

Fluorite Apochromat

FC-76DC

INSTRUCTION MANUAL

TAKAHASHI

Thank you very much for your purchase of Takahashi Fluorite Refractor, FC-76DC. Compact as it is, but the FC-76DC offers wide variation of focal lengths produced by the reducer, the flattener, and the extender for visual and imaging applications.

In order to use your instrument in its highest possible capabilities, please read this instruction manual very carefully and familiarize yourself with all the functions that your instrument offers. All the instruments are strictly inspected before shipment. If there is anything wrong with your instrument, please contact your authorized Takahashi distributors for proper cares.

WARNING

NEVER TRY TO OBSERVE THE SUN THROUGH ANY TELESCOPE WITHOUT PROPER FILTER. IT WILL CAUSE PERMANENT BLINDNESS. KEEP CHILDREN AWAY FROM ANY TELESCOPE DURING DAYTIME. EVEN A SMALL FINDER SCOPE CAN DELIVER SUFFICIENT AMOUNT OF LIGHT TO MAKE EYE BLIND.



CAUTION

- When attaching this instrument on the mount, be careful not to drop it or to be pinched, causing unexpected injuries.
- Never place this instrument on uneven place to prevent this falling or dropping, which might cause injuries.
- Do not place this instrument at the direct sun light.
- When focusing this instrument, be careful not to pinch your finger.
- Be careful that children do not swallow small parts such as button battery, eyepiece, etc.
- Inflammable materials such as styrofoam are used for packing material. Do not place it near the fire. Keep children away from the large vinyl bag not to cover their heads.

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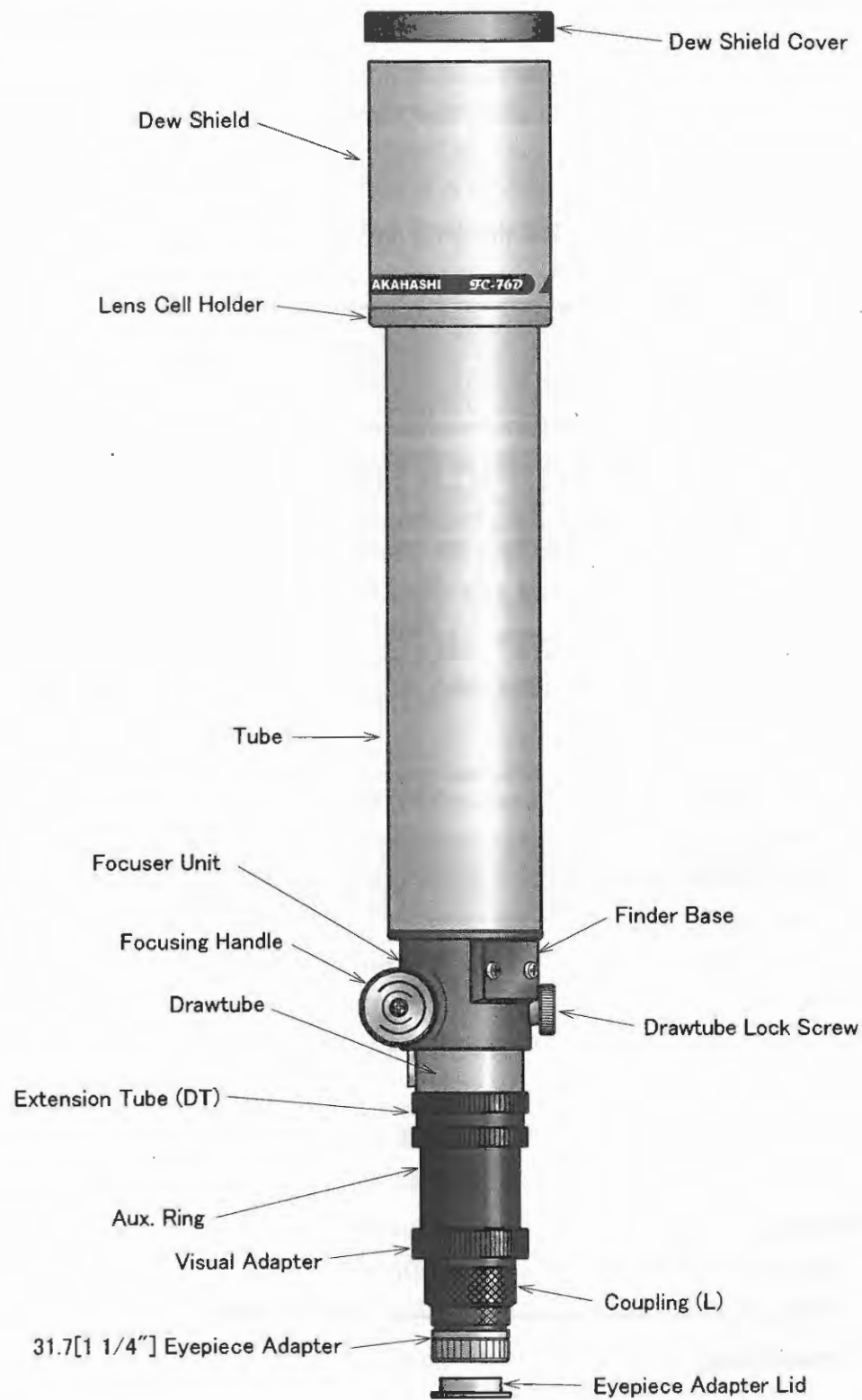
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SPECIFICATIONS

Configuration	Fluorite Apochromat Doublet
Effective Aperture	76mm all planes multi-coated
Focal Length	570mm
Focal Ratio	1: 7.5
<With 76D Flattener>	
Focal Length	594mm
Focal Ratio	1:7.8
Image Circle	40mm
<With 76D Reducer>	
Focal Length	417mm
Focal Ratio	1:5.5
Image Circle	36mm
<With Extender-Q 1.6X>	
Focal Length	916mm
Focal Ratio	1:12.0
Diameter of Main Tube	80mm
Total Length of Main Tube	660mm
Weight of Main Tube Assembly	1.8kg (about 3.6lbs)
Finder Scope	6x30mm (option)

(Note) Image Circle is illuminated 60%.

