

Thank you for purchasing the Ortho Extender 2X or 4X. Please read this manual from front to back carefully before using and handling the Ortho Extender 2X or 4X product.

## ⚠ WARNING

**NEVER ATTEMPT TO LOOK AT THE SUN DIRECTLY WITH THE TELESCOPE OR FINDER. DOING SO WILL CAUSE INSTANT BLINDNESS DUE TO THE INTENSE LIGHT AND HEAT OF THE SUN.**



**DO NOT EXPOSE OPTICS TO DIRECT SUNLIGHT. UNEXPECTED CONCENTRATION OF LIGHT MAY CAUSE FIRE. Be sure to “CAP” telescope/s, and optics related accessories when not in use.**

### Features

The Ortho Extender is an amplifying lens that enlarges the image by extending the focal length while maintaining almost the same image quality as the native focal length. If you install it in an optical system such as the TOA series that is well corrected for central aberration, one can obtain an enlarged image with optimal image quality. If used with an optical system that has peripheral coma, the optimized image circle will become narrower but central image quality is still maintained.

The Ortho Extender 2X, with a magnification ratio of two times is suitable for photographing the entire moon and small astronomical objects such as small galaxies and planetary nebulas. The recommended optical system is a telescope with as little aberration as possible and an f/ratio of f/5 or slower.

The Ortho Extender 4X, which has a magnification ratio of four times, is intended to be attached to telescopes with f/ratios from f/8 to f/10, and is used for close-up photography of planets, craters on the moon, etc. Although eyepieces can be used for magnified photography using afocal or projection techniques, they are designed for visual applications. Our Ortho Extenders, which are optically designed primarily for photography, are better corrected in terms of both central and peripheral aberrations. If used with the TOA series, it will be the perfect combination to magnify the TOA image without chromatic aberration.

The rear end of the main body has a  $\varnothing 31.7\text{mm}$  (1.25 inch) sleeve insertion port and an M42 with P0.75 T-ring screw, allowing you to attach a CMOS camera or other camera mount.

### Specifications

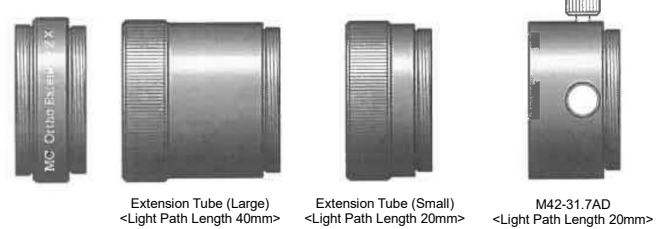
Lens configuration	: 1 group 2 elements (Ortho Extender 2X) : 2 groups 4 elements (Ortho Extender 4X)
Magnification	: 2X (Ortho Extender 2X) : 4X (Ortho Extender 4X)
Image circle	: $\varnothing 20\sim 30\text{mm}$ (Diameter of Optimized Image Circle)
OTA side installation size	: M43 P0.75
End-side installation size	: M42 P0.75/31.7mm (1.25 inch) Sleeve Port
Maximum diameter x total length (excluding protrusions)	: 46mm x 103mm (Ortho Extender 2X) : 46mm x 125mm (Ortho Extender 4X)
Mass	: 190g (Ortho Extender 2X) : 240g (Ortho Extender 4X)

### Description

Both Ortho Extender 2X and Ortho Extender 4X consist of the main body, extension tube (large), extension tube (small), and M42-31.7AD.

✕ Below image is the example of the Ortho Extender 2X

Ortho Extender Main Body



### Magnification Ratio

To connect the Ortho Extender to your Takahashi telescope, first, remove the eyepiece adapter connection ring from the M43 thread of the 50.8 sleeve visual adapter (FS-60CB), visual adapter (CCA-250), etc. Second, thread the Ortho Extender 2X or 4X in to the 50.8 sleeve/visual adapter (FS-60CB), visual adapter (CCA-250), etc.

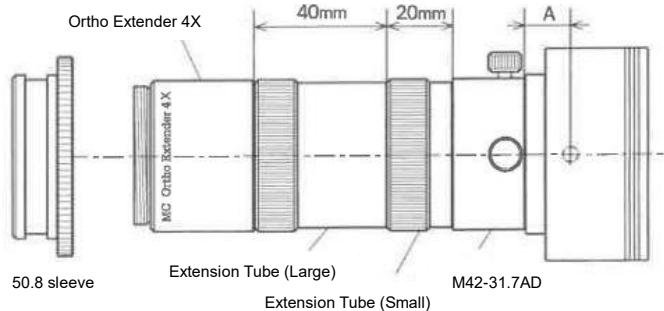
The magnification ratio when using an Ortho Extender is calculated using the following formula:

- Ortho Extender 2X: Magnification =  $1.27 + 0.0126 * b$
  - Ortho Extender 4X: Magnification =  $2.02 + 0.0258 * b$
- b: Back Focus (mm)  
= Extension Tube (large) + Extension Tube (small) + Distance from M42-31.7AD's end-edge without threading area to the imaging plane or principal point of the eyepiece.

