
5	WD			2	4	12	19	21	38	66	128	135	259	294	554	649	1253
	2/3"			15.4x11.1	17.7x12.8	18.5x13.5	23.9x17.5	20.4x15.1	30.0x22.2	24.8x18.5	45.9x34.3	30.3x22.7	61.7x46.2	41.1x30.8	87.2x65.4	61.0x45.8	131.4x98.7
	1/2"			10.7x7.9	12.3x9.1	13.1x9.7	16.9x12.6	14.6x10.9	21.5x16.0	17.9x13.4	33.2x24.9	22.0x16.5	44.8x33.6	29.9x22.4	63.4x47.6	44.4x33.3	95.8x71.9
	1/3"			7.9x5.9	9.1x6.7	9.7x7.2	12.6x9.4	10.9x8.1	16.0x11.9	13.4x10.0	24.9x18.6	16.5x12.4	33.6x25.2	22.4x16.8	47.6x35.7	33.3x25.0	71.9x54.0
	mag			0.624x	0.542x	0.501x	0.388x	0.445x	0.303x	0.360x	0.194x	0.291x	0.143x	0.214x	0.101x	0.144x	0.067x
10	WD							6	11	41	61	95	137	220	308	484	690
	2/3"							12.2x9.0	15.0x11.1	16.1x12.0	23.0x17.2	20.3x15.2	30.9x23.1	27.9x21.0	43.6x32.7	41.7x31.3	65.8x49.4
	1/2"							8.7x6.5	10.7x8.0	11.6x8.7	16.6x12.4	14.8x11.1	22.4x16.8	20.3x15.2	31.7x23.8	30.4x22.8	47.9x36.0
	1/3"							6.5x4.8	8.0x6.0	8.7x6.5	12.4x9.3	11.1x8.3	16.8x12.6	15.2x11.4	23.8x17.8	22.8x17.1	36.0x27.0
	mag							0.748x	0.606x	0.553x	0.387x	0.434x	0.286x	0.315x	0.202x	0.210x	0.133x
15	WD									29	39	75	96	182	226	398	503
	2/3"									11.9x8.9	15.3x11.4	15.3x11.4	20.6x15.4	21.2x15.9	29.1x21.8	31.7x23.8	43.9x33.0
	1/2"									8.6x6.4	11.1x8.3	11.1x8.3	15.0x11.2	15.4x11.5	21.2x15.9	23.1x17.3	32.0x24.0
	1/3"									6.4x4.8	8.3x6.2	8.3x6.2	11.2x8.4	11.5x8.7	15.9x11.9	17.3x13.0	24.0x18.0
	mag									0.747x	0.581x	0.577x	0.429x	0.416x	0.303x	0.277x	0.200x
20	WD									22	28	63	76	159	185	346	409
	2/3"									9.5x7.1	11.5x8.6	12.2x9.2	15.4x11.6	17.0x12.8	21.8x16.4	25.6x19.2	32.9x24.7
	1/2"									6.8x5.1	8.3x6.2	8.9x6.7	11.2x8.4	12.4x9.3	15.9x11.9	18.6x14.0	24.0x18.0
	1/3"									5.1x3.8	6.2x4.7	6.7x5.0	8.4x6.3	9.3x7.0	11.9x8.9	14.0x10.5	18.0x13.5
	mag									0.941x	0.775x	0.720x	0.572x	0.517x	0.403x	0.344x	0.267x
25	WD									17	21	55	63	143	161	311	353
	2/3"									7.8x5.9	9.2x6.9	10.2x7.7	12.3x9.3	14.3x10.7	17.5x13.1	21.4x16.1	26.4x19.8
	1/2"									5.7x4.2	6.6x5.0	7.4x5.6	9.0x6.7	10.4x7.8	12.7x9.5	15.6x11.7	19.2x14.4
	1/3"									4.2x3.2	5.0x3.7	5.6x4.2	6.7x5.0	7.8x5.8	9.5x7.1	11.7x8.8	14.4x10.8
	mag									1.135x	0.969x	0.863x	0.714x	0.618x	0.504x	0.410x	0.333x
30	WD									14	17	49	55	132	144	285	315
	2/3"									6.7x5.0	7.6x5.7	8.8x6.6	10.3x7.7	12.3x9.2	14.5x10.9	18.4x13.8	22.0x16.5
	1/2"									4.8x3.6	5.5x4.1	6.4x4.8	7.5x5.6	8.9x6.7	10.6x7.9	13.4x10.1	16.0x12.0
	1/3"									3.6x2.7	4.1x3.1	4.8x3.6	5.6x4.2	6.7x5.0	7.9x5.9	10.1x7.5	12.0x9.0
	mag									1.328x	1.162x	1.006x	0.857x	0.719x	0.605x	0.477x	0.400x
35	WD									11	13	45	49	123	133	266	289
	2/3"									5.8x4.4	6.6x4.9	7.7x5.8	8.8x6.6	10.7x8.1	12.5x9.3	16.2x12.1	18.8x14.1
	1/2"									4.2x3.2	4.7x3.5	5.6x4.2	6.4x4.8	7.8x5.9	9.1x6.8	11.8x8.8	13.7x10.3
	1/3"									3.2x2.4	3.5x2.7	4.2x3.1	4.8x3.6	5.9x4.4	6.8x5.1	8.8x6.6	10.3x7.7
	mag									1.522x	1.356x	1.149x	1.000x	0.819x	0.706x	0.544x	0.467x
40	WD									10	11	42	45	117	124	251	268
	2/3"									5.2x3.9	5.7x4.3	6.8x5.1	7.7x5.8	9.6x7.2	10.9x8.2	14.4x10.8	16.5x12.4
	1/2"									3.7x2.8	4.1x3.1	5.0x3.7	5.6x4.2	7.0x5.2	7.9x5.9	10.5x7.9	12.0x9.0
	1/3"									2.8x2.1	3.1x2.3	3.7x2.8	4.2x3.2	5.2x3.9	5.9x4.5	7.9x5.9	9.0x6.7
	mag									1.716x	1.550x	1.292x	1.143x	0.920x	0.807x	0.610x	0.533x
45	WD											39	42	111	117	239	253
	2/3"											6.1x4.6	6.9x5.1	8.6x6.5	9.7x7.3	13.0x9.7	14.7x11.0
	1/2"											4.5x3.3	5.0x3.7	6.3x4.7	7.1x5.3	9.4x7.1	10.7x8.0
	1/3"											3.3x2.5	3.7x2.8	4.7x3.5	5.3x4.0	7.1x5.3	8.0x6.0
	mag											1.435x	1.286x	1.021x	0.908x	0.677x	0.600x
50	WD											37	39	107	112	229	240
	2/3"											5.6x4.2	6.2x4.6	7.8x5.9	8.7x6.5	11.8x8.9	13.2x9.9
	1/2"											4.1x3.0	4.5x3.4	5.7x4.3	6.3x4.8	8.6x6.5	9.6x7.2
	1/3"											3.0x2.3	3.4x2.5	4.3x3.2	4.8x3.6	6.5x4.8	7.2x5.4
	mag											1.577x	1.429x	1.122x	1.009x	0.744x	0.667x
70	WD											31	32	95	98	202	208
	2/3"											4.1x3.1	4.4x3.3	5.8x4.3	6.2x4.7	8.7x6.5	9.4x7.1
	1/2"											3.0x2.2	3.2x2.4	4.2x3.1	4.5x3.4	6.3x4.8	6.9x5.1
	1/3"											2.2x1.7	2.4x1.8	3.1x2.4	3.4x2.5	4.8x3.6	5.1x3.9
	mag											2.149x	2.000x	1.526x	1.412x	1.010x	0.933x