Tube Assembly Layout

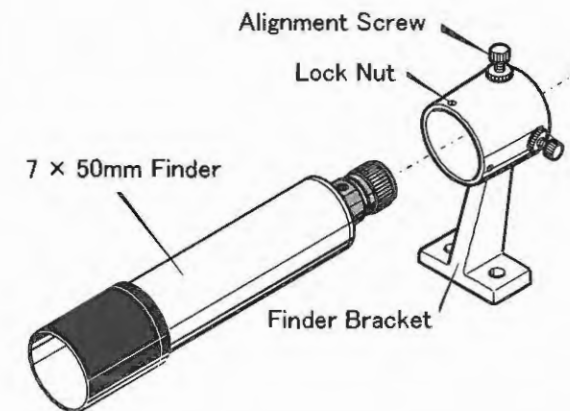
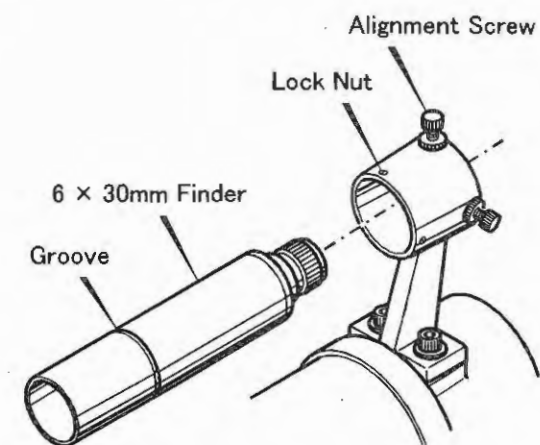
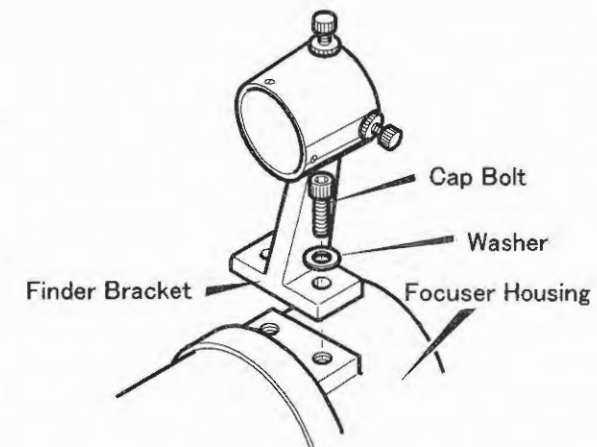


Attaching The Finder And Tube Assembly

■ Attaching the finder scope

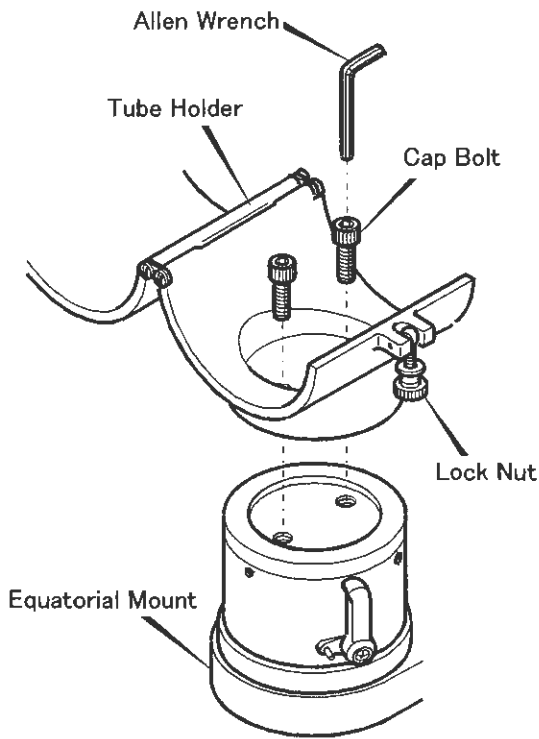
Place the finder bracket leg on the finder base on the tube assembly and lock it firmly with two cap-bolts provided. Set the finder as parallel to the tube as possible. Failure to do so will make alignment difficult.

Takahashi 6x30mm finder scope is available optionally. A provision to attach a 7x50mm finder scope (optionally available from Takahashi) is provided.



■ Setting the main tube assembly onto the equatorial mount

Set the tube holder on the head of the mount with two cap-bolts and lock the tube with a lock nut after balancing the tube. The tube holder can be used with all Takahashi mounts. If astrophotography is one of uses, the heavier duty the mount, the better.



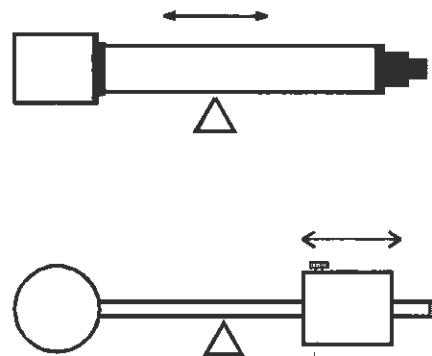
holder can be used with all Takahashi mounts. If astro imaging is one of the uses, then the heavier duty the mount is the better it will be to image.

The correct way to attach the tube holder to the mount is to use the Allen screws provided with the tube holder. After placing the tube assembly into the tube holder, the next step is balancing.

Now that the instrument has been attached to the mount, it will be necessary to balance the load in the R.A. and the Dec.

The first step is to clamp the R.A. and unclamp the Dec. Hold the tube of the telescope in the event it is out of balance. Then, loosen the tube clamp slightly so that the tube can be moved in either direction. Move the tube in either direction until it balances. When the tube is balanced, tighten the clamp.

Next, loosen the R.A. clamp, and tighten the Dec. clamp. Unclamp the counter-weight(s) and slide them in either direction until the package is balanced.

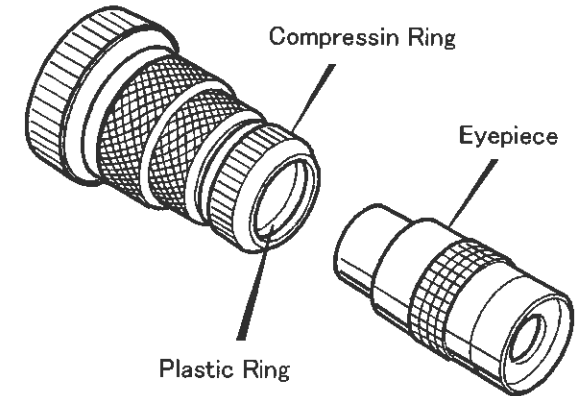


■ Attaching the Tube Assembly to the Mount

Attach the tube holder to the mount using the 8mm Allen screws supplied with the tube holder. The tube assembly can then be placed into the tube holder and secured with the lock nut after the tube holder has been closed over the tube assembly. This tube

■ Compression Ring

Remove the eyepiece adapter cover after the locking ring has been loosened by turning it counter clockwise. Then, insert the desired eyepiece or 31.7(1 1/4") diagonal into the adapter and tighten the eyepiece ring by turning it clockwise.



