

Flat-Field Super Quintuplet

FSQ-130ED

Instruction Manual

TAKAHASHI

Thank you very much for your purchase of the TAKAHASHI Flat-Field Super Quintuplet FSQ-130ED. This outstanding astrograph uses three super ED elements in a five-element design.

A wide range of the system parts are optionally available to allow the user to enjoy a variety of visual/imaging applications with this telescope.

In order to use the FSQ-130ED to the limit of its capabilities, please read this manual very carefully and familiarize yourself with the system parts and their functions before using this telescope.

Warning & Caution



WARNING

NEVER ATTEMPT TO OBSERVE THE SUN THROUGH THIS TELESCOPE WITHOUT A FULL APERTURE SOLAR FILTER DESIGNED FOR THIS PURPOSE. FAILURE TO DO SO COULD CAUSE INSTANT BLINDNESS. COVER THE FINDER WITH AN OPAQUE COVER TO PREVENT ANY LIGHT FROM COMING THROUGH. AN UNCOVERED FINDER CAN ALSO CAUSE SERIOUS DAMAGE TO THE EYE. KEEP CHILDREN AWAY FROM THE TELESCOPE DURING DAYTIME.



CAUTION

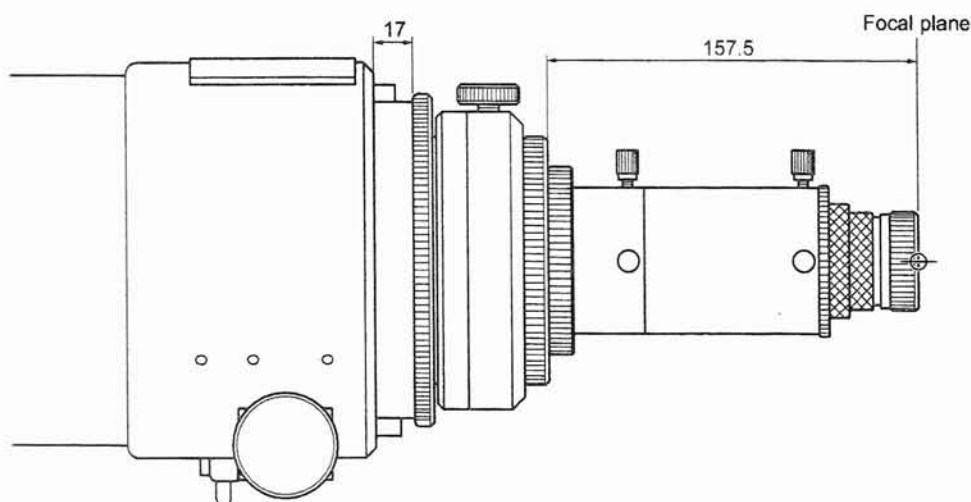
- ◆ When placing the tube assembly on to an equatorial mount, be careful to balance the tube in the tube holder. This will prevent injury to fingers and will prevent it from falling to the ground. When placing the tube assembly in the tube holder, always hold the tube with one hand to keep it from falling off the tube holder onto the ground.
- ◆ Always lay the tube assembly on a completely flat surface that totally supports it to protect it from damage.
- ◆ Keep the tube assembly out of the Sun. Otherwise, the tube assembly could heat up, causing lens damage.
- ◆ Great care should be taken to focus the instrument to insure the sharpest possible image.

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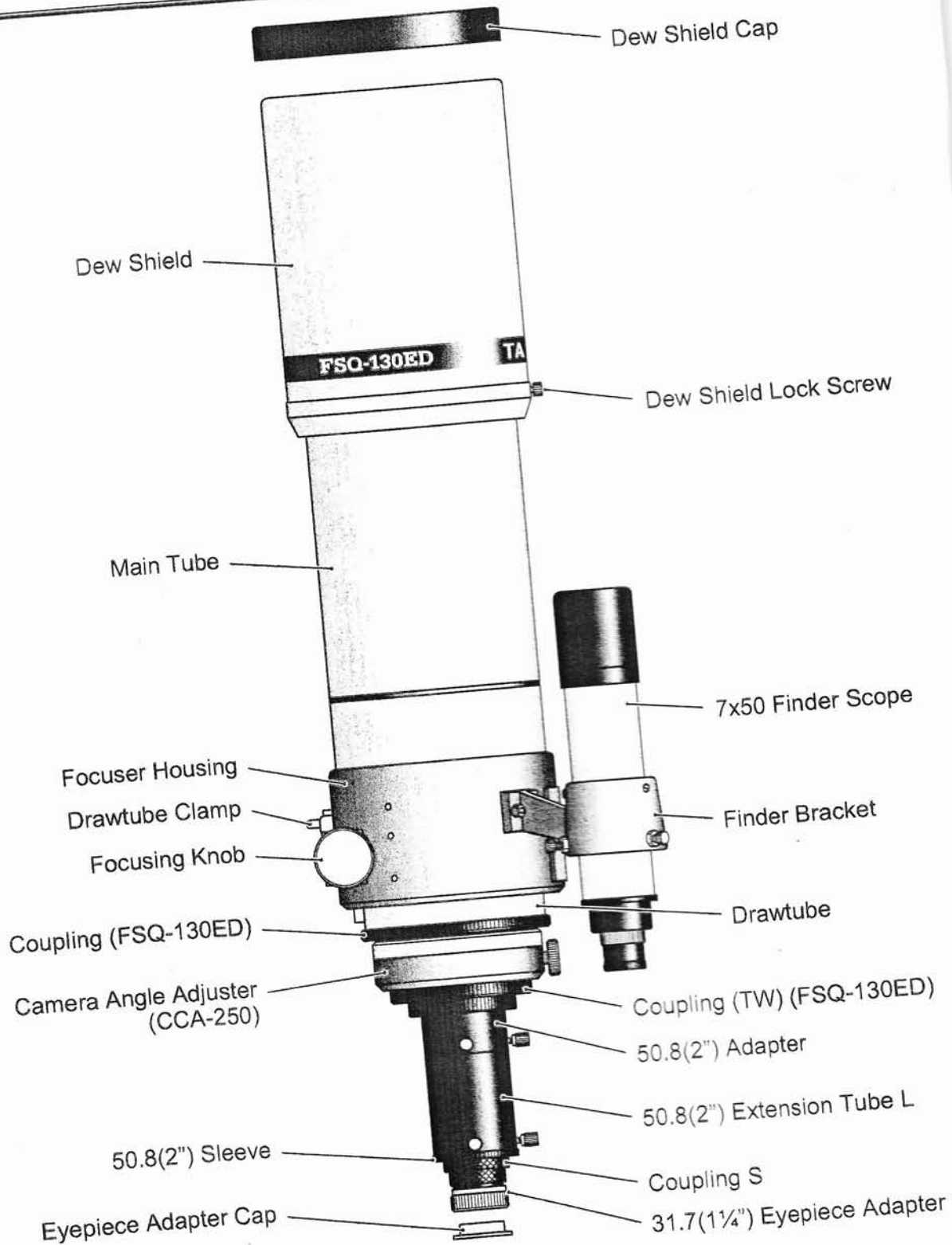
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Specifications

Configuration -----	5-group 5-element Flat-Field Super Apochromat
Objective Aperture -----	130mm
Tube Length -----	650mm
Focal Ratio -----	1:5.0
Working Power -----	0.89"
Resolving Magnitude -----	12.3
Light Gathering Power -----	345x
Field Circle -----	ϕ 110mm
Diameter of Main Tube -----	156mm (Dew Shield: 179mm)
Length of Main Tube -----	830mm (700mm when dew shield retracted)
Weight of Main Tube Assembly -----	12.2kg (24.4lbs) (OTA)
Accessories -----	Warranty Card, Instruction Manual, Allen Wrench (2mm & 4mm)



Tube Assembly Layout



Features of FSQ-130ED

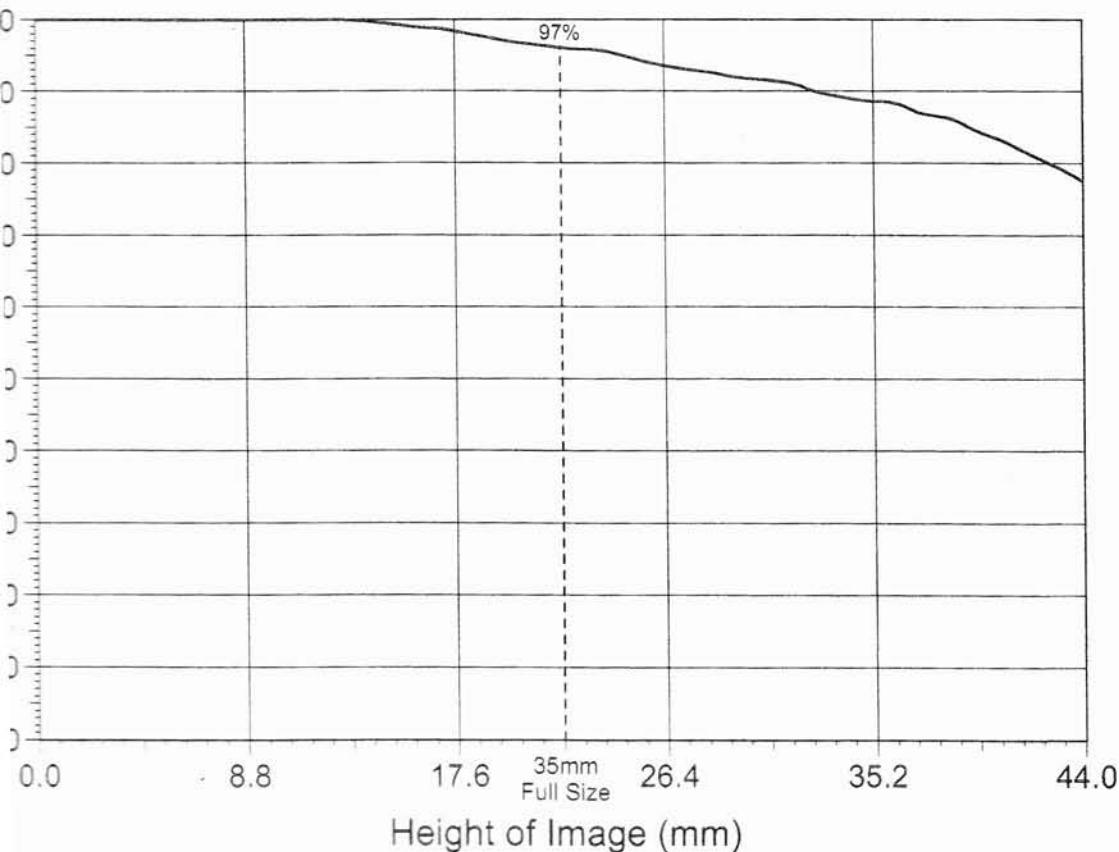
Unique Optical Design by Takahashi

FSQ-130ED is the ultimate model of the Takahashi FSQ Series which are well known throughout the world as the outstanding telegraphs. The FSQ-130ED uses three super ED elements that highly correct aberrations to the very limit. In order to eliminate Longitudinal Chromatic Aberration and Spherical Aberration to almost zero, the three front lenses use the design which enables highly magnified observations. At the same time, remaining two elements at the rear of FSQ correct curvature, astigmatism, distortion, lateral color aberration which are corrected to almost zero, allowing high quality imaging.

◆ Rich illumination at the edge of field

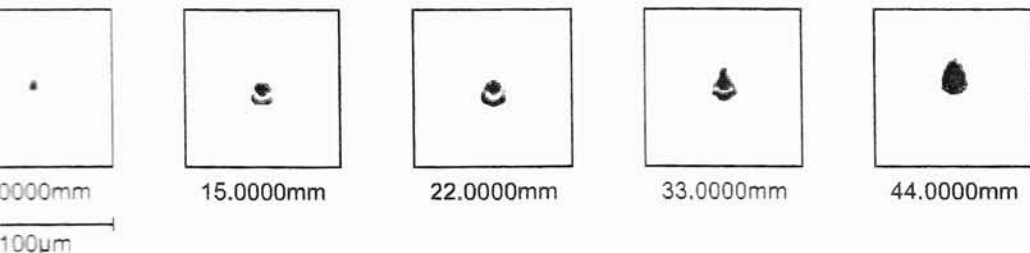
By making G4 lens larger, vignetting becomes less. Relative Illumination is 97% around 44mm off-axis. The relative illumination at an off-axis distance of 22mm of 35mm camera full frame format is a surprising 97%, and at 32mm off axis of a 645 format 92% illumination, at the edge of 67 camera format 78%. The full image circle $\phi 110\text{mm}$ is illuminated 60%. Rich illumination at the edge of the image circle is a very important factor to produce highly saturated fine images across the entire field.

FSQ-130ED Circumference Illumination Graph



II Evaluation by Spot Diagram, MTF (Modulation Transfer Function), and Strehl Ratio
 To make overall evaluation for the optical system, in addition to the evaluation by spot diagram so far used, Takahashi includes MTF for imaging performance and Strehl ratio for visual performance. As a result of these evaluation methods, Takahashi has produced the ultimate visual/imaging astrograph in the world. The highly magnified visual performance of FSQ-130ED is almost equal to that of TOA, which is the ultimate visual instrument for visual observation in the world.