■SAMPLE

[mm]

Extension tube [mm]	Product name	HF9HA-1B	
	Focal Length	f9	
	Focus	Shooting range (HxV)	
		NEAR	FAR
5	WD※	2	4
	2/3"	15.4x11.1	17.7x12.8
	1/2"	10.7x7.9	12.3x9.1
	1/3"	7.9x5.9	9.1x6.7
	mag	0.624x	0.542x

※Working distance

←Lens magnification

↑ Sensor size

■Sensor size

1""	12.8x9.6
2/3"	8.8x6.6
1/2"	6.4x4.8
1/3"	4.8x3.6

■HF-SA series

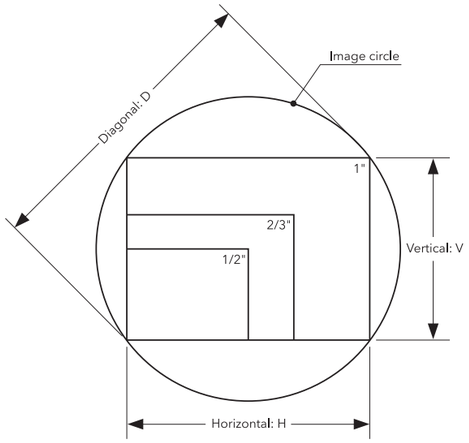
Extension tube [mm]	Product name	HF12.5SA-1		HF16SA-1		HF25SA-1		HF35SA-1		HF50SA-1		HF75SA-1	
	Focal Length	f12.5		f16		f25		f35		f50		f75	
	Focus	Shooting range (HxV)		Shooting range (HxV)		Shooting range (HxV)		Shooting range (HxV)		Shooting range (HxV)		Shooting range (HxV)	
		NEAR	FAR	NEAR	FAR	NEAR	FAR	NEAR	FAR	NEAR	FAR	NEAR	FAR
0	WD	100	INF	100	INF	100	INF	200	INF	400	INF	900	INF
	2/3"	82.8x61.7	-x-	68.9x51.4	-x-	47.5x35.4	-x-	52.3x39.2	-x-	68.5x51.3	-x-	101.7x76.3	-x-
	1/2"	59.8x44.7	-x-	49.8x37.3	-x-	34.3x25.7	-x-	38.0x28.4	-x-	49.8x37.3	-x-	74.0x55.5	-x-
	1/3"	44.7x33.5	-x-	37.3x27.9	-x-	25.7x19.2	-x-	28.4x21.3	-x-	37.3x28.0	-x-	55.5x41.6	-x-
	mag	0.108x	0.000x	0.129x	0.000x	0.187x	0.000x	0.169x	0.000x	0.129x	0.000x	0.087x	0.000x
0.5	WD	68	307	76	503	87	1124	184	2543	372	5347	838	11276
	2/3"	61.3x45.6	227.7x170.3	56.0x41.8	288.2x216.0	42.7x31.9	423.8x317.5	48.3x36.2	628.6x471.6	63.7x47.8	909.2x682.2	94.5x70.8	1319.3x989.6
	1/2"	44.2x33.0	165.1x123.5	40.5x30.2	209.4x156.9	30.9x23.1	307.8x230.7	35.1x26.3	457.3x343.0	46.3x34.7	661.6x496.3	68.7x51.5	959.6x719.7
	1/3"	33.0x24.7	123.5x92.5	30.2x22.6	156.9x117.6	23.1x17.3	230.7x172.9	26.3x19.7	343.0x257.3	34.7x26.0	496.3x372.3	51.5x38.6	719.7x539.8
	mag	0.146x	0.039x	0.159x	0.031x	0.208x	0.021x	0.183x	0.014x	0.138x	0.010x	0.093x	0.007x
1	WD	50	143	59	237	77	548	170	1266	347	2673	784	5655
	2/3"	48.7x36.2	114.2x85.3	47.2x35.2	144.5x108.1	38.9x29.0	212.1x158.8	44.9x33.6	314.5x235.9	59.6x44.6	454.7x341.2	88.2x66.1	659.7x494.8
	1/2"	35.1x26.2	82.7x61.8	34.1x25.5	104.8x78.5	28.1x21.0	154.0x115.4	32.6x24.4	228.7x171.5	43.3x32.4	330.8x248.2	64.1x48.1	479.8x359.9
	1/3"	26.2x19.6	61.8x46.3	25.5x19.1	78.5x58.8	21.0x15.7	115.4x86.5	24.4x18.3	171.5x128.7	32.4x24.3	248.2x186.2	48.1x36.1	359.9x269.9