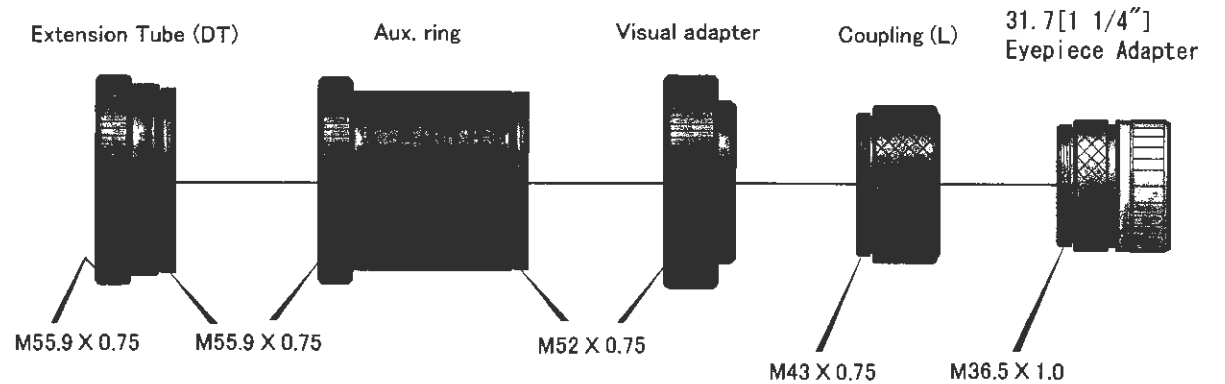
■ Takahashi Eyepieces

The following eyepieces are available from Takahashi.

- LE series: The barrel size is 31.7mm (1 1/4"), wide apparent field, ranging from LE5mm to LE30mm. LE50mm (50.8mm/2" barrel size)
- Hi-LE series: Hi-LE2.8mm and Hi-LE3.6mm are available for highly magnified observation.

■ Connection the System Parts

The adapters and the rings are provided on the visual back to connect various system parts. Carefully study the system chart in this book before connecting any system parts. Connection of the incorrect parts may prevent the telescope from coming to a sharp focus or any focus at all.

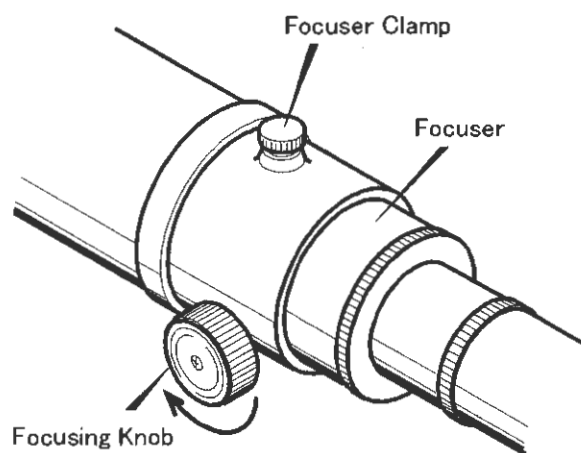


■ Focusing

After inserting the eyepiece into the telescope, it is necessary to achieve the best possible focus. Remember the atmosphere will limit the highest magnification that can be used on any given night. Using the lowest power eyepiece; focus the image and then increase the magnification by using shorter and shorter focal length eyepiece until the desired magnification is reached. This procedure allows the centering of an object at high magnification. Please familiarize yourself with the following.

● Focusing System

The FC-76DC uses a rack-and-pinion focuser. This focuser enables the observer to focus rapidly. Turning the focuser clockwise will move the drawtube out, while turning the counter-clockwise will move the drawtube in. The optional Micro Edge Focuser [MEF-3] adds 8 to 1 fine focus for fine focusing at high magnification or for imaging. Remove the lens shade cover and the alu-



minum plug from the 31.7mm (1 1/4") compression ring adapter. Insert the diagonal into the compression ring adapter. Carefully tighten the compression ring until it begins to make contact with the barrel of diagonal. It is not necessary to overtighten the ring to hold the diagonal.

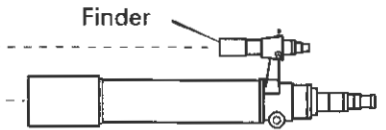
Then insert the eyepiece into the compression ring of the diagonal, repeating previous process. Be careful not to overtighten the compression ring.

Begin the focusing process by choosing a bright star in a convenient position. When you think that you have achieved the best focus, move the focuser inside and outside of what you think is the best focus. This will confirm the critical procedure.

Begin with a low power eyepiece and then proceed higher and higher until the desired magnification has been achieved.

When best focus at high magnifications has been achieved, the observer may notice a bright and dim ring around the star. This is not a defect but rather a diffraction pattern which is an indication of diffraction limited optics.

Finder Alignment



A finder is a useful tool. It permits the precise centering of an object in the field of view. The 6.3-degree field of view allows the easy centering of an object to be viewed or photographed.

The Takahashi finders use an interrupted crosshair which is designed to allow the easy centering of an object to be photographed or observed. The wide field of the finder makes the finding of an object easier, therefore, it is important that the finder and the telescope be in alignment. The following procedure can be used to align the finder.

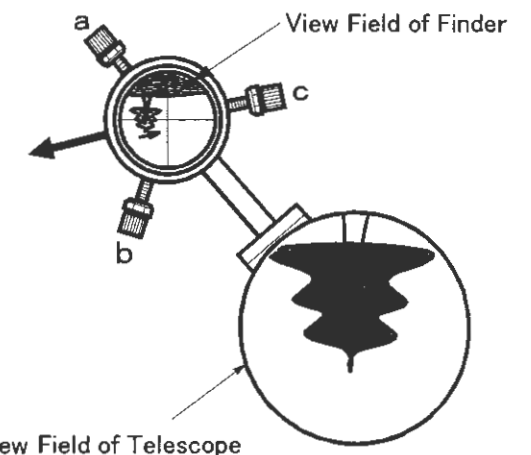
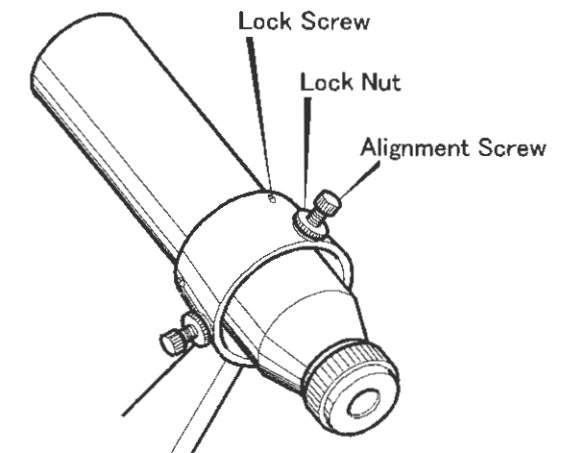
■ Alignment Procedure