FSQ-130ED FL-650mm (f/5) Spot Diagram

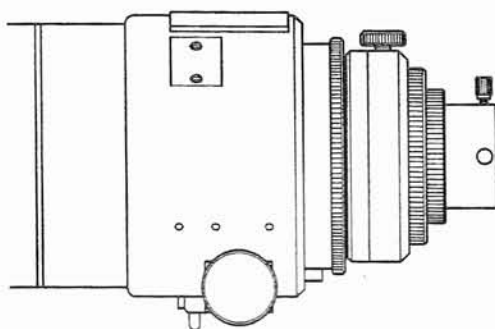
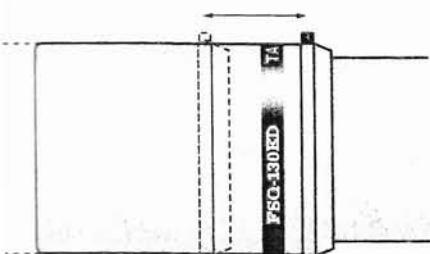


Compact Design with Retractable Dew Shield

The type is very compact for storage or transport when the dew shield is retracted. To protect the tube assembly, it is highly recommended to use an aluminum or airline rated case.

◆ Oversized Focuser Unit includes an MEF

This focuser uses the largest drawtube ever made. Mechanically it is similar design with FSQ-106ED, but stronger to hold larger CCD cameras.

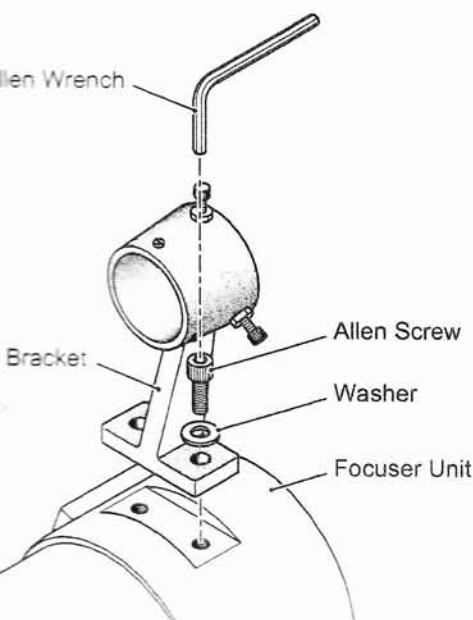
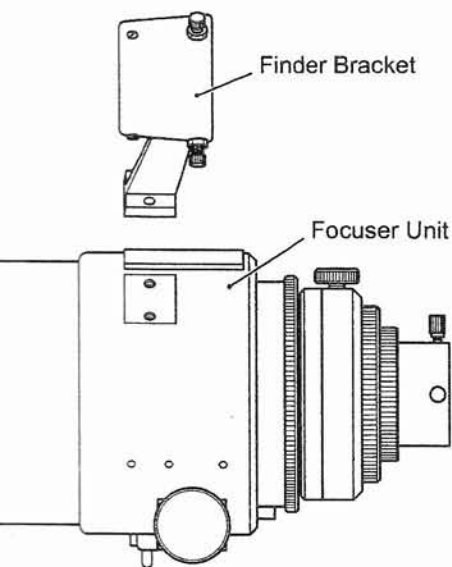


Attaching the Finder

If you have purchased the FSQ-130ED as a set, the finder and bracket have been detached and packed in the same carton. Use the following instructions to attach and align the finder.

Attaching the Finder Bracket

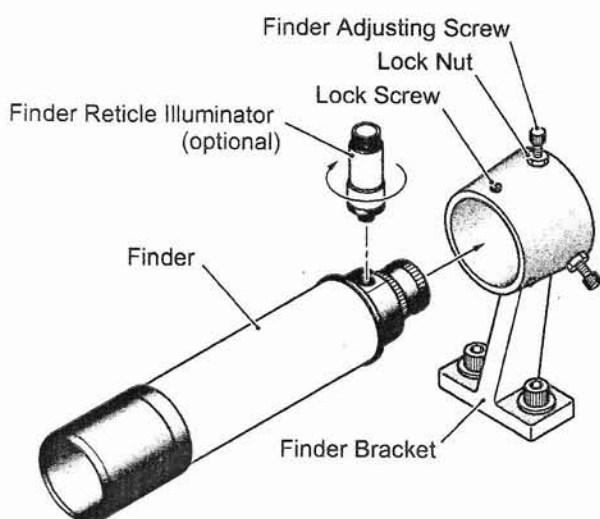
Slide the finder bracket over two holes on the left side of the focuser unit and attach it with the Allen wrench and the Allen screws provided with the finder bracket.



◆ Attaching the Finder

Before inserting the finder into the finder bracket, using standard cellophane tape, place a double layer of this tape around the finder where the three set screws located in front of the finder bracket will come into contact with the finder. This will help the finder tube prevent from being scratched by the screws. Loosen the front and rear finder bracket screws and then carefully insert the finder into the bracket and hold the finder as parallel as possible to the tube assembly when the finder bracket screws are tightened around the finder. This makes alignment easier.

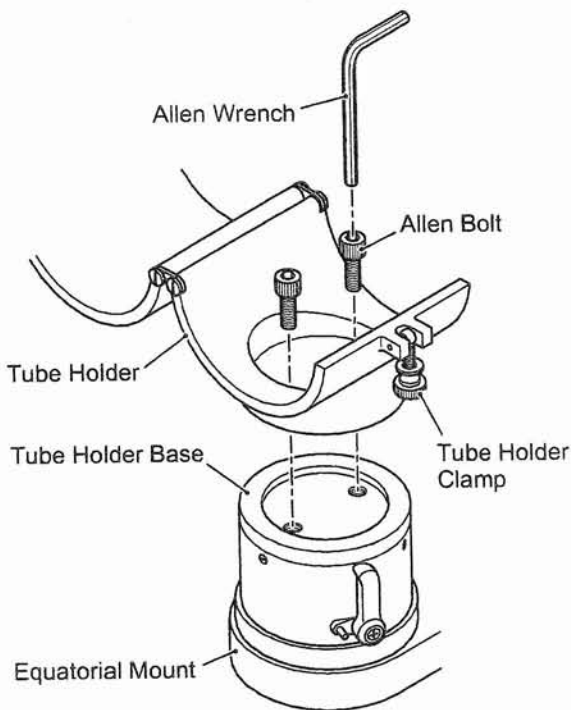
The finder reticle illuminator is optionally available. This illuminates the cross-hair of the finder and allows the easy centering of the desired object to be viewed.



Attaching the Tube Assembly

◆ Attaching the Tube Assembly to the Equatorial Mount

The tube assembly can be attached on the mount with the dedicated tube holder with two Allen bolts supplied with the tube holder. Before locking the tube holder, balance the tube assembly, then lock it firmly. This FSQ-130ED will be used mainly for imaging so a heavy-duty mount is highly recommended to use.



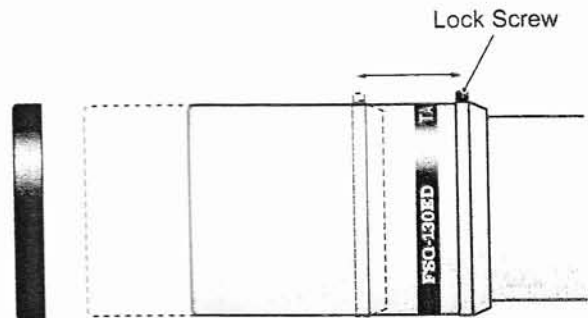
◆ Retractable Dew Shield

The FSQ-130ED is equipped with a retractable lens shade. When the 130 is transported the dew shield can be retracted. When the scope is to be used for observing or imaging, the lens shade is extended and the dew cap removed. The extended shield provides protection from stray light and dew.

When the dew shield is to be extended.

1. Remove the dew shield cap
2. Loosen the two lock screws
3. Extend the dew shield
4. Tighten the two lock screws

When the dew shield is to be retracted, reverse the above procedure.



Caution:

When retracting the dew shield, remove the dew shield cap first. Otherwise, the cap could be blown off.

ancing

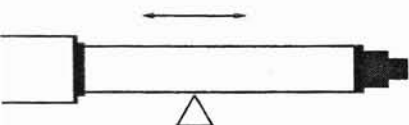
ne tube assembly is attached, balance the tube with the imaging package attached. balanced load will make locking the axes difficult and cause wear of the gears which shorten the life of the mount. Proper balancing will insure the best tracking and long life mount.

ancing the Declination Axis

Loosen the RA clamp and lock the clamp so that the position of the Declination axis is parallel to the ground. If the rotation of the axis is difficult due to unbalancing, gently loosen the Declination clamp and rebalance on the Declination.

Loosen the Declination clamp so that the package does not move suddenly and see balancing on the DEC.

If the package is out of balance, loosen the tube holder and slide the tube assembly forward and backward while holding on to the tube and the mount at the same time to insure that the tube does not swing for balancing.



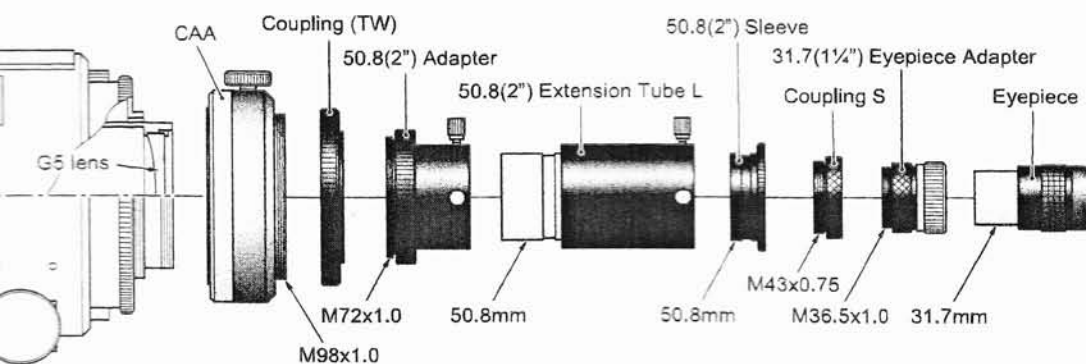
▼Balancing the RA Axis

1. Lock the Declination clamp firmly when the package is balanced in the Declination.
2. Loosen the RA clamp and turn the axis until the Dec axis is parallel to the ground and check balancing of the RA axis. Hold on to the Dec. axis and check the RA balance after unlocking the clamp. Remove the hand from the Dec axis and check the RA balance again.
3. If the package is out of balance, move the counter-weight to the point where balancing is perfect.
4. If the package is still out of balance even when the counter-weight is positioned at the end of the counter-weight shaft, add the counter-weights optionally available.



Adapters

al back of the FSQ-130ED includes the parts as illustrated below. The G5 lens is d at the rear end so it is barely covered by CAA. If the CAA is removed the G5 lens o the end of the tube is exposed. So, when attaching the visual parts, first extend tube and then attach the visual parts and be careful not to touch the G5 lens.



hashi Eyepieces

Series
d type, wide view field and high
ation are available in:

- 30mm 31.7mm (1 1/4") barrel
- m 50.8mm (2") barrel

Series

a-relief, most suitable for planetary
ation with high magnification.
in:

- 3mm - 3.6mm 31.7mm (1 1/4") barrel

W Series

de angle with apparent field of 90
esigned to get sharpest star with a
ope are available in:

- W-10UW 31.7mm (1 1/4") barrel

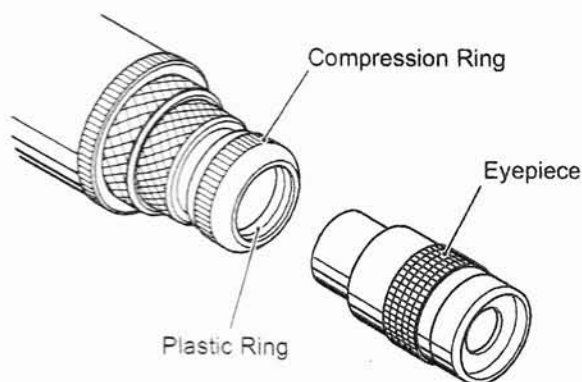
Series

-group 4-element eyepieces with
trast, less expensive with high
ice. Available in:

- n-32mm 31.7mm (1 1/4") barrel

◆ Compression Ring

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



◆ Connecting the System Parts

The adapters and 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. Connecting the parts incorrectly may prevent the telescope from coming to a sharp focus or any focus at all.

