# TAKAHASHI TCA-4 Eyepiece Projection Device
Instruction Manual

The TCA-4 Eyepiece Projection Device is used for imaging the moon and planets with a 35mm DSLR and CMOS camera with high magnification using 31.7mm (1¼") eyepieces.

◆ Main Features

• The TCA-4 device can be attached and removed from the telescope without using a threaded connection.

• When detached, the telescope can be used visually.

• By changing the sliding length of the magnifying tube, the magnifying rate can be adjusted freely.

• The TCA-4 can accept a CMOS astronomical camera.

Lock Ring — Lock Screw — Tube Lock Screw — Adapter — TCA-4 — Magnifying Tube
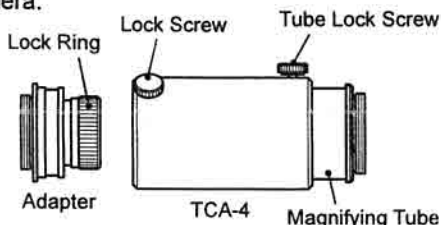
◆ Attaching

1. Remove the visual back as illustrated and attach the adapter.

Visual Back — Adapter

Eyepiece Adapter +
31.7mm (1¼") Eyepiece Adapter
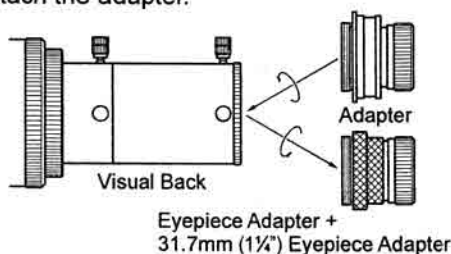
2. Loosen the lock ring and insert a low power eyepiece (LE24mm etc.) and lock it. After centering on the desired object, higher power eyepieces may be used.
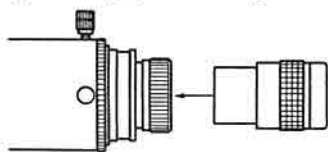
3. As illustrated, attach the T-Mount DX-S and a DSLR and tighten the tube lock screw. (The DX-S T-Mount is available for Nikon and Canon EOS.)

Tube Lock Screw

TCA-4   T-Mount DX-S   DSLR
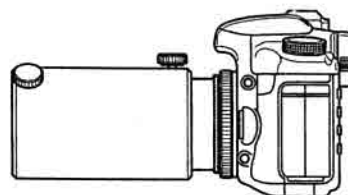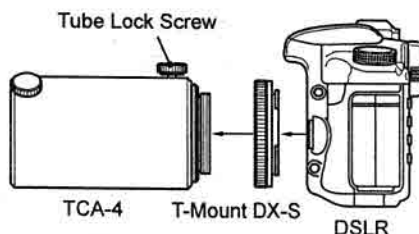
4. Before inserting the adapter into the TCA-4, loosen the lock screw to prevent the tip of the screw from protruding into the tube. With the adapter and the TCA-4 aligned, insert the TCA-4 with a DSLR into the adapter and lock it with the two lock screws.
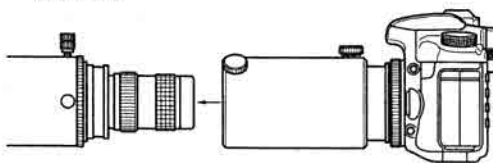
(Note)
There are some differences with the visual backs of telescopes, so please refer to the system chart.

◆ How To Use

1. Make certain with camera finder or LCD monitor that the desired object is in the field of view, and focus it by operating the focusing system of the telescope. If necessary, remove the TCA-4 to center the desired object visually, and then attach the TCA-4 again. (When the desired object is within the field of view of the camera finder or the LCD monitor, it is advisable to realign the finder axis. Then, it will be easy to center the next desired object with the camera as attached.)

2. When roughly focused, determine the magnification and the camera angle. For higher magnification, draw out the magnifying tube or change to a higher power eyepiece. For lower magnification, push in the magnifying tube or use a lower power eyepiece. With the tube lock screw loosened to determine magnification, also determine the camera angle and imaging layout, then retighten the tube lock screw. (When the magnification is changed, the focal point will be changed, so it is necessary to refocus every time.)