	mag	0.184x	0.078x	0.189x	0.061x	0.229x	0.042x	0.197x	0.028x	0.148x	0.019x	0.100x	0.013x
1.5	WD	38	88	47	148	68	356	158	840	326	1781	737	3781
	2/3"	40.4x30.0	76.4x57.0	40.9x30.4	96.6x72.2	35.7x26.6	141.5x105.9	41.9x31.4	209.8x157.3	55.9x41.9	303.3x227.5	82.7x62.0	439.8x329.9
	1/2"	29.1x21.7	55.2x41.3	29.5x22.0	70.0x52.4	25.8x19.3	102.7x76.9	30.4x22.8	152.5x114.4	40.6x30.5	220.6x165.5	60.1x45.1	319.9x239.9
	1/3"	21.7x16.2	41.3x30.9	22.0x16.5	52.4x39.2	19.3x14.4	76.9x57.6	22.8x17.1	114.4x85.8	30.5x22.8	165.5x124.1	45.1x33.8	239.9x179.9
	mag	0.223x	0.117x	0.220x	0.092x	0.250x	0.063x	0.211x	0.042x	0.158x	0.029x	0.107x	0.020x
2	WD	29	60	38	103	61	260	147	627	307	1335	696	2844
	2/3"	34.6x25.7	57.5x42.8	36.0x26.8	72.6x54.2	33.0x24.6	106.3x79.5	39.3x29.4	157.4x118.0	52.7x39.5	227.5x170.6	77.8x58.3	329.9x247.4
	1/2"	24.9x18.5	41.5x31.0	25.9x19.4	52.6x39.3	23.8x17.8	77.1x57.7	28.5x21.4	114.4x85.8	38.3x28.7	165.5x124.1	56.6x42.4	239.9x179.9
	1/3"	18.5x13.9	31.0x23.2	19.4x14.5	39.3x29.4	17.8x13.3	57.7x43.2	21.4x16.0	85.8x64.3	28.7x21.5	124.1x93.1	42.4x31.8	179.9x135.0
	mag	0.261x	0.156x	0.250x	0.122x	0.271x	0.083x	0.225x	0.056x	0.167x	0.039x	0.113x	0.027x
5	WD			10	23	33	87	104	244	228	533	523	1158
	2/3"			21.1x15.6	29.5x21.9	22.6x16.8	42.7x31.9	28.7x21.4	63.1x47.3	39.2x29.3	91.1x68.3	57.5x43.1	132.0x99.0
	1/2"			15.1x11.3	21.2x15.8	16.3x12.2	30.9x23.1	20.8x15.6	45.8x34.3	28.4x21.3	66.2x49.7	41.8x31.3	96.0x72.0
	1/3"			11.3x8.4	15.8x11.8	12.2x9.1	23.1x17.3	15.6x11.7	34.3x25.7	21.3x16.0	49.7x37.2	31.3x23.5	72.0x54.0
	mag			0.430x	0.306x	0.396x	0.208x	0.309x	0.140x	0.225x	0.097x	0.153x	0.067x
10	WD					12	30	68	116	159	266	374	596
	2/3"					14.9x11.1	21.5x16.0	19.7x14.8	31.6x23.7	27.4x20.5	45.6x34.2	40.1x30.0	66.0x49.5
	1/2"					10.7x8.0	15.5x11.6	14.3x10.7	22.9x17.2	19.9x14.9	33.1x24.8	29.1x21.8	48.0x36.0
	1/3"					8.0x6.0	11.6x8.7	10.7x8.0	17.2x12.9	14.9x11.2	24.8x18.6	21.8x16.4	36.0x27.0
	mag					0.604x	0.417x	0.449x	0.280x	0.322x	0.193x	0.220x	0.133x
15	WD							49	74	122	176	295	408
	2/3"							15.0x11.3	21.1x15.8	21.1x15.8	30.4x22.8	30.7x23.0	44.0x33.0
	1/2"							10.9x8.2	15.3x11.5	15.3x11.5	22.1x16.6	22.3x16.8	32.0x24.0
	1/3"							8.2x6.1	11.5x8.6	11.5x8.6	16.6x12.4	16.8x12.6	24.0x18.0