1. Place a low power eyepiece in the telescope and center a bright star in a convenient part of the sky. Do not forget to engage the motor drive to keep the star centered. If this procedure is done in daylight, use an object that is at least one mile away. Loosen the lock nuts on the finder bracket and slightly move the star to the center of the field using the adjusting alignment screws.
2. Then use a higher magnification eyepiece and repeat the procedure by centering the object in the field of view of the telescope and then the finder. Continue this process until the highest possible magnification has been used.

Finally, tighten the lock nuts and locking screws. If the object moves slightly, adjust alternately tighten and loosen the locking nuts until the object stays in the center.

■ Adjusting Screw Procedure

1. Turn all the lock nuts until they reach the head of the alignment screws.



2. In order to move the crosshair in the direction of the arrow, first loosen screw (a) and tighten (push) the finder with screw (c). This procedure will move the crosshair in the desired direction. The top of the finder will move in the opposite direction and the object will move in the direction of the smaller arrow.

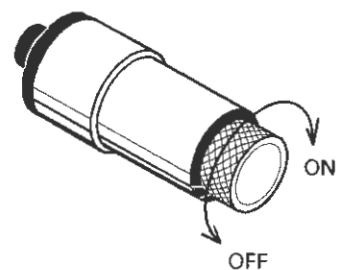
3. In a similar fashion the direction of the movement of the finder is made by adjusting the three screws.

Learn the relationship between the movement of the three adjusting screws. If the finder cannot be moved in the desired direction, loosen the locking nuts.

■ Reticle Illuminator [Optional]

The 7x50 finder has provision for an optional reticle illuminator.

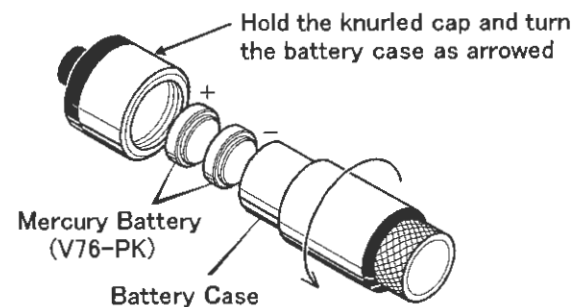
If an illuminator will be installed, remove the cap screw at the end of the finder and install the reticle illuminator. The illuminator makes the centering of dim objects easier.



In order to turn the illuminator on, turn the knob clockwise. The knob will click when the illuminator turns on. As the knob is turned, the reticle will brighten. Adjust the knob to the desired brightness. Turn the knob counter-clockwise past the click to turn the illuminator off.

■ Replacing The Battery

Before changing the batteries in the illuminator, please be certain to turn it off. Unscrew the battery holder. Remove the old batteries and insert new one after they have been wiped with a clean dry cloth. Check the polarity of the batteries before inserting them into the holder. Use two silver [V76-PK] or equivalent batteries.



Observation

■ Visual Observation

◆ Determining Magnification

The magnification of any eyepiece used with the telescope can be calculated by using the following formula.

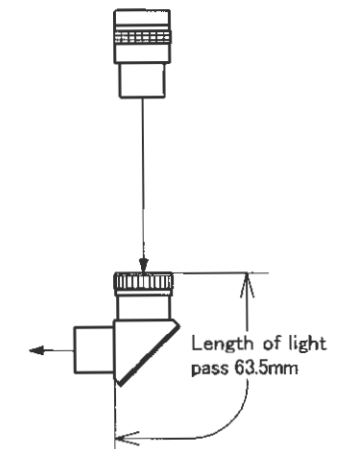
$$\frac{\text{(focal length of a telescope)}}{\text{(focal length of an eyepiece)}}$$

Therefore, the shorter focal length eyepiece will produce the higher magnification. On some nights of exceptional seeing, it is a fun to use highest possible magnification to view the Moon and planets.

In general, the limit of magnification will be highest 20X and lowest 1.4X respectively to the effective aperture. In case of FC-76DC, the highest will be 152X and the lowest 11X. Therefore, most of Takahashi LE eyepieces can be used with FC-76DC except Hi-LE 2.8mm and Hi-LE 3.6mm.

◆ Compression Ring Star Diagonals

A 90-degree diagonal prism is optionally available from Takahashi. This permits easy viewing of objects at the zenith. The 31.7mm(1 1/4") standard diagonal prism is set into the compression ring adapter at the end of the telescope and then the ring is tightened just enough to hold the diagonal prism. The, the eyepiece is placed in the compression ring on the prism and held by the same procedure.



Star diagonal prism 31.7(1 1/4")

◆ Lunar observation

The Moon is an excellent object to observe for beginners as well as advanced amateurs. Though the entire full Moon can be observed at 50x, its intense brightness warrants a Moon filter to protect the eye from the Moon's bright glare and allow some detail to be observed. The best time to observe lunar detail is when the Moon is in its partial phases. Then viewing the terminator and its adjacent area will allow the observer to see small detail, ray structures and rilles. The high contrast images produced by the FC-76DC will reward the observer with great views of the lunar surface and its many features at high magnification.

◆ Observing the Planets

The FC-76DC is capable of producing planetary images of great detail and contrast. This is possible on a night of good seeing. The twinkle of lack thereof from stars at the zenith will tell the observer the quality of the seeing. The less twinkle the stars show, the better the seeing will be. Since the aperture of the FC-76DC is small it has an advantage on nights of poor seeing; since it is less affected by poor seeing. On those nights of steady seeing, pictures of the planets and the Moon taken with a digital SLR will produce detailed images.