3. Keep in mind that air current (the "seeing") and the telescope vibration may impact photography. When pressing the shutter, use the release to avoid vibration. For best results, it is advisable to take multiple images using various shutter speeds.

⚠ Caution

1. At certain magnifications, you may not be able to achieve focus using the telescope focuser. In this case, attach or detach an extension tube and adjust the focal point. Change the eyepiece and adjust the moving length of the magnifying tube in order to obtain the similar magnification. Then, it could focus with the telescope focuser.

2. When the TCA-4 and camera are attached, the weight at the visual back side will be heavy and the scope will be unbalanced. Before imaging, rebalance the telescope. When the telescope is unbalanced, it can turn abruptly and dangerously, especially when the Dec. clamp is loosened. Be certain to hold the camera with one hand as the Dec. clamp is loosened.

TCA-4

T-Mount DX-S   DSLR
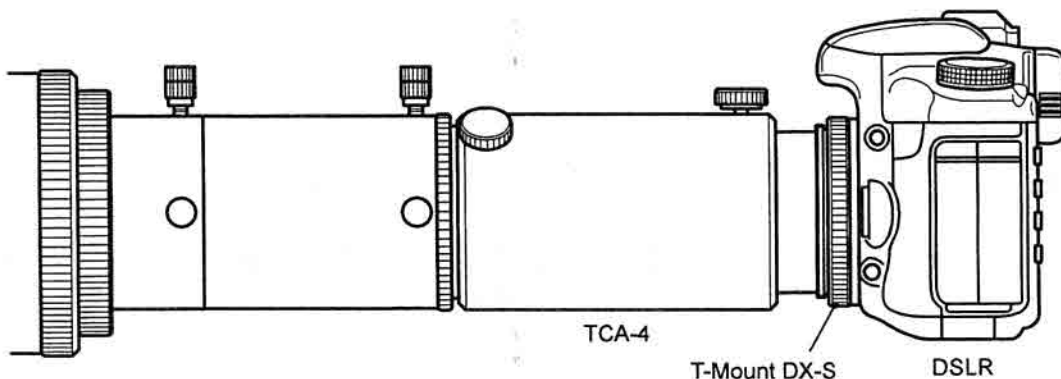
◆ Calculation for Magnifying Rate

As the length(mm) from the focal point of an eyepiece to the imaging plane = EL
As the focal length(mm) of an eyepiece =FE,

Magnifying rate can be calculated with the following formula.

$$\text{Magnifying Rate} = \frac{EL}{FE} - 1$$

• Regarding the focal points of the eyepieces, refer to the table on the next page.

• The distance from the T-Mount to the imaging plane is 55mm.
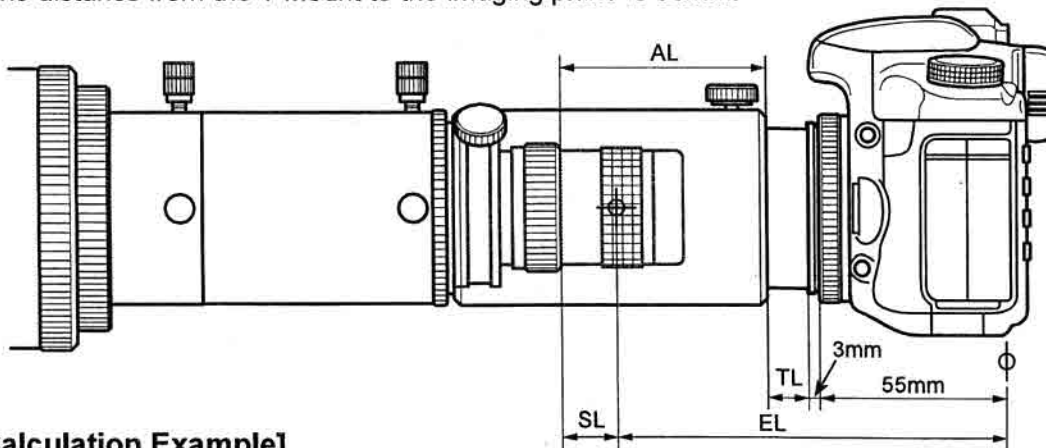
[Calculation Example]