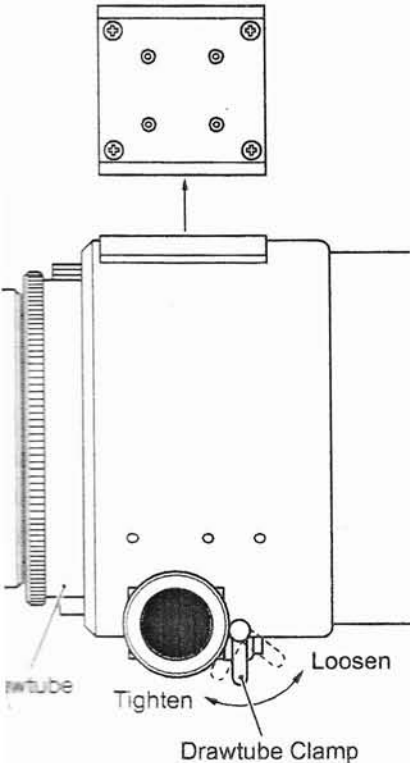
Focusing Unit

FSQ-130ED uses a rack-and-pinion focuser which enables the user to focus rapidly. Loosen the drawtube clamp and turn the focusing knob to focus. Turning the focuser clockwise will move the drawtube out, while turning it counter-clockwise will move the drawtube in. Do not turn the knob while the drawtube is locked by the clamp. Doing so will damage the gears, resulting in gear play.

Drawtube Clamp

The drawtube clamp of the FSQ-130ED is located at the rear of the focusing knob. Pushing it to the rear of the focuser will lock the focuser and pushing it forward will unlock the focuser. This newly designed locking system will lock the focuser with great force so do not over tighten the

Never loosen these screws



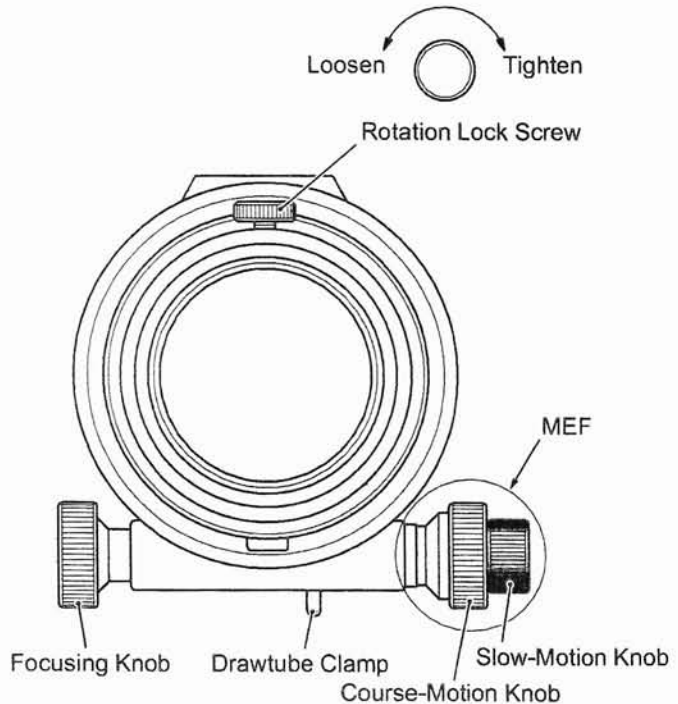
◆ Micro Edge Focuser (MEF)

The FSQ-130ED has an MEF built-in. This unit focuses with a reduction of 10 to 1 when the black knob is turned.

◆ Camera Angle Adjuster (CAA)

The oversized CAA is built-in the focuser unit. This allows a camera attached to the focuser to be turned 360° without loss of focus.

When the camera is rotated, turn the CAA to the desired angle for the camera.

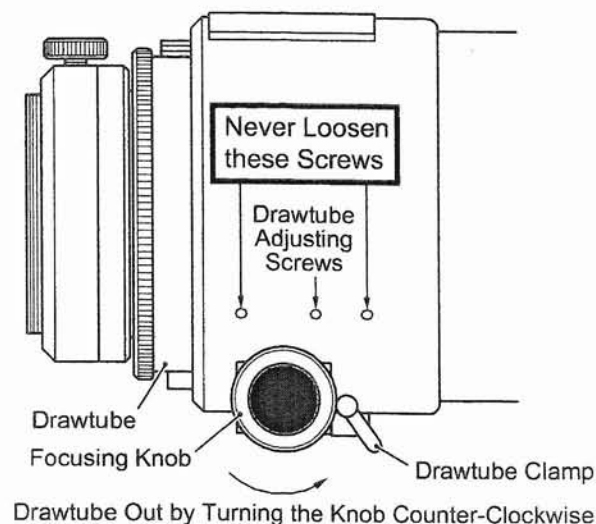


Focusing

After inserting an 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 an object at high magnification. Please familiarize yourself with the following.

◆ Focusing System

As explained on P-13, the FSQ-130ED uses the rack-and-pinion focusing system, which allows the user to focus rapidly by turning the focusing knob. In combination use with MEF, you can do fine focusing.



◆ Focusing Knob

When the telescope is directed to the zenith, the drawtube would come down by its dead weight and a heavy imaging set-up attached on the focuser unit. Before shipment, the focuser has been so adjusted that the focuser does not come down with a DSLR camera attached on it and the focuser knob can be turned lightly. So, if the turning of the focuser knob is heavy, adjust it with the following method.

The drawtube adjusting screw is provided on the side of the focuser unit. Under no circumstances should the other two screws be loosened. By tightening the drawtube adjusting screw with an Allen wrench provided, the movement of the drawtube can be made stiffer.

◆ Drawtube Clamp

The drawtube clamp is provided to lock the drawtube when focused. Visual observation will not so require the clamp, but when imaging, the clamp is needed to firmly lock the drawtube and prevent it from moving by the weight of imaging set-up. Whenever the drawtube is moved, do the clamp loosen.

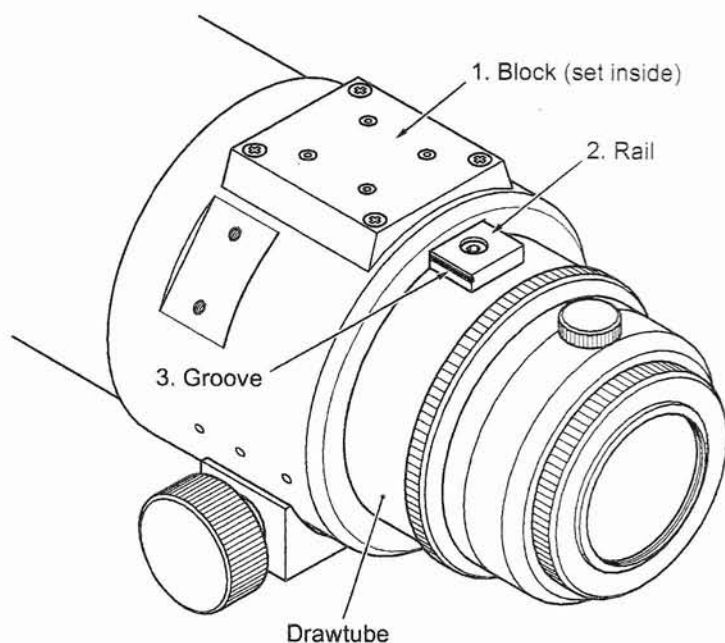
◆ Slide Guide

The Slide Guide is used in the focusing system of FSQ-130ED. A highly accurate ball bearing assembly provides smooth, accurate movement while remaining rigid.

Caution on use

1. Never loosen the Allen bolts locking the block and rail. The two bolts lock the block and rail on the draw tube.
2. Special grease is applied on the slide rail 2 & 3. This grease can keep the accuracy of the system. So, do not wipe off the grease. When dust sticks to the grease, remove the dust, but not the grease. When the grease is removed to a significant degree, move the draw tube forward and backward to lubricate the draw tube.

Do not use any other grease. When lubrication is necessary, call your local distributor for the proper grease.



Caution

Never loosen the screws plates 1 and 2. If these screws are loosened, the bearing assembly and drawtube can become in a loss of rigidity.

Finder Adjustment

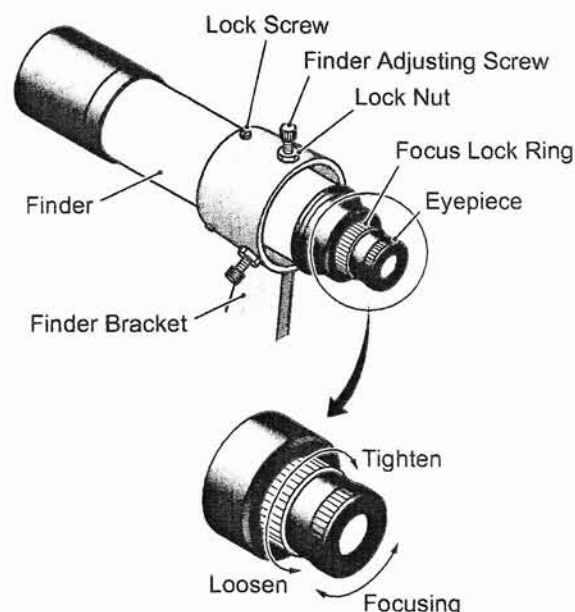
In the field of view of a telescope, the image is seen highly magnified so it is so difficult to get a desired object in the view field. Also when taking an object with a camera, the image of the object on the focal plane is so dark that makes it difficult to get it at the center of the field. A finder 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 imaged.

The Takahashi finder uses an interrupted crosshair which is designed to allow the easy centering of an object to be imaged or observed. The wide field of the finder can find an object easier in the view field. Therefore, it is important that the finder and the telescope be in alignment. The following procedures can be used to align the finder.

◆ Finder Focusing

If the finder is out of focus when you see an object far away, you can adjust the finder with the following procedures.

1. Loosen the focus lock ring.
2. Hold the eyepiece and turn it clockwise or counter-clockwise to find best focus point.
3. When the finder is focused, tighten the focus lock ring.

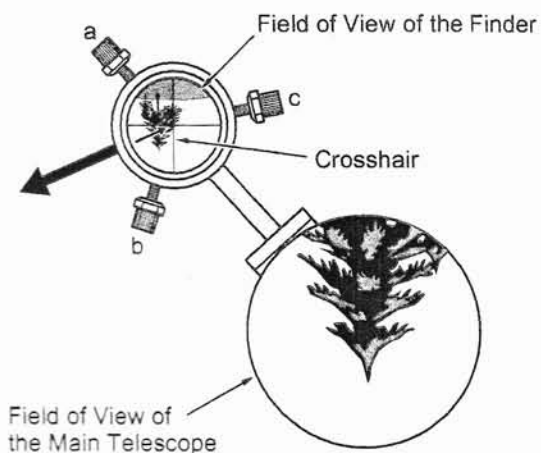


◆ Finder Alignment Procedure

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. Loosen the lock nuts on the finder bracket and slightly move the star to the center of the field using the adjusting alignment screws. If this procedure is done in daylight, use an object that is at least one mile away.
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.

◆ Adjusting Screw Procedure

1. Turn all the lock nuts until they reach the head of the finder adjusting screws. In order to move the crosshair in the direction of the arrow, first loosen screw (a) and tighten (push) the finder with screw (c). Next loosen screw (b) 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.
2. In the 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 lock screws.

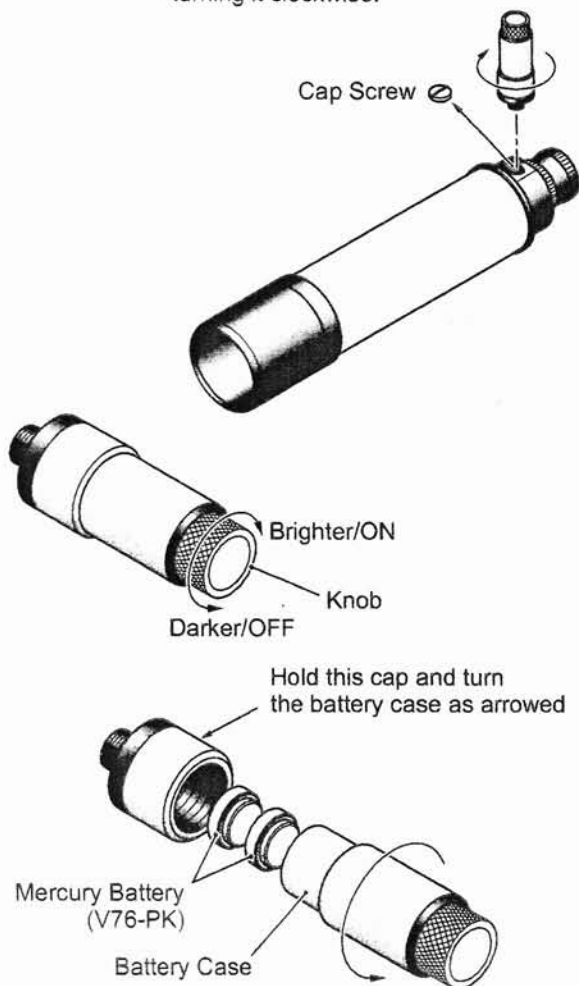


◆ Reticle Illuminator (Optional)

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.

Attach the illuminator on the finder, turning it clockwise.