◆ Observing Nebulae and Star Clusters

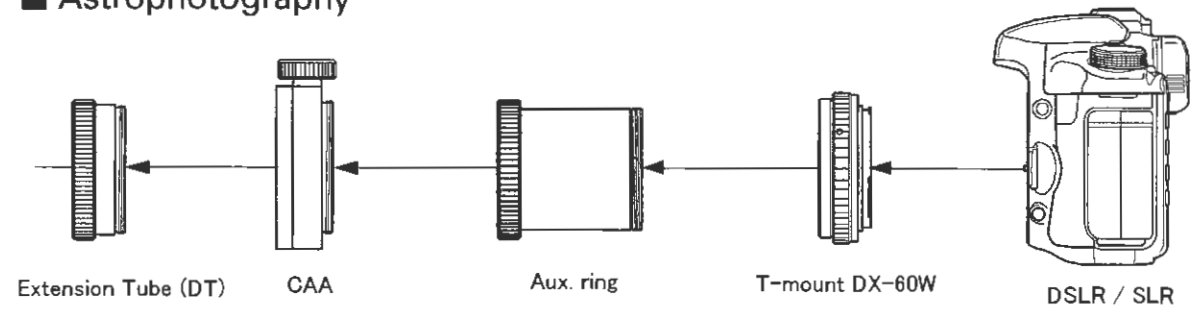
In general, observing nebulae and star clusters is best done with low power wide field eyepieces. On the other hand, observing globular clusters and small nebulae requires higher power to reduce the background glow and increase the contrast. This is particularly true in cities with a great deal of sky glow. Therefore, higher magnification can benefit the observer with the FC-76DC.

◆ Observing the Sun

Never observe the Sun directly; this will cause instant and permanent damage to the eye. If the Sun is to be observed there are two options available. The first, is a high quality glass filter that blocks out 99.999% of the light and heat. This filter should be secured over the lens shade with nylon set screws to prevent the filter from falling off the telescope and an opaque cover placed over the finder. The observer can now view the disc of the Sun and see sunspots and other phenomena. The second is the dedicated sub angstrom solar filter systems which allow prominences and great detail to be seen on the solar surface.



■ Astrophotography



◆ Prime Focus Photography

This is the method to take images at the focal point just like to use the telescope as a telephoto lens. Since the focal length of a telescope is far longer than that of a telephoto lens, slight mistake in guiding will make star images poor. Therefore, a steady mount should be used to keep the images as sharp as possible. The camera can be attached to the prime focus tube using a T-mount available from Takahashi.

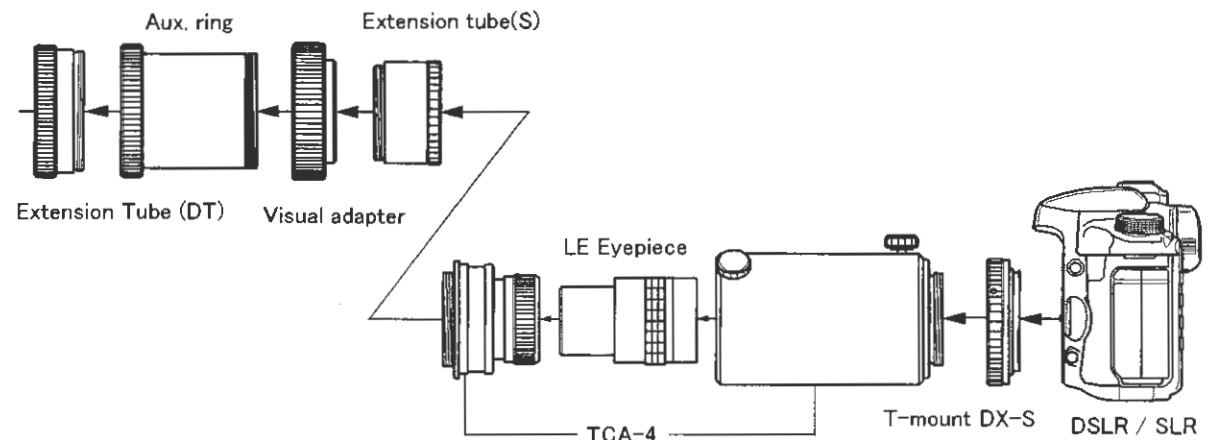
Note: The focal length of the fluorite lens will be varied a bit by a temperature fluctuation. Therefore, when making a long-time exposure, be careful on the temperature fluctuation. If it would happen more than three times, stop imaging and refocus your telescope.

◆ Eyepiece Projection Photography

When the FC-76DC is used to make images of lunar craters or the planets, the TCA-4 eyepiece projection system can be used. The magnification for each eyepiece can be increased or decreased using the sliding tube that is an integral part of the TCA-4. It is easily attached and detached.

⚠ Cautions

When making long focal length images with the FC-76DC, it is very important that the telescope and camera be in perfect balance. When the telescope is moved to a different object, be sure to rebalance the telescope and camera package.

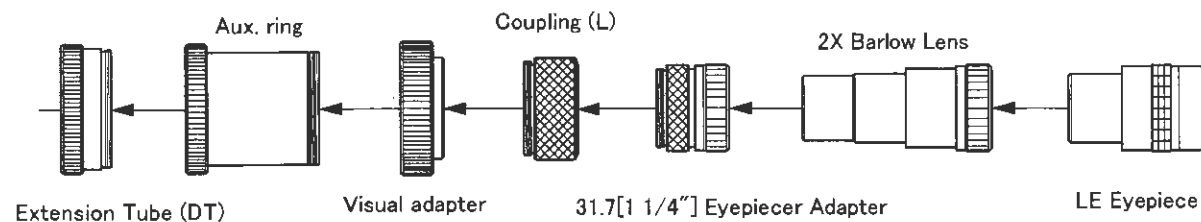


Accessories for Photo/Visual Application

Takahashi offers a wide variation of the system parts for imaging and visual applications.

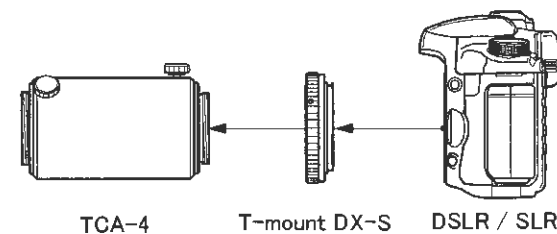
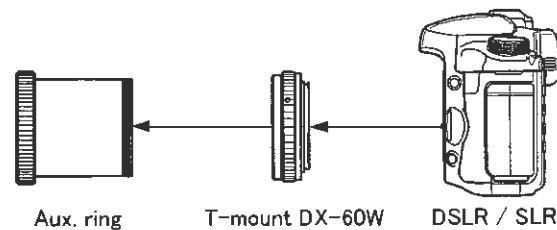
■ 2X Barlow Lens

This can extend the focal length of FC-76DC by 2X, keeping the aberration good.