[Examples]

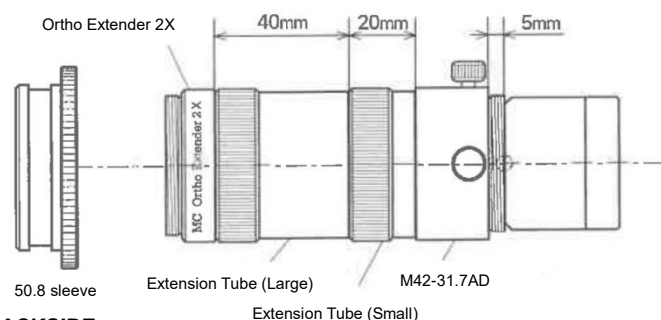
- Connection between Extender 4X and CMOS camera using M42-31.7AD

A is the distance from M42-31.7AD's end-edge without threading area to the camera sensor, and if distance is set to 14mm, then if you connect a CMOS camera with M42-31.7AD, the magnification ratio will be  $2.02 + 0.0258 * (74)$ , approximately 3.93 times.



- Extender 2X with TPL eyepiece attached

The principal point of the TPL eyepiece is at the base of the sleeve, and the back focus is 65mm, so the magnification is  $1.27 + 0.0126 * (65)$ , which is approximately 2.09 times.



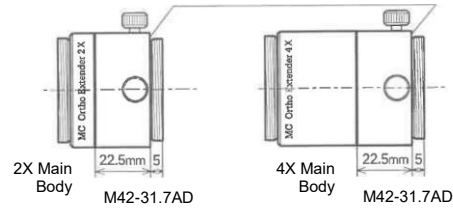
**CONTINUE TO THE BACKSIDE**

**【Recommended Magnification】**

The recommended back focus considering the aberration tolerances of the Ortho Extender is:

- Ortho Extender 2X: 45~92mm  
→ Magnification rate: 1.9~2.49x
- Ortho Extender 4 X: 60~92mm  
→ Magnification rate: 3.7~4.53x

Where b= 0's position, the base point is 22.5mm from the end of the main body towards the focal point.



WARNING: If you connect the M42-31.7AD directly to the Ortho Extender 2X, the sleeve will "HIT" the metal frame if it is longer than 23mm and cannot be inserted.

**Ortho Extender Adaptation Table**

Telescope	Ortho Extender 2X		Ortho Extender 4X	
	Visual	Imaging	Visual	Imaging
FS-60CB	○	∅30mm	○	∅20mm
FS-60Q	◎	∅30mm	◎	∅30mm
FC-76D	◎	∅30mm	◎	∅30mm
FC-100D/FC-100DZ	◎	∅30mm	◎	∅30mm
FSQ-85EDX	○	∅20mm	○	∅20mm
FSQ-85EDX + EXT-ED1.5X	◎	∅30mm	◎	∅30mm
FSQ-106EDX4	○	∅20mm	○	∅20mm
FSQ-106EDX4 + EXQ-1.6X	◎	∅30mm	◎	∅30mm
FOA-60	◎	∅30mm	◎	∅20mm
FOA-60Q	◎	∅30mm	◎	∅30mm
TSA-120	◎	∅20mm	◎	∅20mm
TSA-120 + 35FL	◎	∅30mm	◎	∅30mm
TOA-130	◎	∅20mm	◎	∅20mm
TOA-130 + 35FL	◎	∅30mm	◎	∅30mm
TOA-150	◎	∅20mm	◎	∅20mm
TOA-150 + 35FL	◎	∅30mm	◎	∅30mm
Mewlon-180C	◎	∅20mm	◎	∅20mm
Mewlon-210	◎	∅20mm	◎	∅20mm
Mewlon-250CRS	◎	∅30mm	◎	∅30mm
Mewlon-300CRS	◎	∅30mm	◎	∅30mm
ε-130D	×	×	×	×
ε-130D + ε-EXT1.5X	○	∅20mm	○	∅20mm
ε-160ED	×	×	×	×
ε-160ED + ε-EXT1.5X	◎	∅20mm	○	∅20mm
ε-180ED	×	×	×	×
ε-180ED + ε-EXT1.5X	○	∅20mm	○	∅20mm
CCA-250	○	∅20mm	○	∅20mm
CCA-250 + EXT-CR1.5X	○	∅30mm	○	∅20mm
Discontinued FC/FS series	◎	∅30mm	◎	∅30mm
Discontinued FCT series	◎	∅20mm	◎	∅20mm

- ※ ◎ Best result for visual.
- ※ ○ Standard result for visual.
- ※ × NOT compatible for visual and imaging.
- ※ ∅ Diameter of optimized image circle.

**Please note: Information presented in the table is a general evaluation; results may differ depending on user's specific configuration.**

Initials that use in the table:

- ※EXT-ED1.5X: Extender-ED1.5X [TKA37595]
- ※EXQ-1.6X: Extender-Q1.6X (50.8) [TKA36595]
- ※35FL: TOA-35 Flattener [TKA31582]
- ※ε-EXT: ε-Extender [TKA59595]
- ※EXT-CR1.5X: Extender-CR1.5X [TKA82595]

**【Note for ε Series User】**

Since the draw tube travel of ε series is short, it may not be able to focus depending on the connection method. If the target is out of focus, take the following steps:

1. Remove the Extension Tube (Small) and use only the Extension Tube (Large).
2. If 1 does not work, change the Extension Tube (Large) to Extension Tube (Small).