◆ Replacing the Battery

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

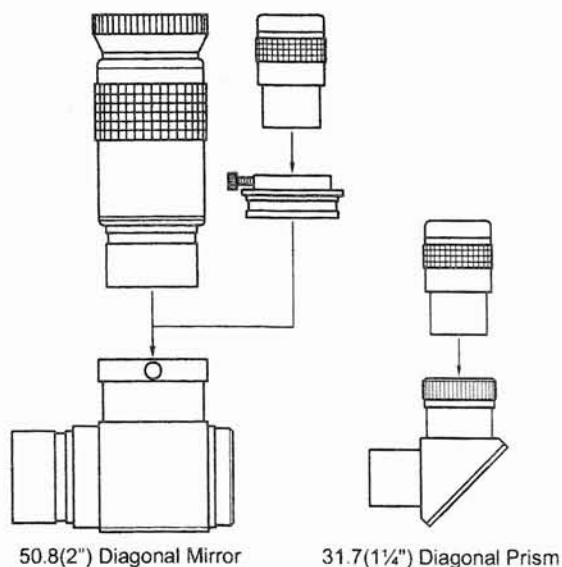
Observing

◆ Preparation for Observing

The FSQ-130ED has 5-element optical system including the largest lens of 130mm in diameter. Therefore it will take some time for the elements to reach the ambient temperature of the outside air, especially in low temperature. In order to equalize system to ambient temperature, the telescope and camera package should be left outside about one hour before imaging or observing can begin.

◆ Seeing

High magnification imaging of the Moon and planets require good or better seeing conditions. The method for determining the quality of seeing on a scale of 1 to 10, with 10 being perfectly steady seeing is to look to the zenith at a bright star. If it is twinkling rapidly, the seeing is between 1 to 4. If the twinkling is moderate, this is 5-6. If the star twinkles slowly to no twinkling, we have the 7 to 10 night. The less twinkle there is the better the seeing conditions.



(Note) 31.7/50.8 stand for 31.7mm/50.8mm.

◆ Visual Applications

▼ Determining Magnification

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

(focal length of a telescope) divided by
(focal length of an eyepiece)

For example with LE-5mm
 $650\text{mm} / 5\text{mm} = 130\times$

Therefore, shorter focal length eyepieces will produce the higher magnification. However, generally the upper limit of magnification will be $2\times$ of the aperture of a telescope and the lowest will be $0.14\times$ of the aperture of a telescope. Therefore, FSQ-130ED can produce the highest $260\times$ and the lowest $18\times$. Takahashi eyepieces can produce all the magnifications that FSQ-130ED can use.

▼ 31.7(1 1/4") Diagonal Prism

The 31.7 (1 1/4") diagonal prism is inserted into the compression ring adapter at the end of the focuser and tighten it until it holds the diagonal prism firmly in place. Then the eyepiece can be inserted into the compression ring adapter of the diagonal prism and held firmly by tightening the compression ring.

▼ 50.8(2") Diagonal Mirror

The Takahashi 50.8(2") diagonal mirror is useful for using a 50.8 (2") eyepiece when you view an object around the zenith. Please refer to the system chart for connection.

◆ Imaging

▼ Prime Focus Imaging

Focusing is the most critical element necessary to make outstanding astro images. Once critical focus has been achieved, then outstanding images can be made. It is a good practice to recheck critical focus before the image is made.

▼ Eyepiece Projection Imaging

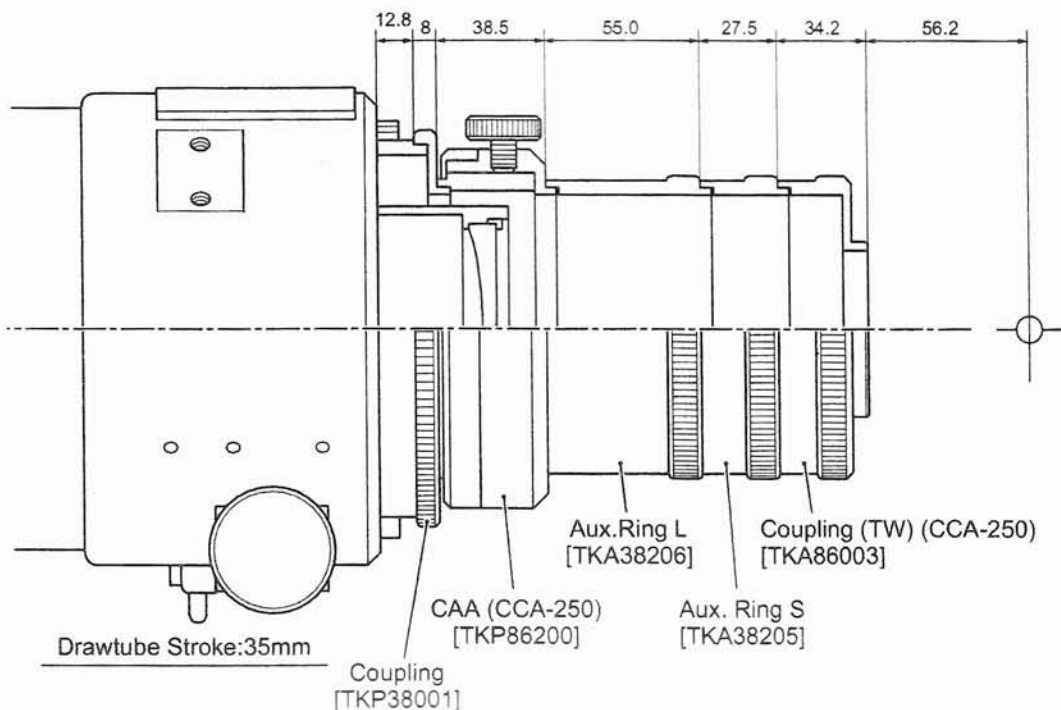
When you want to make lunar or planetary images, the TCA-4 is designed to make eyepiece projection images easier. The TCA-4 will accept any Takahashi 31.7 (1¼") eyepiece and variable feature sliding tube gives the imager latitude in determining the size of the final image.

▼ Back Focus

The back focus (the distance from the corrector lens to the focal plane) of FSQ-130ED is determined. In order to get highest possible optical performance as originally designed, this must be strictly kept. When you attach any accessory to the telescope, do it as shown in the system chart to insure the proper spacing.

⚠ Caution

When taking high magnification images of the Moon and planets, pay careful attention to balance. Rebalance the telescope when the object is placed in the center of the camera. If the Dec. clamp is not clamped, any unbalance will cause the scope to move abruptly. Whenever the Dec. clamp is loosened, hold the telescope with one hand and then loosen the clamp carefully.

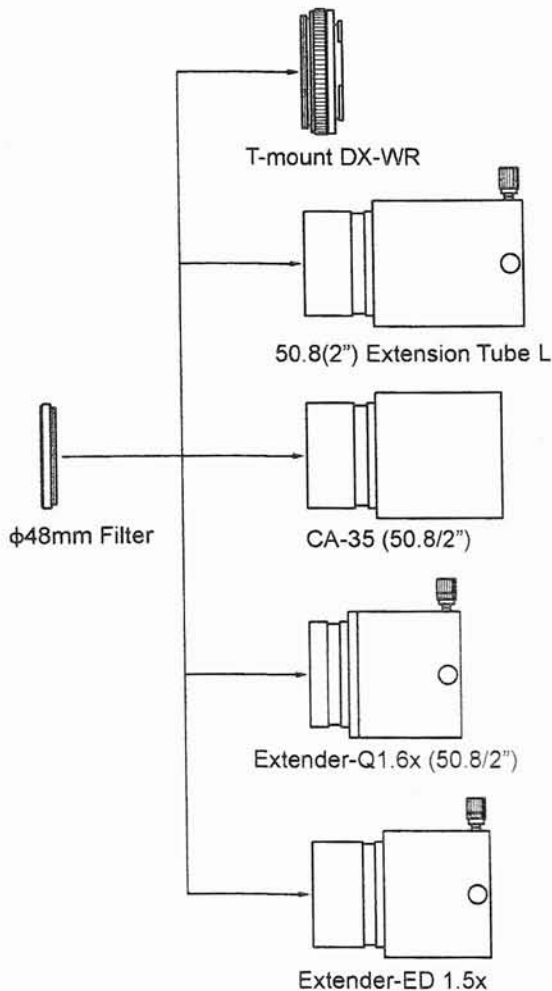


▼ Filter

The FSQ-130ED provides various system parts to attach 48mm filter.

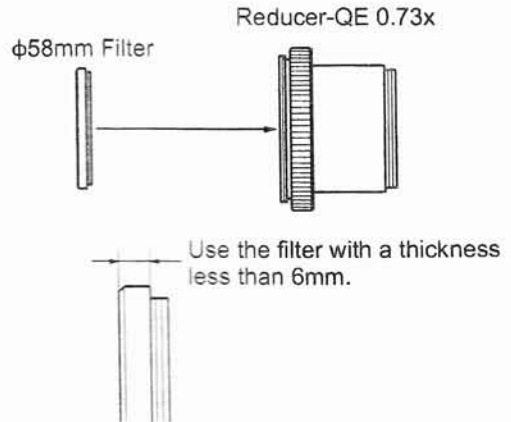
Some 48mm filters cannot be attached due to their frame and some can cause ghosting.

- 50.8(2") Extension Tube L, CA-35 (50.8/2"), Extender-Q 1.6x (50.8/2"), Extender-ED1.5x accepts a 48mm filter. 48mm filters with larger frame or larger sleeve are not usable with these system parts.
- Takahashi T-mount DX-WR accepts most of 48mm filters.



(Note) "50.8" in the connection stands for "50.8mm".

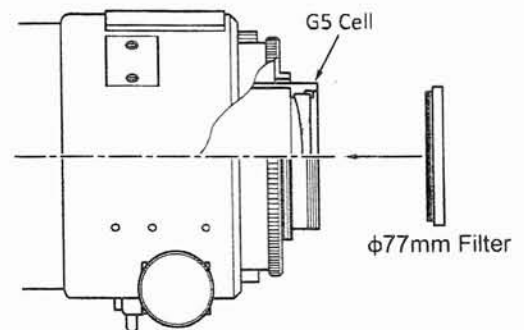
- Reducer-QE 0.73x accepts a 58mm filter.



⚠ Caution

When the drawtube of FSQ-130ED is drawn into the focuser, the clearance of the G5 lens is about 8mm. So, use a filter with a thickness of less than 6mm. Please take special care when double filters are used.

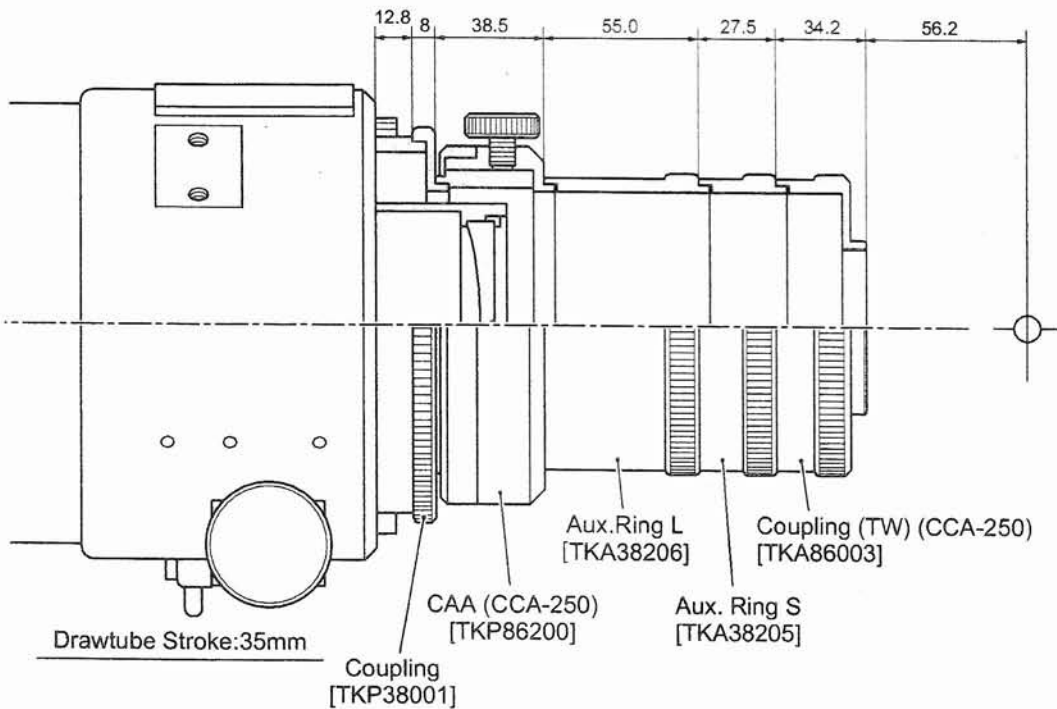
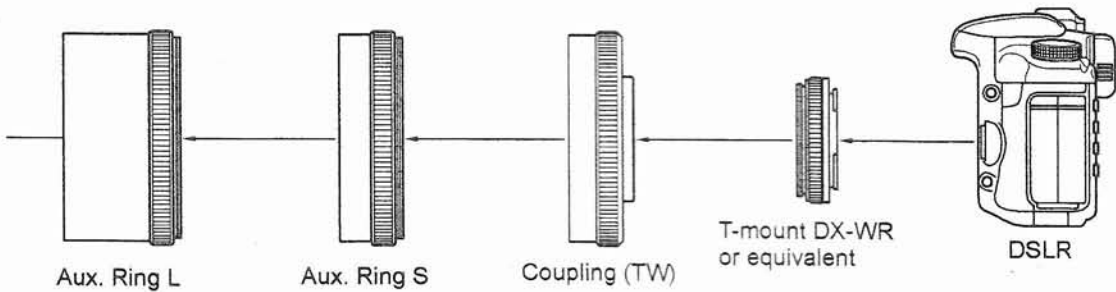
- At the end of the G5 cell, threads are provided for a 77mm filter. Remove the CAA (Camera Angle Adjuster)(CCA-250) and attach the filter after the drawtube is slid to the stop.