■ T-Mount Adapter

In order to attach 35mm DSLR camera and TCA-4 Projection Device, the T-Mount DX-S is used. For imaging with the 76D Reducer and 76D Flattener, the T-Mount DX-60W is used. These mounts are available for EOS & Nikon.



⚠ Cautions

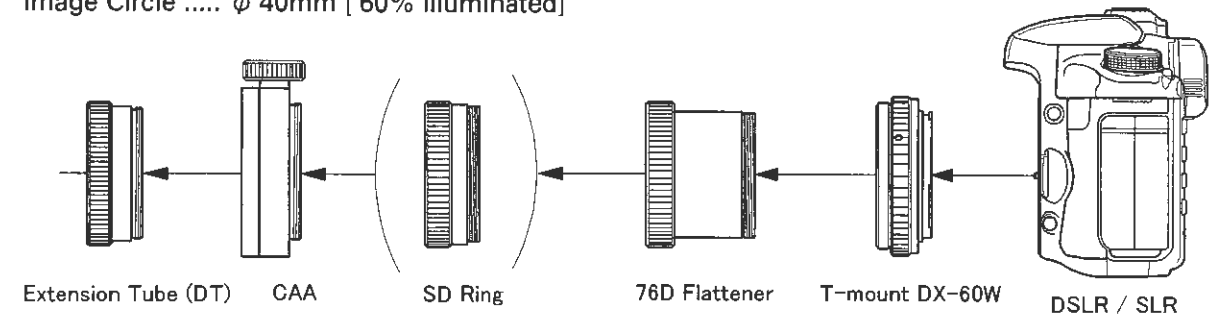
Be careful on the scratches and dirt on the T-Mount. These will be some causes the camera attached not squarely, making star images deformed.

■ Camera Angle Adjuster (CAA)

This is a necessary tool for imaging at the prime focus, with the reducer. You can rotate your camera to get ideal photo angle when imaging.

Connections for imaging with 76D Flattener

Focal Length 594mm
 Focal Ratio f/ 7.8
 Image Circle ϕ 40mm [60% illuminated]



■ 76D Flattener

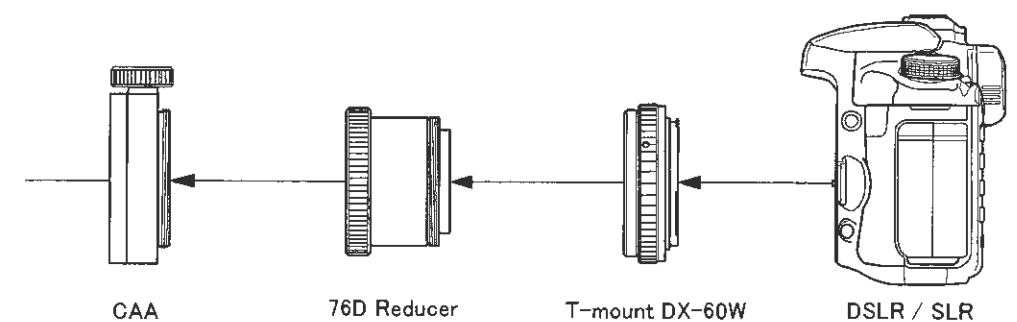
This flattener can make 40mm image circle almost flat across the field, keeping images at the center sharp. With a bit longer focal length of 594mm (f/7.8), this flattener will make the FC-76DC an ideal telephoto lens to image the ground and the sky. Also by using the SD (short distance imaging adapter) ring, the FC-76DC can focus an object 6 meter off.

■ 76D Reducer

The 76D Reducer is designed for deep sky imaging, reducing the focal ratio brighter to f/5.5 and making images as small as 20 microns across the image circle in wave area of g line to C line. Field illumination is 95% on 25mm circle and more than 70% on 35mm.

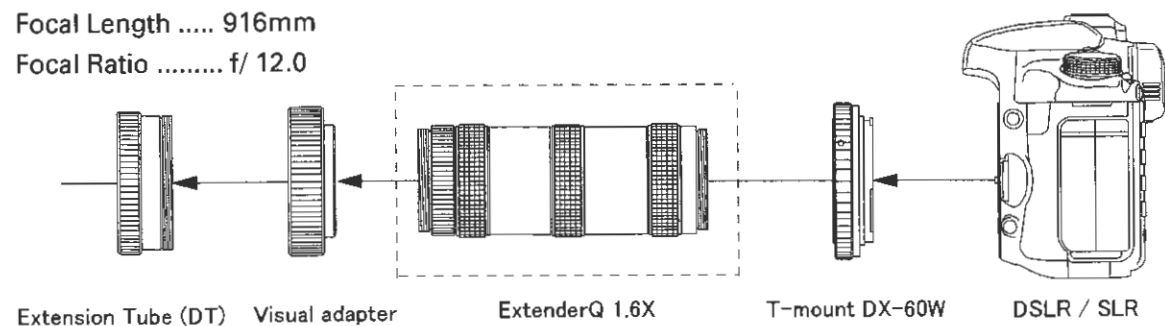
Connections for imaging with 76D Reducer

Focal Length 417mm
 Focal Ratio f/ 5.5
 Image Circle ϕ 36mm [60% illuminated]



Connection for magnifying imaging with the Extender-Q 1.6X

Focal Length 916mm
Focal Ratio f/ 12.0



■ Extender-Q 1.6X

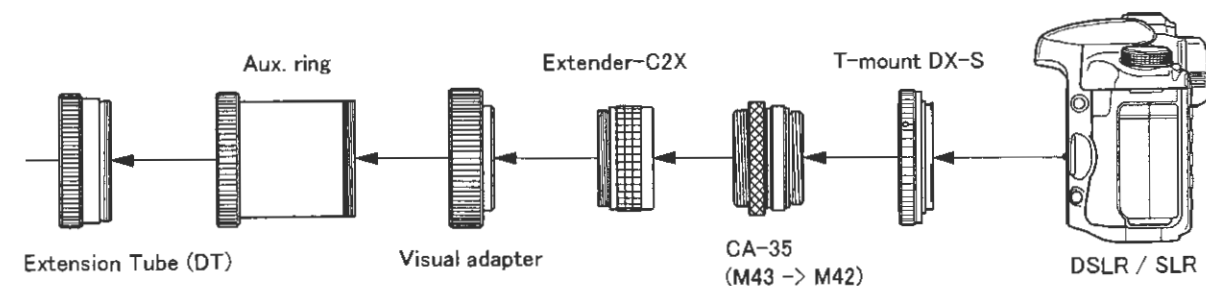
This can extend the focal length to take magnified image at the focal point by extending the original focal length by 1.6X, most suited for highly magnified lunar and planetary imaging.