	mag							0.589x	0.420x	0.419x	0.290x	0.287x	0.200x
20	WD							38	52	98	132	246	315
	2/3"							12.2x9.1	15.8x11.8	17.1x12.8	22.8x17.1	24.9x18.7	33.0x24.8
	1/2"							8.8x6.6	11.5x8.6	12.4x9.3	16.6x12.4	18.1x13.6	24.0x18.0
	1/3"							6.6x4.9	8.6x6.4	9.3x7.0	12.4x9.3	13.6x10.2	18.0x13.5
	mag							0.729x	0.560x	0.515x	0.387x	0.353x	0.267x
25	WD							30	40	83	105	212	258
	2/3"							10.2x7.6	12.7x9.5	14.4x10.8	18.3x13.7	21.0x15.7	26.4x19.8
	1/2"							7.4x5.5	9.2x6.9	10.5x7.9	13.3x9.9	15.2x11.4	19.2x14.4
	1/3"							5.5x4.1	6.9x5.2	7.9x5.9	9.9x7.5	11.4x8.6	14.4x10.8
	mag							0.869x	0.700x	0.612x	0.483x	0.420x	0.333x
30	WD							24	31	71	87	188	221
	2/3"							8.8x6.6	10.5x7.9	12.5x9.3	15.2x11.4	18.1x13.6	22.0x16.5
	1/2"							6.4x4.8	7.6x5.7	9.0x6.8	11.1x8.3	13.2x9.9	16.0x12.0
	1/3"							4.8x3.6	5.7x4.3	6.8x5.1	8.3x6.2	9.9x7.4	12.0x9.0
	mag							1.008x	0.839x	0.709x	0.580x	0.487x	0.400x
35	WD							20	25	62	75	169	194
	2/3"							7.7x5.8	9.0x6.8	11.0x8.2	13.1x9.8	15.9x11.9	18.9x14.1
	1/2"							5.6x4.2	6.6x4.9	8.0x6.0	9.5x7.1	11.6x8.7	13.7x10.3
	1/3"							4.2x3.1	4.9x3.7	6.0x4.5	7.1x5.3	8.7x6.5	10.3x7.7
	mag							1.148x	0.979x	0.805x	0.677x	0.553x	0.467x
40	WD							16	20	55	65	154	174
	2/3"							6.9x5.1	7.9x5.9	9.8x7.3	11.4x8.6	14.2x10.7	16.5x12.4
	1/2"							5.0x3.7	5.7x4.3	7.1x5.3	8.3x6.2	10.3x7.7	12.0x9.0
	1/3"							3.7x2.8	4.3x3.2	5.3x4.0	6.2x4.7	7.7x5.8	9.0x6.7
	mag							1.288x	1.119x	0.902x	0.773x	0.620x	0.534x
45	WD							13	17	50	58	143	158
	2/3"							6.2x4.6	7.0x5.3	8.8x6.6	10.1x7.6	12.8x9.6	14.7x11.0
	1/2"							4.5x3.4	5.1x3.8	6.4x4.8	7.4x5.5	9.3x7.0	10.7x8.0
	1/3"							3.4x2.5	3.8x2.9	4.8x3.6	5.5x4.1	7.0x5.2	8.0x6.0
	mag							1.428x	1.259x	0.999x	0.870x	0.687x	0.600x
50	WD							11	14	45	52	133	146
	2/3"							5.6x4.2	6.3x4.7	8.1x6.0	9.1x6.8	11.7x8.8	13.2x9.9
	1/2"							4.1x3.1	4.6x3.4	5.9x4.4	6.6x5.0	8.5x6.4	9.6x7.2
	1/3"							3.1x2.3	3.4x2.6	4.4x3.3	5.0x3.7	6.4x4.8	7.2x5.4
	mag							1.568x	1.399x	1.096x	0.967x	0.753x	0.667x
70	WD									33	36	107	114
	2/3"									6.0x4.5	6.5x4.9	8.6x6.5	9.4x7.1
	1/2"									4.3x3.2	4.7x3.5	6.3x4.7	6.9x5.1
	1/3"									3.2x2.4	3.5x2.7	4.7x3.5	5.1x3.9
	mag									1.482x	1.354x	1.020x	0.934x