Accessories for Visual/Imaging Applications

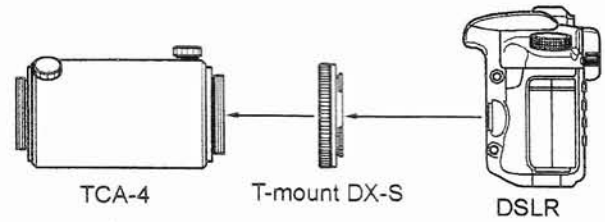
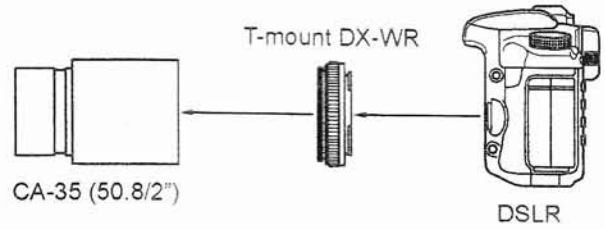
◆ Auxiliary Rings

In order to attach a camera for prime focus imaging, use the Aux. Rings. For connecting DSLR camera, Aux. Rings L, S and Coupling (TW) are used. Threads for connection are male and female of M98 P1.0 for all these couplings.



◆ **T-mount**

To attach a DSLR camera on the telescope, T-mount (DX-S) or equivalent for eyepiece projection imaging and T-mount (DX-WR) or equivalent for imaging with the prime focus, with 645 Reducer 0.7x, Reducer-QE 0.73x, Extender-ED 1.5x, and Extender-Q 1.6x. Takahashi T-mounts for EOS and Nikon are available.



(Note) 31.7/50.8 stand for 31.7mm/50.8mm.

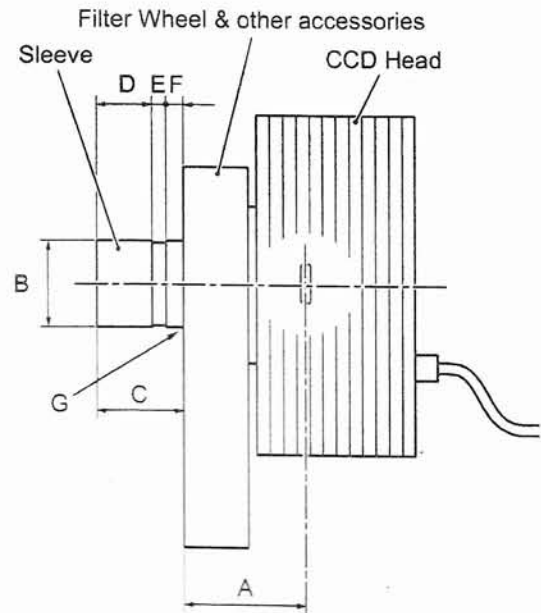
Caution

When connecting the wide T-mount or T-mount check the connector to see that both surfaces are clean and smooth to insure proper connection of these system parts. Incorrect connection will cause the parts to shift and distort the stars in the field. Make certain that all imaging parts in the train are properly connected.

◆ **CCD Camera**

In general, a CCD camera can be attached by way of 31.7(1¼)/50.8(2") Sleeve or T-Thread (42mm P-0.75). A CCD camera which can be attached with T-Mount and can be attached to FSQ-130ED with a combination of CA-35 and Wide T-Mount as same adapter used for connecting a 35mm DSLR.

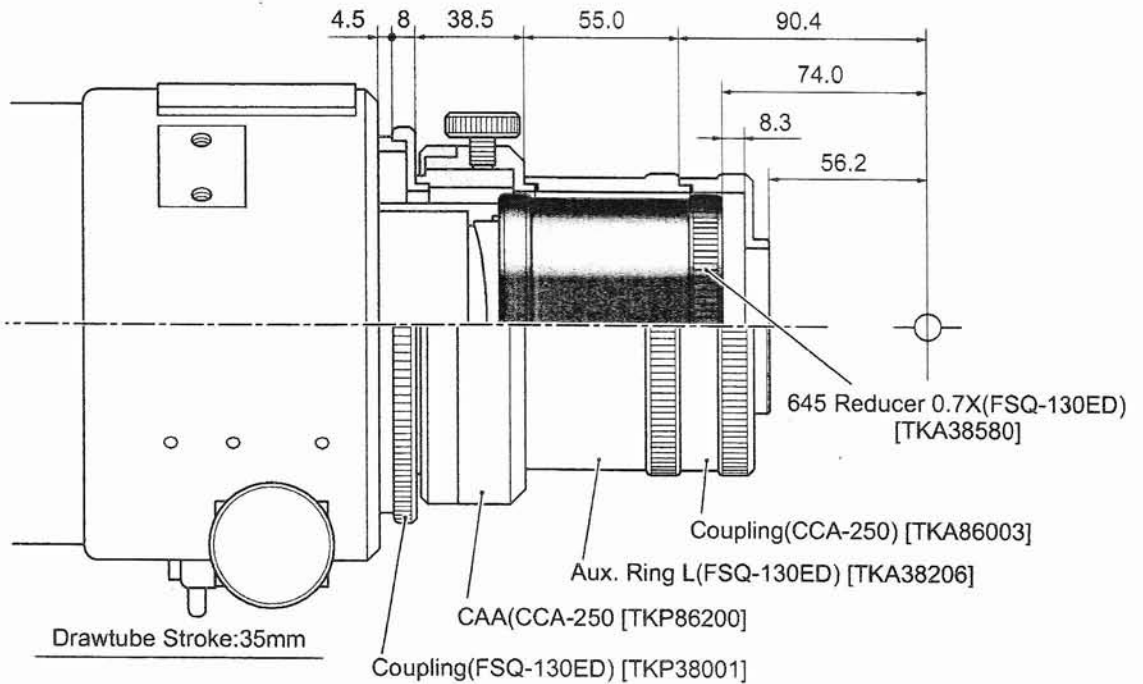
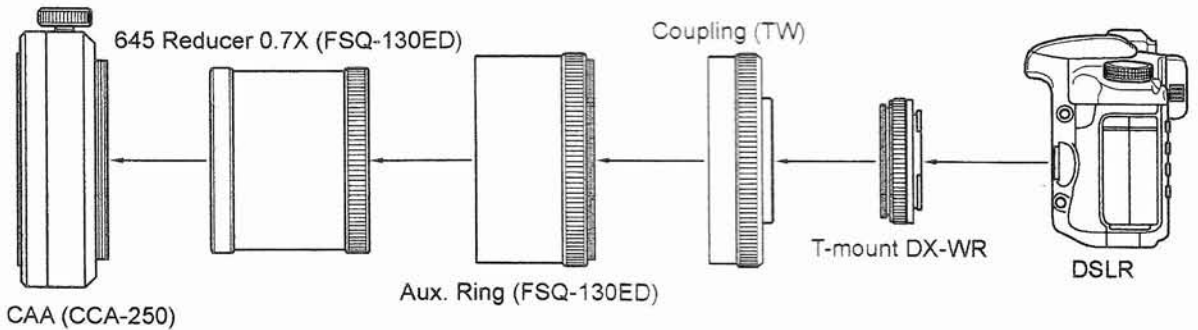
The FSQ-130ED has a long metal back (182.9mm). This will allow the attaching of various imaging set-ups. Refer to right figure.



- A. Distance of Plane Sleeve Connector to CCD Focal Plane [be accurate within less than 1mm]
- B. Outer Diameter of the Sleeve [31.7(1 ¼") or 50.8(2")]
- C. Full Length of Sleeve
- D. ————
- E. ———— Position of Sleeve's Groove
- F. ————
- G. Diameter and Pitch of Sleeve's Thread

◆ 645 Reducer 0.7x (FSQ-130ED)

The 645 reducer 0.7x changes the focal ratio 455mm (f/3.5), The image circle is $\phi 70\text{mm}$ dia., large enough to cover a full sized 645 sensor. The full frame 35mm format is illuminated 90% across the entire field. The Takahashi T-Mount DX-WR or equivalent is used to attach the 645 reducer 0.7x to FSQ-130ED.

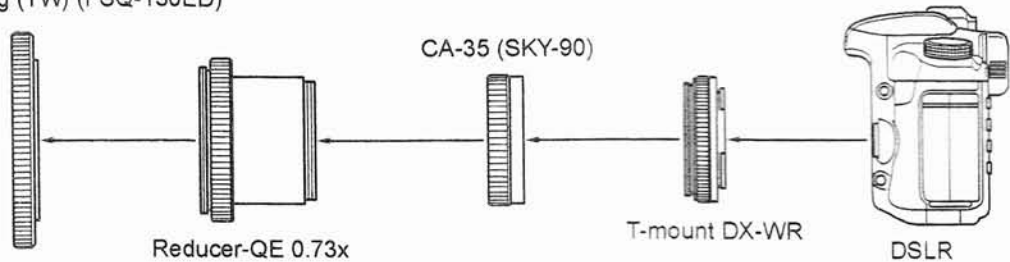


◆ **Reducer-QE 0.73x**

The Reducer-QE 0.73x changes the focal length of FSQ-130ED 470mm (f/3.6) and can produce a flat image less than 10 microns across. CA-35(SKY-90) or T-Mount DX-WR can be used for connection.

▼ **Reducer-QE 0.73x**
 Focal length: 470mm
 Focal ratio: f/3.6
 Image circle: ø44mm dia.

Coupling (TW) (FSQ-130ED)

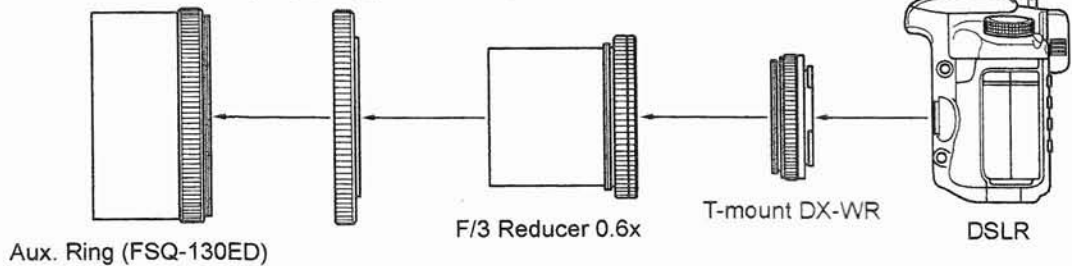


◆ **F/3 Reducer 0.6x**

The new f/3 reducer 0.6x is a high-performance reducer designed to reduce the focal length to f/3 for FSQ-130ED premium astrograph.

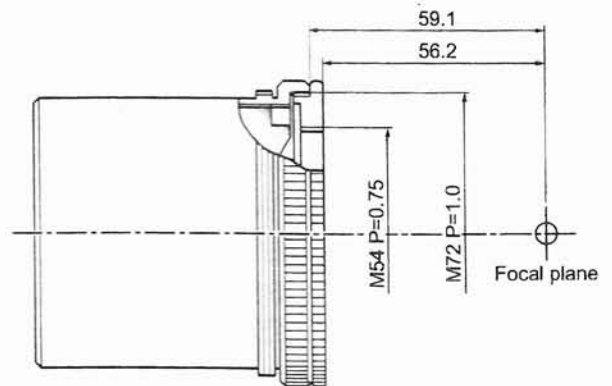
▼ **F/3 Reducer 0.6x**
 Focal length: 390mm
 Focal ratio: f/3
 Image circle: ø44mm dia.

Coupling (TW) (FSQ-130ED)



The image circle of ø44mm corresponds to a full 35mm frame. At f/3 the use of high refractive index and low dispersion glass suppresses any possible lateral chromatic aberration and chromatic coma.

The f/3 reducer 0.6x produces very sharp 6 microns stars when used with the FSQ-130ED.