As EL = (AL + TL + 3 + 55) - SL, when LE-18(FE-18) is used for imaging and drawing length of the magnifying tube is 5mm (TL-5mm),

EL = (58 + 5 + 3 + 55) - 27.4 = 93.6 $\frac{93.6}{18} - 1 = 4.2$

Therefore, the magnifying rate will be 4.2x.

If the TOA-130 is used, as its focal length is 1000mm, the effective focal length will be:
1000mm x 4.2 = 4200mm and the effective focal ratio will be 4200 divided by 130 ≒ 32.
So, determine the exposure time, referring to this calculation.

◆ Attaching CMOS Camera

Attach the 31.7mm (1¼") eyepiece adapter with the magnifying tube as illustrated. A CMOS camera with a 31.7mm (1¼") nosepiece can then be attached.

TCA-4   31.7mm (1¼") Eyepiece Adapter

CMOS Camera
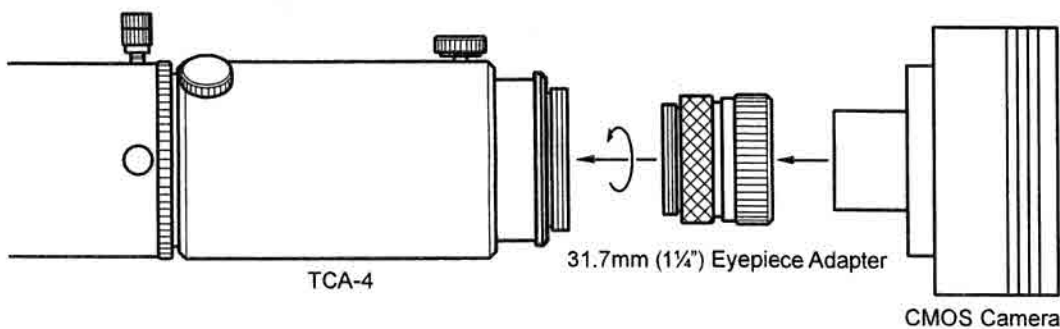
Focal Point of Eyepiece

Eyepiece	SL(mm)	T-Mount DX-S + DSLR Metal Back: 55mm	
		Minimum Magnifying Rate	Maximum Magnifying Rate
LE 5mm	41.6	13.9	19.9
LE 7.5mm	29.1	10.6	14.6
LE 10mm	13.8	9.2	12.2
LE 12.5mm	18.2	6.8	9.2
LE 18mm	25.8	4.0	5.7
LE 24mm	34.0	2.4	3.7
Abbe 4mm	5.6	26.6	34.1
Abbe 6mm	7.9	17.0	22.0
Abbe 9mm	11.9	10.8	13.9
Abbe 12.5mm	16.4	7.0	9.4
Abbe 18mm	22.9	4.2	5.8
Abbe 25mm	31.3	2.4	3.6
Abbe 32mm	39.8	1.4	2.3
TOE-2.5mm	53.0	24.2	36.2
TOE-3.3mm	48.1	19.6	28.7
TOE-4.0mm	43.5	17.1	24.6
Erfle 28mm	36.1	1.9	2.9

[To get the effective focal length]

$$\text{Effective Focal Length} = \left(\frac{\text{Length(mm) from the focal point of an eyepiece to imaging plane}}{\text{Focal length(mm) of an eyepiece}} - 1 \right) \times \text{Focal length(mm) of the objective lens}$$

[To get the effective focal ratio]

$$\text{Effective focal ratio} = \frac{\text{Effective focal length (mm)}}{\text{Effective aperture (mm) of the objective lens}}$$

(Note)

• LE 30mm cannot be used due to interference.

• Abbe 32mm can be used only without rubber eyecup.

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