■CF-HA series

Extension tube [mm]	Product name	CF12.5HA-1		CF16HA-1		CF25HA-1		CF35HA-1		CF50HA-1		CF75HA-1	
	Focal Length	f12.5		f16		f25		f35		f50		f75	
	Focus	Shooting range (HxV)		Shooting range (HxV)		Shooting range (HxV)		Shooting range (HxV)		Shooting range (HxV)		Shooting range (HxV)	
		NEAR	FAR	NEAR	FAR	NEAR	FAR	NEAR	FAR	NEAR	FAR	NEAR	FAR
0	WD	100	INF	100	INF	100	INF	200	INF	400	INF	900	INF
	1"	121.9x90.6	-x-	101.4x75.3	-x-	69.8x51.9	-x-	76.5x57.1	-x-	99.8x74.8	-x-	148.1x111.0	-x-
	2/3"	82.8x61.7	-x-	68.9x51.4	-x-	47.5x35.4	-x-	52.3x39.2	-x-	68.5x51.3	-x-	101.7x76.3	-x-
	1/2"	59.8x44.7	-x-	49.8x37.3	-x-	34.3x25.7	-x-	38.0x28.4	-x-	49.8x37.3	-x-	74.0x55.5	-x-
	mag	0.108x	0.000x	0.129x	0.000x	0.187x	0.000x	0.169x	0.000x	0.129x	0.000x	0.087x	0.000x
0.5	WD	68	307	76	503	87	1124	184	2543	372	5347	838	11276
	1"	90.6x67.1	331.9x248.7	82.7x61.3	418.7x314.4	62.9x46.7	617.0x462.5	70.7x52.8	913.7x685.7	92.9x69.5	1320.6x991.6	137.5x103.1	1918.8x1439.2
	2/3"	61.3x45.6	227.7x170.3	56.0x41.8	288.2x216.0	42.7x31.9	423.8x317.5	48.3x36.2	628.6x471.6	63.7x47.8	909.2x682.2	94.5x70.8	1319.3x989.6
	1/2"	44.2x33.0	165.1x123.5	40.5x30.2	209.4x156.9	30.9x23.1	307.8x230.7	35.1x26.3	457.3x343.0	46.3x34.7	661.6x496.3	68.7x51.5	959.6x719.7
	mag	0.146x	0.039x	0.159x	0.031x	0.208x	0.021x	0.183x	0.014x	0.138x	0.010x	0.093x	0.007x
1	WD	50	143	59	237	77	548	170	1266	347	2673	784	5655
	1"	72.3x53.3	167.3x124.8	70.0x51.7	210.7x157.7	57.3x42.5	309.2x231.5	65.7x49.0	457.5x343.1	86.9x65.0	660.8x496.0	128.3x96.2	959.5x719.7
	2/3"	48.7x36.2	114.2x85.3	47.2x35.2	144.5x108.1	38.9x29.0	212.1x158.8	44.9x33.6	314.5x235.9	59.6x44.6	454.7x341.2	88.2x66.1	659.7x494.8
	1/2"	35.1x26.2	82.7x61.8	34.1x25.5	104.8x78.5	28.1x21.0	154.0x115.4	32.6x24.4	228.7x171.5	43.3x32.4	330.8x248.2	64.1x48.1	479.8x359.9
	mag	0.184x	0.078x	0.189x	0.061x	0.229x	0.042x	0.197x	0.028x	0.148x	0.019x	0.100x	0.013x
1.5	WD	38	88	47	148	68	356	158	840	326	1781	737	3781
	1"	60.2x44.3	112.4x83.5	60.7x44.7	141.4x105.5	52.6x39.0	206.6x154.5	61.3x45.8	305.4x228.9	81.6x61.0	440.8x330.8	120.3x90.2	639.8x479.8
	2/3"	40.4x30.0	76.4x57.0	40.9x30.4	96.6x72.2	35.7x26.6	141.5x105.9	41.9x31.4	209.8x157.3	55.9x41.9	303.3x227.5	82.7x62.0	439.8x329.9
	1/2"	29.1x21.7	55.2x41.3	29.5x22.0	70.0x52.4	25.8x19.3	102.7x76.9	30.4x22.8	152.5x114.4	40.6x30.5	220.6x165.5	60.1x45.1	319.9x239.9
	mag	0.223x	0.117x	0.220x	0.092x	0.250x	0.063x	0.211x	0.042x	0.158x	0.029x	0.107x	0.020x
2	WD	29	60	38	103	61	260	147	627	307	1335	696	2844
	1"	51.7x37.9	85.0x62.9	53.6x39.4	106.7x79.4	48.7x36.0	155.3x116.0	57.6x42.9	229.3x171.8	76.9x57.5	330.8x248.2	113.2x84.9	479.9x359.9
	2/3"	34.6x25.7	57.5x42.8	36.0x26.8	72.6x54.2	33.0x24.6	106.3x79.5	39.3x29.4	157.4x118.0	52.7x39.5	227.5x170.6	77.8x58.3	329.9x247.4
	1/2"	24.9x18.5	41.5x31.0	25.9x19.4	52.6x39.3	23.8x17.8	77.1x57.7	28.5x21.4	114.4x85.8	38.3x28.7	165.5x124.1	56.6x42.4	239.9x179.9
	mag	0.261x	0.156x	0.250x	0.122x	0.271x	0.083x	0.225x	0.056x	0.167x	0.039x	0.113x	0.027x
5	WD			10	23	33	87	104	244	228	533	523	1158
	1"			31.9x23.2	44.2x32.3	33.6x24.8	62.9x46.7	42.0x31.3	92.2x68.9	57.2x42.7	132.7x99.4	83.7x62.7	192.1x144.0