Back Focus Diagram

◆ CA-35

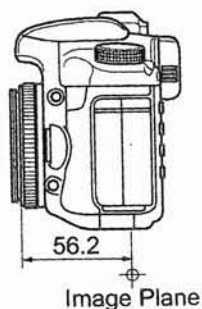
When the Reducer-QE 0.73x or a Takahashi Extender is used for imaging with a DSLR, CA-35 is necessary to connect some connection parts and T-Mount DX-WR. Dependent on imaging, CA-35(50.8/2") or CA-35(SKY-90) is used with FSQ-130ED. CA-35(50.8/2") can be used for prime focus imaging.

▼ Light Path Length

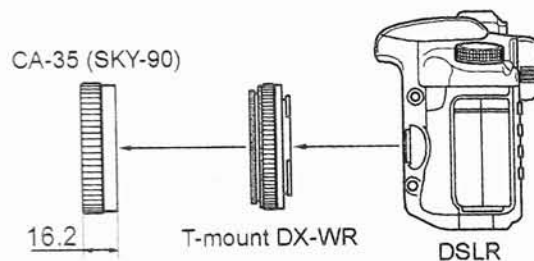
CA-35(SKY-90) : About 16.2mm

CA-35(50.8/2") : About 61.5mm

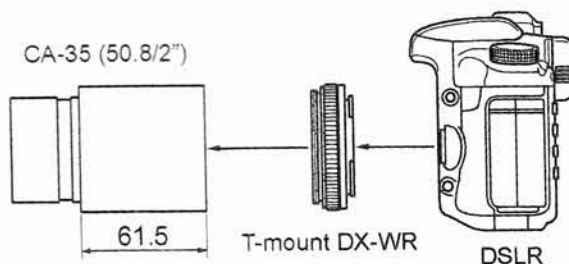
CA-35 front end to the image plane :
About 56.2mm



▼ CA-35(SKY-90) for imaging with the Reducer-QE 0.73x



▼ CA-35(50.8/2") for imaging at the prime focus or with an extender



(Note) 31.7/50.8 stand for 31.7mm/50.8mm.

◆ **Extender-ED 1.5x**

The Extender-ED 1.5x has 2-group 2-element extender that extends the focal length by 1.5x, while maintaining the high level of correction for the FSQ-130ED. When this extender is used, the corrected field of the FSQ-130ED will be best at the center of the field and the high magnification views will rival the TOA-130.

The focal length of FSQ-130ED is a short, 650mm. Therefore to get high magnification, an eyepiece with shorter focal length must be used. In general, eyepieces with shorter focal length have shorter eye-relief, which will make the observer tired in a long observing session. The Extender-ED 1.5x will extend the focal length of FSQ-130ED to 980mm. So, the observer can use an eyepiece with a long eye relief with FSQ-130ED for more comfortable observing of highly magnified lunar and planets.

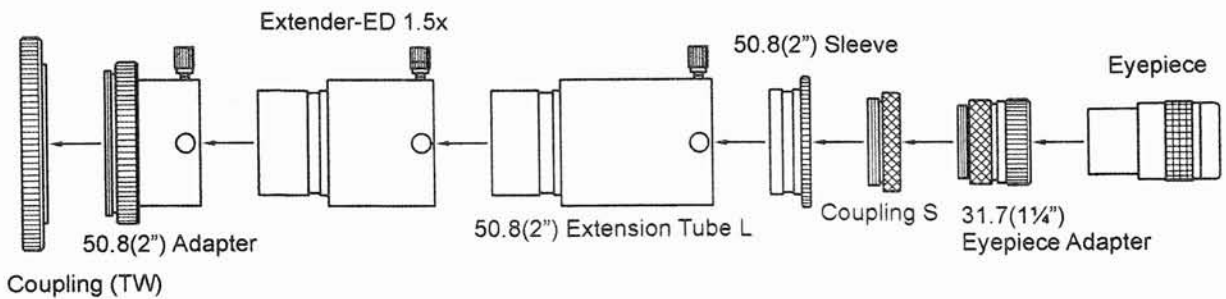
When used with the Extender-ED 1.5x, aberration toward the edge of the field will be increased, but the image size will be 30 micron at the corner of full size, keeping 65% illuminated. So, this can be used well for deep sky imaging.

▼ **Extender-ED 1.5x**

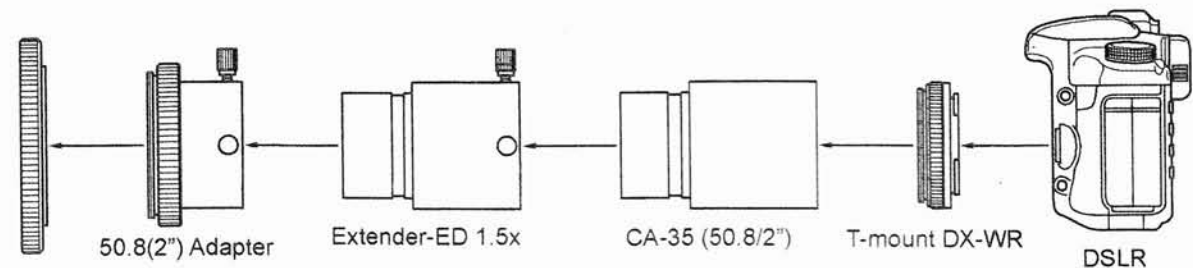
Focal length: 980mm

Focal ratio: f/7.5

Image circle: ϕ 44mm dia.



Coupling (TW)



Coupling (TW)

(Note) 31.7/50.8 stand for 31.7mm/50.8mm.

Caution:

When 50.8(2'') Extension Tube L or CA-35(50.8/2'') is connected with the Extender-ED 1.5x at the rear, do not attach any filter with these parts. It would hit the extender lens, causing damage on it.

◆ Extender-Q 1.6x (50.8/2")

The FSQ-130ED is a short focal length visual/imaging astrograph. Nonetheless, due to the very high performance of the optics, the FSQ-130ED can be used for high magnification lunar and planetary observations. The Extender-Q 1.6x (50.8/2") is designed to increase the focal length sufficiently to produce the higher magnifications necessary for this type of observing.

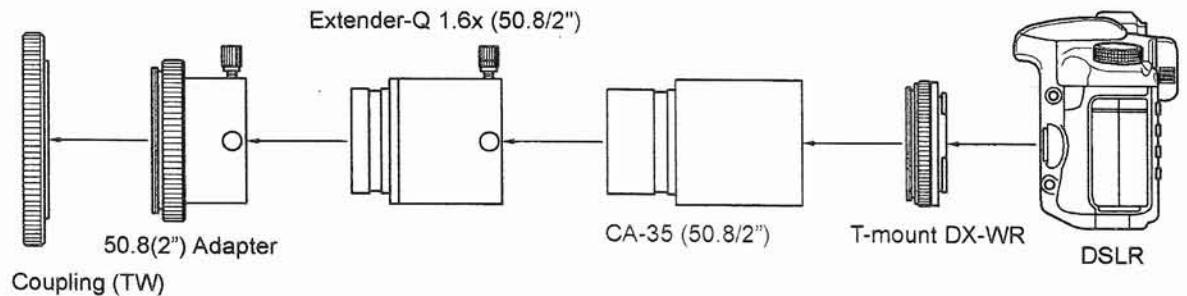
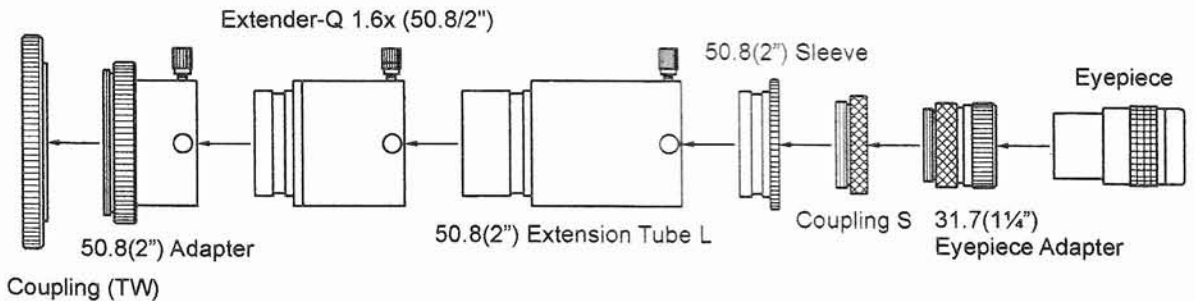
When used with the Extender-Q 1.6x, the image size will be 10 micron at the corner of full size. So, this can be used well for deep sky imaging.

▼ Extender-Q 1.6x (50.8/2")

Focal length: 1040mm

Focal ratio: f/8.0

Image circle: \varnothing 44mm dia.



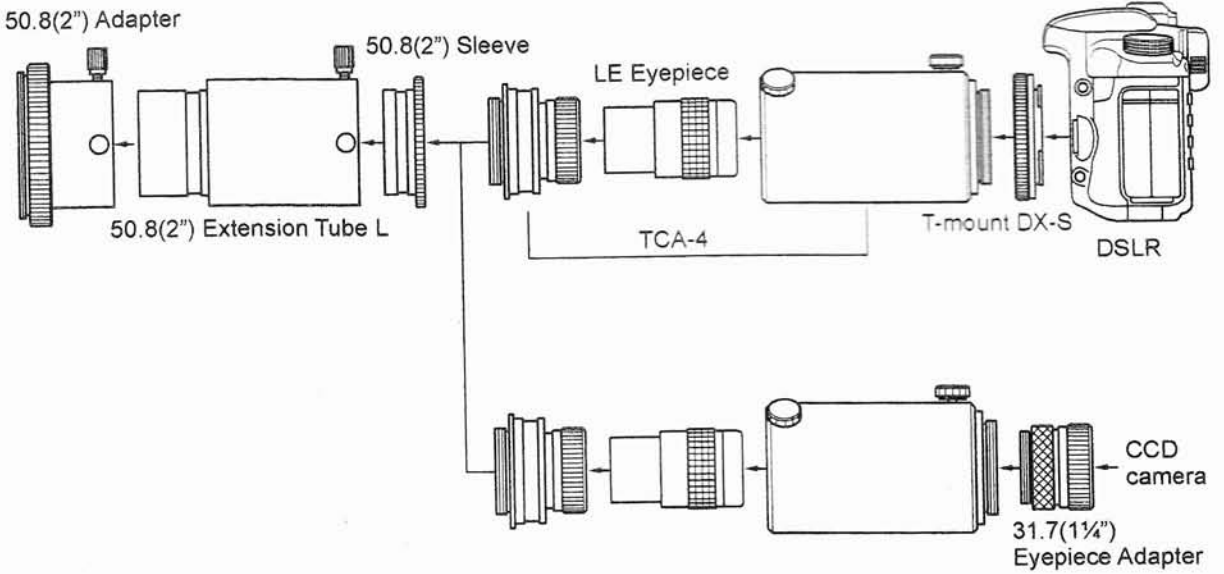
(Note) 31.7/50.8 stand for 31.7mm/50.8mm.

Caution:

When 50.8(2") Extension Tube L or CA-35(50.8/2") is connected with the Extender-Q 1.6x at the rear, do not attach any filter to these parts. It will hit the extender lens, causing damage.

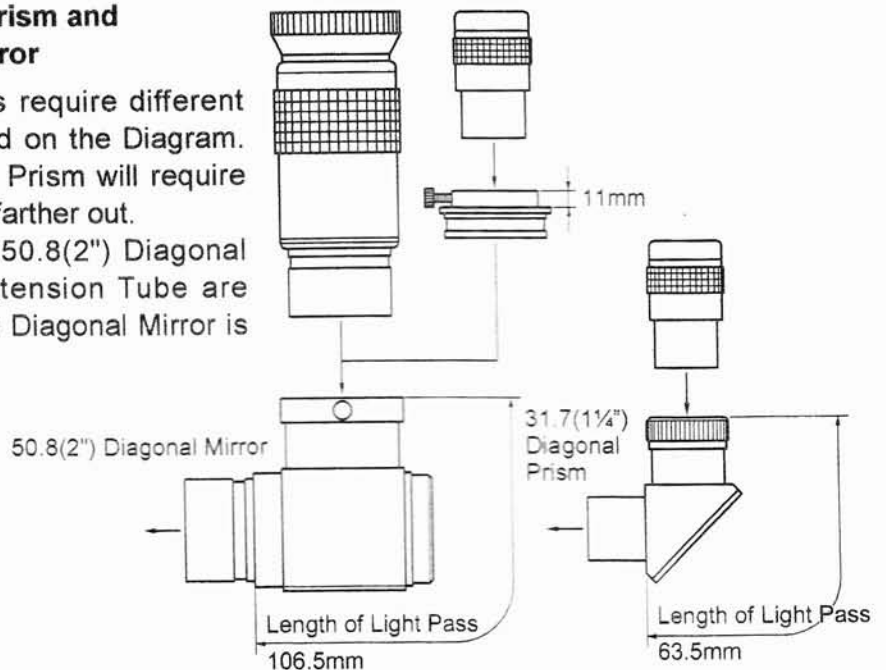
◆ **TCA-4**

This variable eyepiece projection device can be attached easily on the FSQ-130ED for high quality and high magnification imaging of the surface of the Moon and planets. It can be used with a DSLR or CCD camera.