■ Extender-C2X

This extender can extend the focal length of FC-76DC by 2X, which is useful for imaging the Moon at the moderate magnification, ground and bird. Refer to the system chart shown below. With this system, you can take images across 35mm format with almost no vignette.

Connection for magnifying imaging with the Extender-C2X

Focal Length 1140mm
Focal Ratio f/ 15.0



■ Some Advices on Imaging

● To get the sharpest images
Use the faxed star to focus your telescope, selecting 3 to 4 magnitude ones, which are ideal for this purpose. Make some trial shots with your camera to detect the focal point. It is a good idea to check focus with the images appearing on the display if your camera has life view function.

● Test Shot

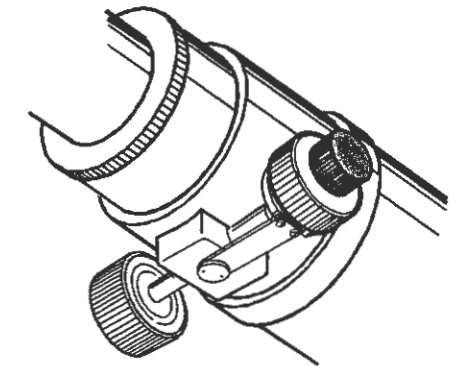
Before going to the remote place suitable for star imaging, it is advisable to make some test shots. Even in a light polluted city area, 5-minute exposure will be enough to learn imaging process to determine the best focusing.

● Imaging with Guiding

With the optical system that can produce very sharp images just like the FC-76DC, even a slight error in guiding will appear on the images. So, the most precise guiding is always required. Especially imaging with the FC-76DC, longer exposure is necessary due to darker F ratio. If the guiding set-up has some wobble and bent, you cannot make precise guiding. So, steady guiding scope and mount should be used.

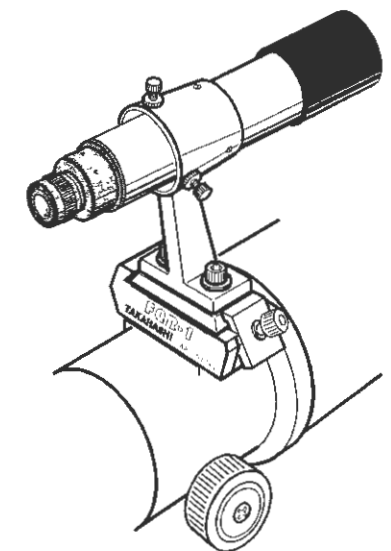
■ MEF-3

The Micro Edge Focuser, MEF-3, is an optionally available 8 to 1 fine focus attachment that permits 8 to 1 fine focus for critical focusing for imaging or high magnification.



■ FQR-1

The Finder Quick Release, FQR-1, is very convenient device to attach and detach the finder quickly. Once it is set on the focuser housing, you can attach and detach the finder quickly by thumb turn screws. The finder alignment almost the same in doing so.



Care & Maintenance

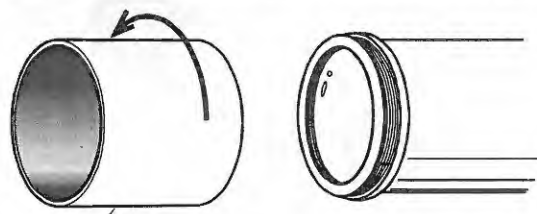
● Optical Axis

Before Attempting To Clean Your Optics, Contact Your Local Distributor For Precise Instruction Or Advice On How To Proceed.

● Lens Cleaning

If the front lens of the objective has dust or dirt particles on it, use a large hand powered blower to remove the particles. Under no circumstances should dust be removed by any other means, rubbing the surface will cause scratches. If the lens must be cleaned, be certain that all dust and dirt particles have been removed by using a blower. Then using cotton swabs slightly moistened with cleaner dab the surface, changing cotton swabs often until the objective is cleaned. If any questions arise during this process, immediately contact your local distributor for help. Under no circumstances should the surface ever be rubbed.

● REMEMBER, DO NOT USE ANY FORM



Dew Shield

OF CANNED AIR TO REMOVE THE PARTICLES.

This product is very cold and could harm the front lens of the objective. Be certain that the dew cap is removed before attempting to clean the objective. Use the

following procedure, if the front and rear surfaces of the objective must be cleaned.

■ Additional Precautions

● Keep the telescope away from large fluctuations in temperature. When the instrument is brought out from a warm room to colder air, dew may form.

● Store the telescope in a cool dry environment. Any dew should be removed by blowing it with a hair dryer with the heating element turned off, which means the air will be at room temperature. This flow of cool room temperature air will dry the dew and not leave a residue. Additionally, it is a good idea to store the telescope with a drying agent near the objective to keep any moisture away from the objective.

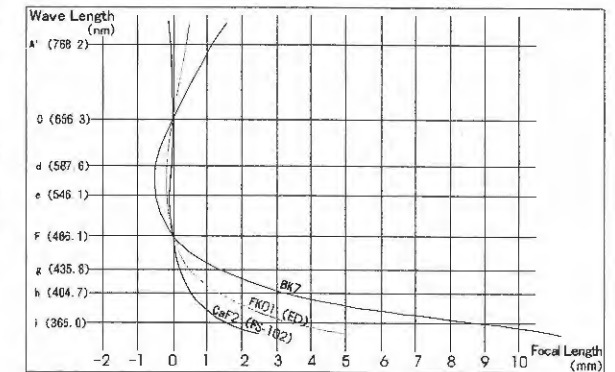
● As mentioned previously, never use canned air due to the fact that the propellant is a refrigerant which could cause damage to the front element. If the element must be cleaned, make certain it is done in cool room.

NEVER USE ALCOHOL TO CLEAN THE LENS. IT WILL DESTROY THE COATING.

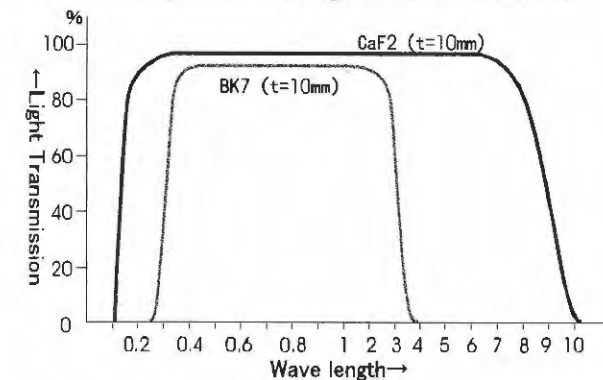
● Under no circumstances should the lenses be disassembled. The lenses have been properly aligned and set in place by skilled optical technician with special tools. Doing so will void any warranty on the tube assembly.