	2/3"			21.1x15.6	29.5x21.9	22.6x16.8	42.7x31.9	28.7x21.4	63.1x47.3	39.2x29.3	91.1x68.3	57.5x43.1	132.0x99.0
	1/2"			15.1x11.3	21.2x15.8	16.3x12.2	30.9x23.1	20.8x15.6	45.8x34.3	28.4x21.3	66.2x49.7	41.8x31.3	96.0x72.0
	mag			0.430x	0.306x	0.396x	0.208x	0.309x	0.140x	0.225x	0.097x	0.153x	0.067x
10	WD					12	30	68	116	159	266	374	596
	1"					22.3x16.3	32.0x23.6	28.9x21.6	46.3x34.5	40.1x29.9	66.6x49.8	58.3x43.7	96.1x72.0
	2/3"					14.9x11.1	21.5x16.0	19.7x14.8	31.6x23.7	27.4x20.5	45.6x34.2	40.1x30.0	66.0x49.5
	1/2"					10.7x8.0	15.5x11.6	14.3x10.7	22.9x17.2	19.9x14.9	33.1x24.8	29.1x21.8	48.0x36.0
	mag					0.604x	0.417x	0.449x	0.280x	0.322x	0.193x	0.220x	0.133x
15	WD							49	74	122	176	295	408
	1"							22.1x16.4	30.9x23.0	30.8x23.0	44.5x33.2	44.8x33.5	64.1x48.0
	2/3"							15.0x11.3	21.1x15.8	21.1x15.8	30.4x22.8	30.7x23.0	44.0x33.0
	1/2"							10.9x8.2	15.3x11.5	15.3x11.5	22.1x16.6	22.3x16.8	32.0x24.0
	mag							0.589x	0.420x	0.419x	0.290x	0.287x	0.200x
20	WD							38	52	98	132	246	315
	1"							17.8x13.3	23.2x17.3	25.0x18.7	33.4x24.9	36.3x27.2	48.1x36.0
	2/3"							12.2x9.1	15.8x11.8	17.1x12.8	22.8x17.1	24.9x18.7	33.0x24.8
	1/2"							8.8x6.6	11.5x8.6	12.4x9.3	16.6x12.4	18.1x13.6	24.0x18.0
	mag							0.729x	0.560x	0.515x	0.387x	0.353x	0.267x
25	WD							30	40	83	105	212	258
	1"							14.9x11.1	18.6x13.8	21.1x15.8	26.7x20.0	30.5x22.9	38.5x28.8
	2/3"							10.2x7.6	12.7x9.5	14.4x10.8	18.3x13.7	21.0x15.7	26.4x19.8
	1/2"							7.4x5.5	9.2x6.9	10.5x7.9	13.3x9.9	15.2x11.4	19.2x14.4
	mag							0.869x	0.700x	0.612x	0.483x	0.420x	0.333x
30	WD							24	31	71	87	188	221
	1"							12.8x9.6	15.5x11.5	18.2x13.6	22.3x16.6	26.4x19.7	32.1x24.0
	2/3"							8.8x6.6	10.5x7.9	12.5x9.3	15.2x11.4	18.1x13.6	22.0x16.5
	1/2"							6.4x4.8	7.6x5.7	9.0x6.8	11.1x8.3	13.2x9.9	16.0x12.0
	mag							1.008x	0.839x	0.709x	0.580x	0.487x	0.400x
35	WD							20	25	62	75	169	194
	1"							11.3x8.4	13.2x9.9	16.0x12.0	19.1x14.3	23.2x17.4	27.5x20.6
	2/3"							7.7x5.8	9.0x6.8	11.0x8.2	13.1x9.8	15.9x11.9	18.9x14.1
	1/2"							5.6x4.2	6.6x4.9	8.0x6.0	9.5x7.1	11.6x8.7	13.7x10.3
	mag							1.148x	0.979x	0.805x	0.677x	0.553x	0.467x
40	WD							16	20	55	65	154	174
	1"							10.0x7.5	11.6x8.6	14.3x10.7	16.7x12.5	20.7x15.5	24.0x18.0
	2/3"							6.9x5.1	7.9x5.9	9.8x7.3	11.4x8.6	14.2x10.7	16.5x12.4
	1/2"							5.0x3.7	5.7x4.3	7.1x5.3	8.3x6.2	10.3x7.7	12.0x9.0
	mag							1.288x	1.119x	0.902x	0.773x	0.620x	0.534x
45	WD							13	17	50	58	143	158
	1"							9.1x6.8	10.3x7.7	12.9x9.7	14.8x11.1	18.7x14.0	21.4x16.0
	2/3"							6.2x4.6	7.0x5.3	8.8x6.6	10.1x7.6	12.8x9.6	14.7x11.0
	1/2"							4.5x3.4	5.1x3.8	6.4x4.8	7.4x5.5	9.3x7.0	10.7x8.0
	mag							1.428x	1.259x	0.999x	0.870x	0.687x	0.600x
50	WD							11	14	45	52	133	146
	1"							8.2x6.2	9.2x6.9	11.8x8.8	13.3x10.0	17.0x12.8	19.2x14.4
	2/3"							5.6x4.2	6.3x4.7	8.1x6.0	9.1x6.8	11.7x8.8	13.2x9.9
	1/2"							4.1x3.1	4.6x3.4	5.9x4.4	6.6x5.0	8.5x6.4	9.6x7.2
	mag							1.568x	1.399x	1.096x	0.967x	0.753x	0.667x
70	WD									33	36	107	114
	1"									8.7x6.5	9.5x7.1	12.6x9.4	13.7x10.3
	2/3"									6.0x4.5	6.5x4.9	8.6x6.5	9.4x7.1
	1/2"									4.3x3.2	4.7x3.5	6.3x4.7	6.9x5.1
	mag									1.482x	1.354x	1.020x	0.934x