◆ **31.7(1 1/4'') Diagonal Prism and 50.8(2'') Diagonal Mirror**

Both of these diagonals require different back focus. This is noted on the Diagram. The 31.7(1 1/4'') Diagonal Prism will require the focuser to be racked farther out. Length of light pass in 50.8(2'') Diagonal Mirror and 50.8(2'') Extension Tube are same size, then 50.8(2'') Diagonal Mirror is more useful.

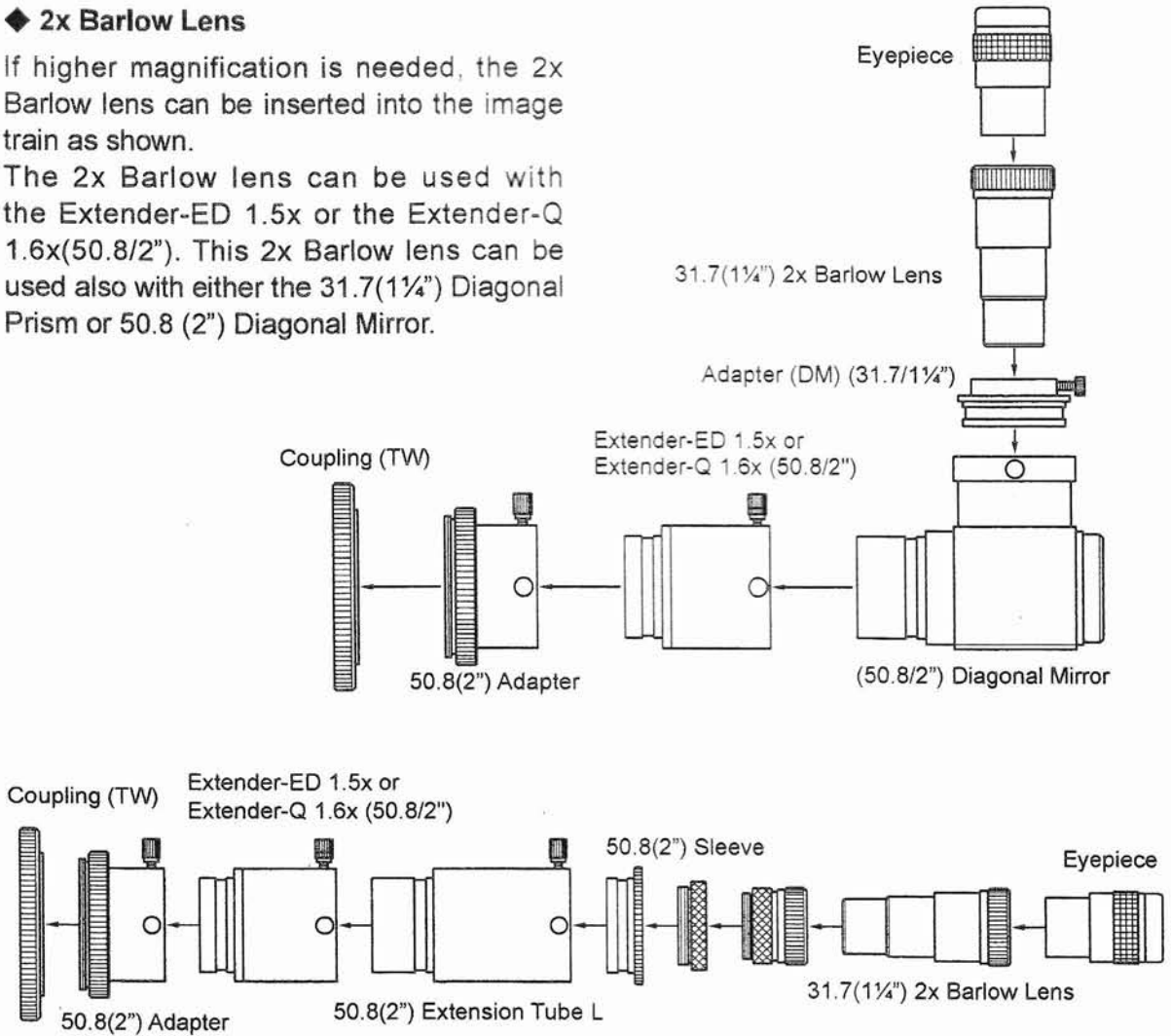


(Note) 31.7/50.8 stand for 31.7mm/50.8mm.

◆ 2x Barlow Lens

If higher magnification is needed, the 2x Barlow lens can be inserted into the image train as shown.

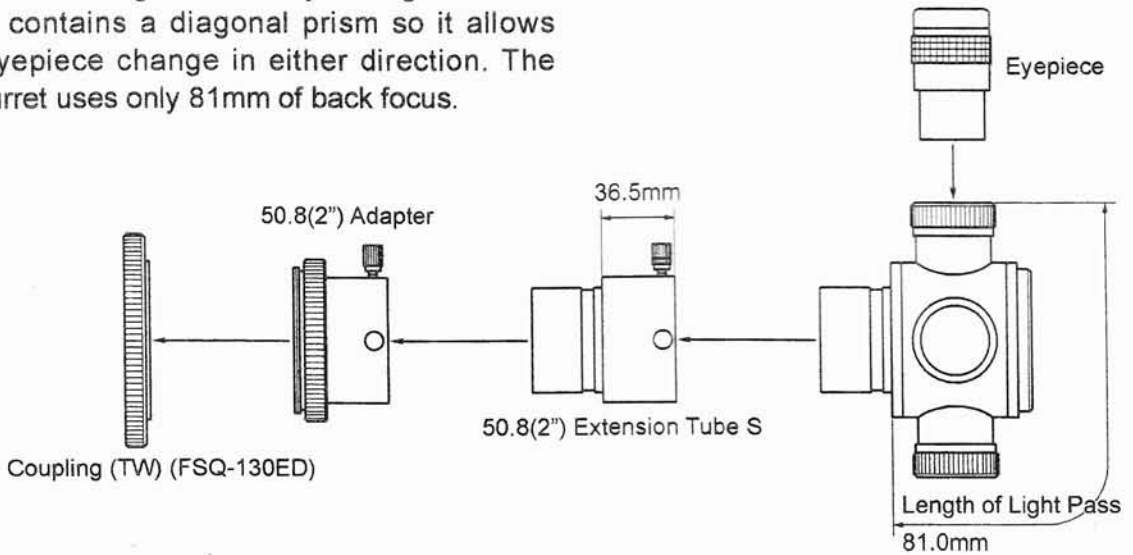
The 2x Barlow lens can be used with the Extender-ED 1.5x or the Extender-Q 1.6x(50.8/2"). This 2x Barlow lens can be used also with either the 31.7(1¼") Diagonal Prism or 50.8 (2") Diagonal Mirror.



(Note) 31.7/50.8 stand for 31.7mm/50.8mm.

◆ 4-Turret Eyepiece Holder 31.7D

The Takahashi 4-Turret Eyepiece Holder 31.7D is a very convenient tool for quick change of 31.7(1¼") eyepieces during an observing session to obtain various magnifications. 4 different eyepieces can be attached at one time so that it permits 4 different magnifications by turning the turret. It contains a diagonal prism so it allows eyepiece change in either direction. The turret uses only 81mm of back focus.

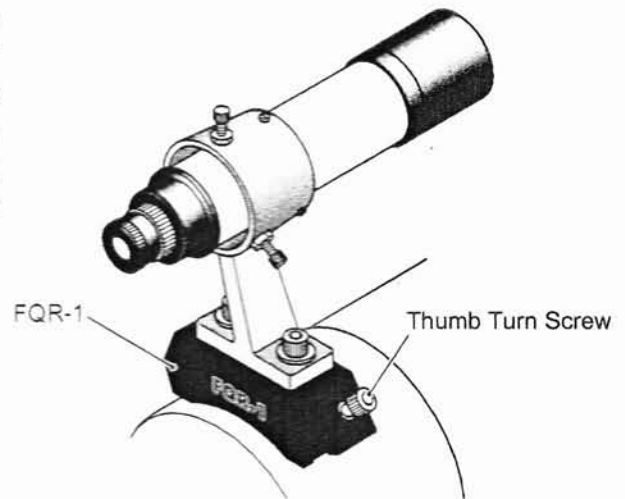


(Note) 31.7/50.8 stand for 31.7mm/50.8mm.

4-Turret Eyepiece Holder 31.7D

◆ FQR-1

The FQR-1 is a very convenient device which allows a finder to be attached or removed from the telescope. Once it is set on the focuser housing, you can attach and detach the finder quickly by thumb turn screw. The finder alignment remains almost the same.



Care & Maintenance

◆ Collimation

FSQ-130ED is provided with collimation device. However, it is very hard for a user to collimate the optical axis of 5-element. Under no circumstance should it be touched. Doing so will void the warranty.

Every FSQ-130ED has been strictly and perfectly collimated in the factory before shipment and there will be little chance to be decollimated in normal use. If the FSQ-130ED decollimates as a result of a strong shock during transport, contact your local distributor for help with this situation.

◆ Care of Lens

Before attempting to clean your optics, contact your local distributor for precise instructions on the cleaning procedures.

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 the proper lens cleaner, gently clean the particles off.

Additional Precautions

◆ REMEMBER, DO NOT USE ANY FORM OF CANNED AIR TO REMOVE THE PARTICLES.

This product is very cold and could harm the front lens of the objective. Use the following procedure, if the front and rear surfaces of the objective must be cleaned.

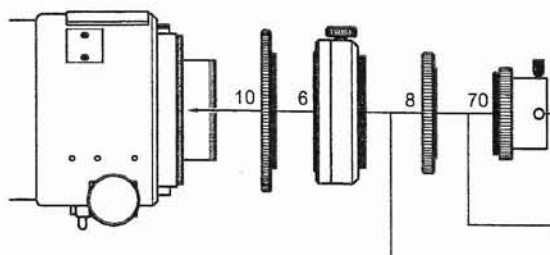
- ▼ Keep the telescope away from large fluctuations in temperature. When the instrument is brought out from a warm room to cold air, dew may form.
- ▼ Store the telescope in a cool dry environment. Any dew should be removed by blowing it with a hair dryer with the heat element **TURNED OFF**, which means 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 desiccant (drying agent) near the objective to keep any moisture away.
- ▼ 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 a cool room using a hand blower to remove unwanted dust.
- ▼ 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.

System Charts

◆ Visual/Imaging System Chart

▼ Standard Accessories

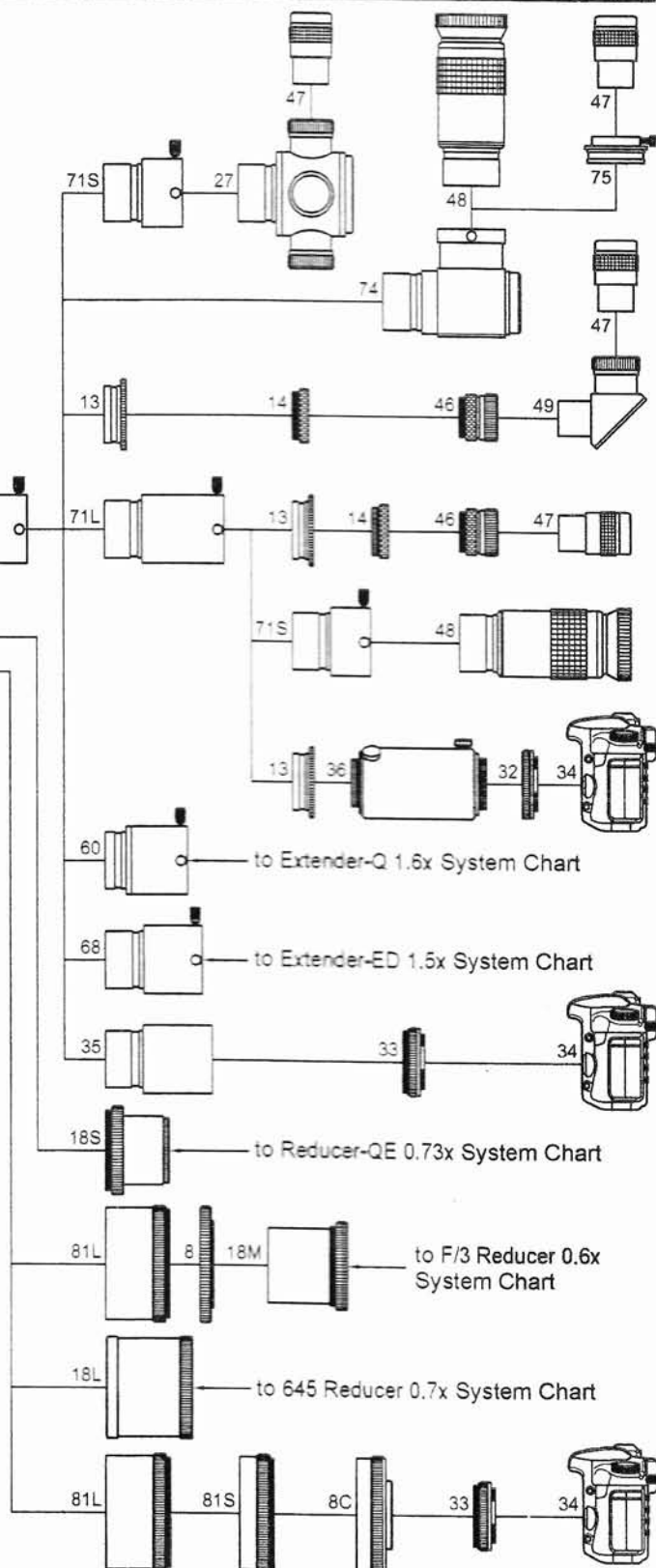
- 6. CAA (CCA-250) [TKP86200]
- 8. Coupling (TW) (FSQ-130ED) [TKP38003]
- 10. Coupling (FSQ-130ED) [TKP38001]
- 13. 50.8(2") Sleeve [TKP00113]
- 14. Coupling S [TKP00103]
- 46. 31.7(1 1/4") Eyepiece Adapter (TKP00101)
- 70. 50.8(2") Eyepiece Adapter [TKP27110]
- 71L. 50.8(2") Extension Tube L [TKP31112]