What is Fluorite?

Calcium fluoride (CaF_2) is a naturally occurring crystal. Its very low refractive index makes it the best of materials to use in the manufacture of apochromatic telescopes. Unfortunately, the natural crystal contains impurities and as a result, displays some properties that make it unsuited for use in a telescope.



Comparative Diagram (non-coated)



As the diagram shows, the band pass of fluorite of 1000 to over 100,000 angstroms eclipses by many magnitudes that of any optical glass. Additionally, the use of multicoatings further increases light transmission over any ED glass. These features make the fluorite objective the premier photo/visual instruments for deep sky or lunar and planetary applications in their size class.

Now thanks to modern technology, fluorite crystals are grown in an oven. This process produces a totally pure mono crystal structure that does not display any of the unsuitable properties of the natural crystal and has the same very low refractive index. Now, calcium fluoride crystal can be hard multicoated for maximum light transmission and durability.

When the fluorite telescope is taken out for an observing session, it will take about 30 minutes for the objective to temperature equalize for maximum performance. This fact is also true for any optical system used.

■ Extender-Q 1.6X System Chart

< Standard Accessories >

- 15. Visual Adapter [TKP20005]
- 46. Eyepiece adapter (31.7 / 1 1/4") [TKP00101]
- 81. Extension Tube (DT) [TKP20006B]

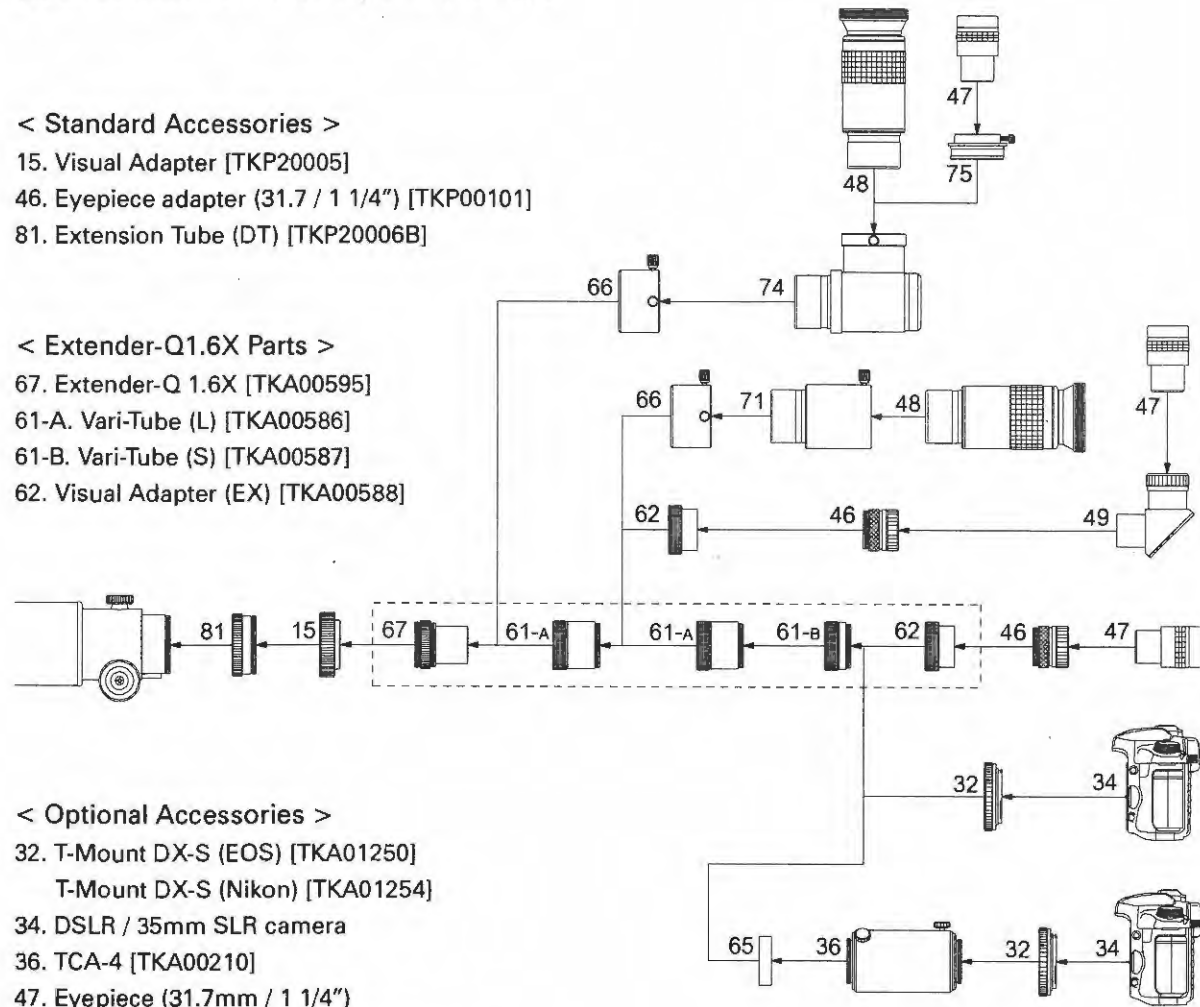
< Extender-Q1.6X Parts >

- 67. Extender-Q 1.6X [TKA00595]
- 61-A. Vari-Tube (L) [TKA00586]
- 61-B. Vari-Tube (S) [TKA00587]
- 62. Visual Adapter (EX) [TKA00588]

< Optional Accessories >

- 32. T-Mount DX-S (EOS) [TKA01250]
T-Mount DX-S (Nikon) [TKA01254]
- 34. DSLR / 35mm SLR camera
- 36. TCA-4 [TKA00210]
- 47. Eyepiece (31.7mm / 1 1/4")
- 48. LE-50 Eyepiece (50.8/2") [TKA00530]
- 49. Diagonal prism(31.7 / 1 1/4") [TKA00541]
- 65. EC Ring [TKA00590]
- 66. 50.8(2") Adapter (EX-Q1.6X) [TKA00596]
- 74. Diagonal Mirror (50.8mm/2") [TKA00541]
- 75. Adapter (DM) [TKA00111]

[Note] Some DSLR cannot be attached.



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