Technical Information

■Image Sizes

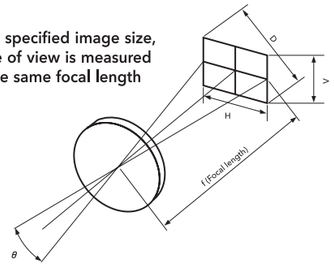


There are several types of imaging sensors for FA cameras, with different image sizes.
The aspect ratio of FA camera is normally 4:3 (H:V).

Product symbol	Image sensor	Image size (mm)		
		Horizontal:H	Vertical:V	Diagonal:D
C	1″	12.8	9.6	16.0
H	2/3″	8.8	6.6	11.0
D	1/2″	6.4	4.8	8.0
35mm camera lens (Reference)	35mm Film	36.0	24.0	43.3

■Angle of View

The angle of view is the object size that can be captured at a specified image size, which is represented by angular measure. Normally the angle of view is measured assuming a lens is focused at infinity. When using a lens of the same focal length with a different image size, the angle of view will differ.



$$\theta = 2\tan^{-1}\frac{Y'}{2f}$$

θ : Angle of view
Y' : Image size
f : Focal length

Eg. The angle of view when the camera size is 1/2" and the focal length is 12.5mm:

Y' : 6.4
f : 12.5

$$\theta = 2\tan^{-1}\frac{6.4}{2\times12.5} = 28.72°$$

■Depth of Field

When focusing on a certain area in front of and behind the deep object appears in focus. This area is called the depth of field. This is because the focus appears sharp if the focus misalignment is under a certain volume. This certain volume is called the permissible circle of confusion.