▼ Optional Accessories

- 8C. Coupling (CCA-250) [TKP86003]
- 18S. Reducer-QE 0.73x [TKA36580]
- 18M. F/3 Reducer 0.6x (FSQ-130ED) [TKA38581]
- 18L. 645 Reducer 0.7x (FSQ-130ED) [TKA38580]
- 27. 4-Turret Eyepiece Holder 31.7D [TKA00404]
- 32. T-Mount DX-S (EOS) [TKA01250]
T-Mount DX-S (Nikon) [TKA01254]
- 33. T-Mount DX-WR (EOS) [TKA01251]
T-Mount DX-WR (Nikon) [TKA01255]
- 34. Digital SLR Camera (Canon/Nikon)
- 35. CA-35 (50.8/2") [TKA31201]
- 36. TCA-4 (Eyepiece Projection) [TKA00210]
- 47. 31.7(1 1/4") Eyepiece
- 48. 50.8(2") Eyepiece
- 49. 31.7(1 1/4") Diagonal Prism MC [TKA00547]
- 60. Extender-Q 1.6x (50.8/2") [TKA36595]
- 68. Extender-ED 1.5x [TKA37595]
- 71S. 50.8(2") Extension Tube S [TKA00105]
- 74. 50.8(2") Diagonal Mirror [TKA00543]
- 75. Adapter (DM) (31.7/1 1/4") [TKA00111]
- 81S. Aux. Ring S (FSQ-130ED) [TKA38205]
- 81L. Aux. Ring L (FSQ-130ED) [TKA38206]

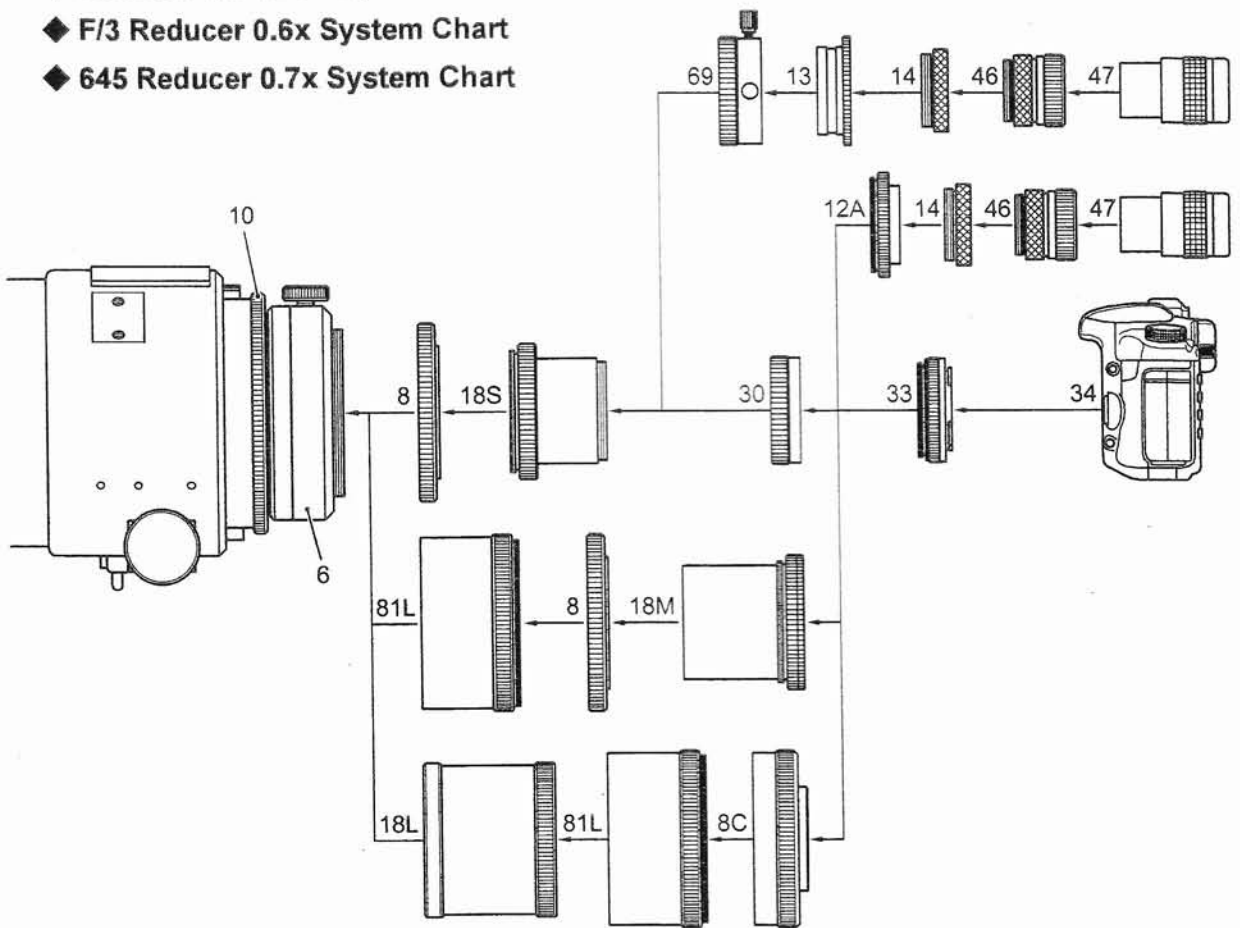
(Note) Some DSLR can not be attached.
31.7/50.8 stand for 31.7mm/50.8mm.



◆ Reducer-QE 0.73x System Chart

◆ F/3 Reducer 0.6x System Chart

◆ 645 Reducer 0.7x System Chart



▼ Standard Accessories

- 6. CAA(CCA-250) [TKA86200]
- 8. Coupling (TW) (FSQ-130ED) [TKP38003]
- 10. Coupling (FSQ-130ED) [TKP38001]
- 13. 50.8(2") Sleeve [TKP00113]
- 14. Coupling S [TKP00103]
- 46. 31.7(1¼") Eyepiece Adapter [TKP00101]

▼ Optional Accessories

- 8C. Coupling (CCA-250) [TKP86003]
- 12A. Visual Adapter (CCA-250) [TKP86005]
- 18S. Reducer-QE 0.73x [TKA36580]
- 18M. F/3 Reducer 0.6x [TKA38581]
- 18L. 645 Reducer 0.7x(FSQ-130ED) [TKA38580]
- 30. CA-35 (SKY-90) [TKA35201]
- 33. T-Mount DX-WR (EOS) [TKA01251]
T-Mount DX-WR (Nikon) [TKA01255]
- 34. Digital SLR Camera (Canon/Nikon)
- 47. 31.7(1¼") Eyepiece
- 69. 50.8(2") Eyepiece Adapter (SKY-90) [TKA35110]
- 81L. Aux. Ring (FSQ-130ED) [TKA38206]

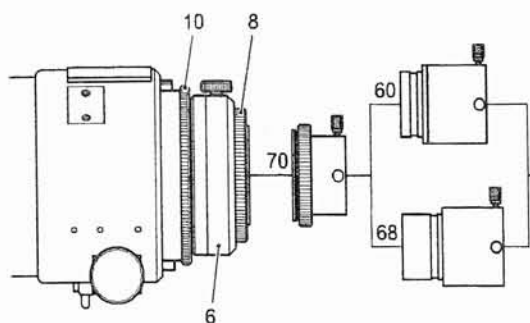
(Note) Some DSLR cameras can not be attached.
31.7/50.8 stand for 31.7mm/50.8mm.

◆ Extender-Q 1.6x(50.8/2") System Chart

◆ Extender-ED 1.5x System Chart

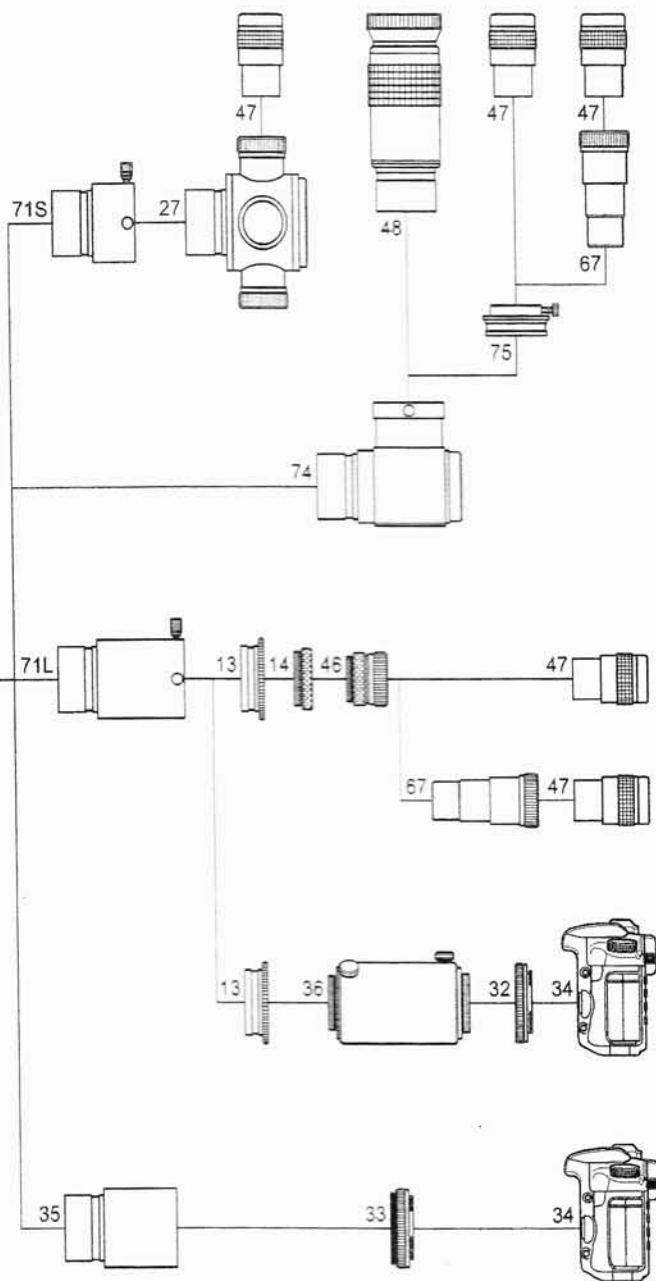
▼ Standard Accessories

- 6. CAA (CCA-250) [TKP86200]
- 8. Coupling (TW)(FSQ-130ED) [TKP38003]
- 10. Coupling (FSQ-130ED) [TKP38001]
- 13. 50.8(2") Sleeve [TKP00113]
- 14. Coupling S [TKP00103]
- 46. 31.7(1¼") Eyepiece Adapter [TKP00101]
- 70. 50.8(2") Eyepiece Adapter [TKP27110]
- 71L. 50.8(2") Extension Tube L [TKP31112]



▼ Optional Accessories

- 27. 4-Turret Eyepiece Holder 31.7D [TKA00404]
- 32. T-Mount DX-S (EOS) [TKA01250]
T-Mount DX-S (Nikon) [TKA01254]
- 33. T-Mount DX-WR (EOS) [TKA01251]
T-Mount DX-WR (Nikon) [TKA01255]
- 34. Digital SLR Camera (Canon/Nikon)
- 35. CA-35 (50.8/2") [TKA31201]
- 36. TCA-4 (Eyepiece Projection) [TKA00210]
- 47. 31.7(1¼") Eyepiece
- 48. 50.8(2") Eyepiece
- 60. Extender-Q 1.6x (50.8/2") [TKA36595]
- 67. 31.7(1¼") 2x Barlow Lens [TKA00597]
- 68. Extender-ED 1.5x [TKA37595]
- 71S. 50.8(2") Extension Tube S [TKA00105]
- 74. 50.8(2") Diagonal Mirror [TKA00543]
- 75. Adapter DM (31.7/1¼") [TKA00111]



(Note) Some DSLR can not be attached.
31.7/50.8 stand for 31.7mm/50.8mm.

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