The depth of field has following properties.
1)The larger the F No. is, the wider the depth of field becomes.
2)The shorter the focal length is, the wider the depth of field becomes.
3)The longer the distance to the object is, the wider depth of field becomes.
4)The backward depth of field is wider than the forward depth of field.

Reference

Image sensor	Permissible circle of confusion
1"	0.03 mm
2/3"	0.021 mm
1/2"	0.015 mm
1/3"	0.011 mm
1/4"	0.008 mm

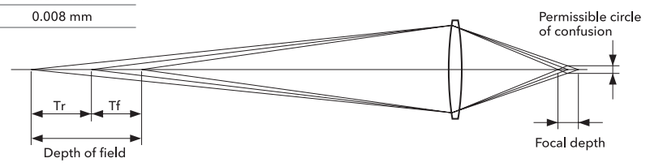
The depth of field can be calculated by the following formula.

Backward depth of field $Tr = \frac{\delta \cdot F \cdot L^2}{f^2 - \delta \cdot F \cdot L}$

Forward depth of field $Tf = \frac{\delta \cdot F \cdot L^2}{f^2 + \delta \cdot F \cdot L}$

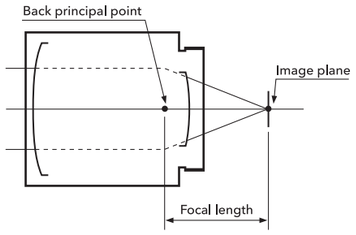
Depth of field $= Tr + Tf$
Focal depth $= 2\delta \cdot F$

f : Focal distance
F : F No.
δ : Permissible circle diameter of confusion
L : Object distance



■Focal Length

The focal length will be the distance from the back principal point to the image plane. Lower the focal length wider the image



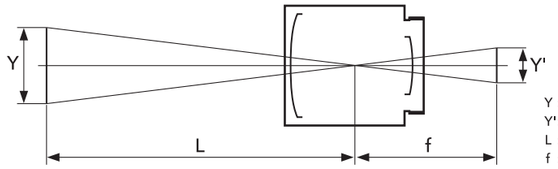
■Brightness of a Lens (F No.)

The F No. is an indication of the brightness of lens. The smaller the value, the brighter the image produced by the lens. The F No. is inversely proportional to the effective diameter of the lens and directly proportional to the focal length.
The F No. is a value determined on the assumption that the transmittance of the lens is 100%. Virtually all lenses however, have different spectral transmittance, and thus, the same F No. can have different levels of brightness.

$$\text{F No.} = \frac{f}{d}$$

f : Focal length of a lens
d : Effective diameter of a lens

■Field of View and Focal Length



Y : Object size
Y': Image size
L : Object distance
f : Focal length

(1) How to calculate the field of view

If the distance to the object is finite, you can use the following formula to calculate the field of view.

$$Y = Y' \cdot \frac{L}{f}$$

Eg.1/3" CCD camera with an 8mm lens is used, and the distance to the object is 3m. The maximum horizontal width as viewed on the monitor can be calculated as follows.

Y' : 4.8
L : 3000
f : 8

$$Y = 4.8 \times \frac{3000}{8} = 1800 \rightarrow \text{Horizontal width 1.8 m}$$

(2) How to calculate focal length

If the distance to the object is finite, you can use the following formula to calculate the focal length.

$$f = Y' \cdot \frac{L}{Y}$$

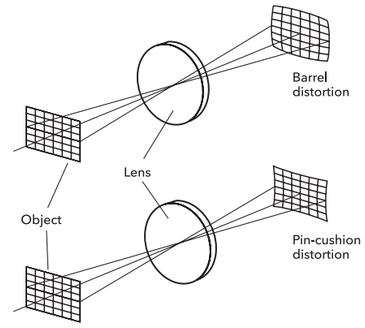
Eg. 1/3" CCD camera with an 8mm lens is used, and the distance to the object is 3m. The maximum horizontal width as viewed on the monitor can be calculated as follows.

Y' : 4.8
L : 3000
Y : 2000

$$f = 4.8 \times \frac{3000}{2000} = 7.2 \rightarrow \text{Focal length approx. 7 mm}$$

■Distortion

Distortion is an aberration where the geometric figure of the object is not reproduced faithfully at the image plane. It is normally represented by the level shift of an image point from its ideal position by a percentage of image height or width.



■MTF (Modulation Transfer Function)

MTF (Modulation Transfer Function) represents the declining contrast rate when shooting a chart consisted of black and white lines.