Instruction Manual for the Obsession 12.5” Dobsonian Telescope

Obsession 12.5” Telescope Model Specifications

Focal Ratio	f/5
Focal Length	1590 mm (±50mm)
Primary Mirror	12.5”
Secondary Mirror	2.14”
Limiting stellar magnitude	15
Rayleigh Resolution Limit	0.38 arc seconds
Contrast Limit	6.0 arc minute
Mirror Box Weight	Around 18 kg
Weight at Handles	Around 3 kg

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Cover image: “The Starry Night” by Vincent van Gogh

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This instruction manual is only applicable to the model listed above (including the specifications). Please read the entire manual carefully before beginning.

Do not use this telescope to look directly at the sun. Attempts to do so may result in eye damage. Do not leave the telescope under sunlight, as it can set itself on fire.

Understanding the Telescope

What is a Dobsonian telescope and how does it work?

A Dobsonian telescope is an alt-azimuth-mounted Newtonian telescope design popularised by John Dobson in 1965. As shown in Figure 1, the image is formed by the primary mirror and reflected by the secondary mirror to the eyepiece, from which we can observe the object.

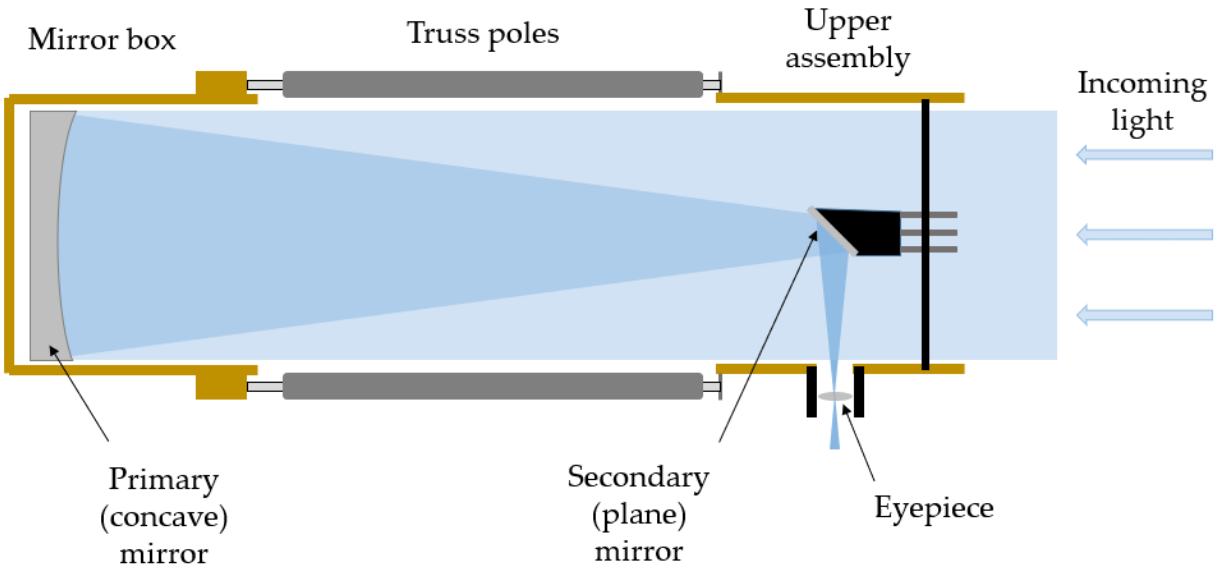


Figure 1: Ray diagram of the telescope.

Inventory List

It is a good idea to make sure you have everything before an observation session (and after!). Do return everything to their original place(s) once you have finished using the telescope.

Index	Name of component (with quantity)	Description
A	Lower assembly (1)	Contains the mirror box with the primary mirror inside Also contains the ServoCAT main unit, motors and encoders
B	Upper assembly (1)	Contains the secondary mirror, the focuser and the finder scope mounting bracket
C	Wheelbarrow handles (2)	For transporting the telescope
D	Power tank (1)	Provides power to the ServoCAT system and the fan
E	Power tank cable (1)	Has a “cigarette” plug at one end, for connecting the power tank to the telescope
F	Truss poles (8)	Connects the upper assembly with the lower assembly
G	ServoCAT hand controller (1)	Controls the motor for navigating the telescope
H	Argo Navis unit (1)	A telescope computer that provides positioning information of the telescope and a database of a large number of astronomical objects
I	Tangent arm (1)	A black metal plank that holds the servo arm of the altitude encoder
J	8-conductor RJ-45 cable (1)	A split cable that connects the Argo Navis unit to the two encoders on the telescope
K	4-conductor RJ-11 cable (1)	A single cable that connects the Argo Navis unit to the ServoCAT main unit
L	Finder scope (box) (1)	Provides a wide-field view when locating objects
M	3.5-mm eyepiece (box) (1)	For the observer to look through and view the image of the object. In general, the larger the focal length of the eyepiece, the smaller the magnification and the wider the field of view
	8-mm eyepiece (box) (1)	
	17.3-mm eyepiece (box) (1)	
	31-mm eyepiece (box) (1)	
N	2-to-1.25-inch eyepiece adapter (1)	For fitting 1.25-inch eyepieces to the focuser
O	Laser collimator (box) (1)	Contains a laser used for collimation
P	2” Barlow lens (box) (1)	Gives additional magnification
Q	Ultra High Contrast (UHC) filter (1)	A light pollution filter to improve the visibility of deep-sky objects
R	Counterweight kit (1)	Balances the mount, especially when using a heavy eyepiece, Barlow lens or camera

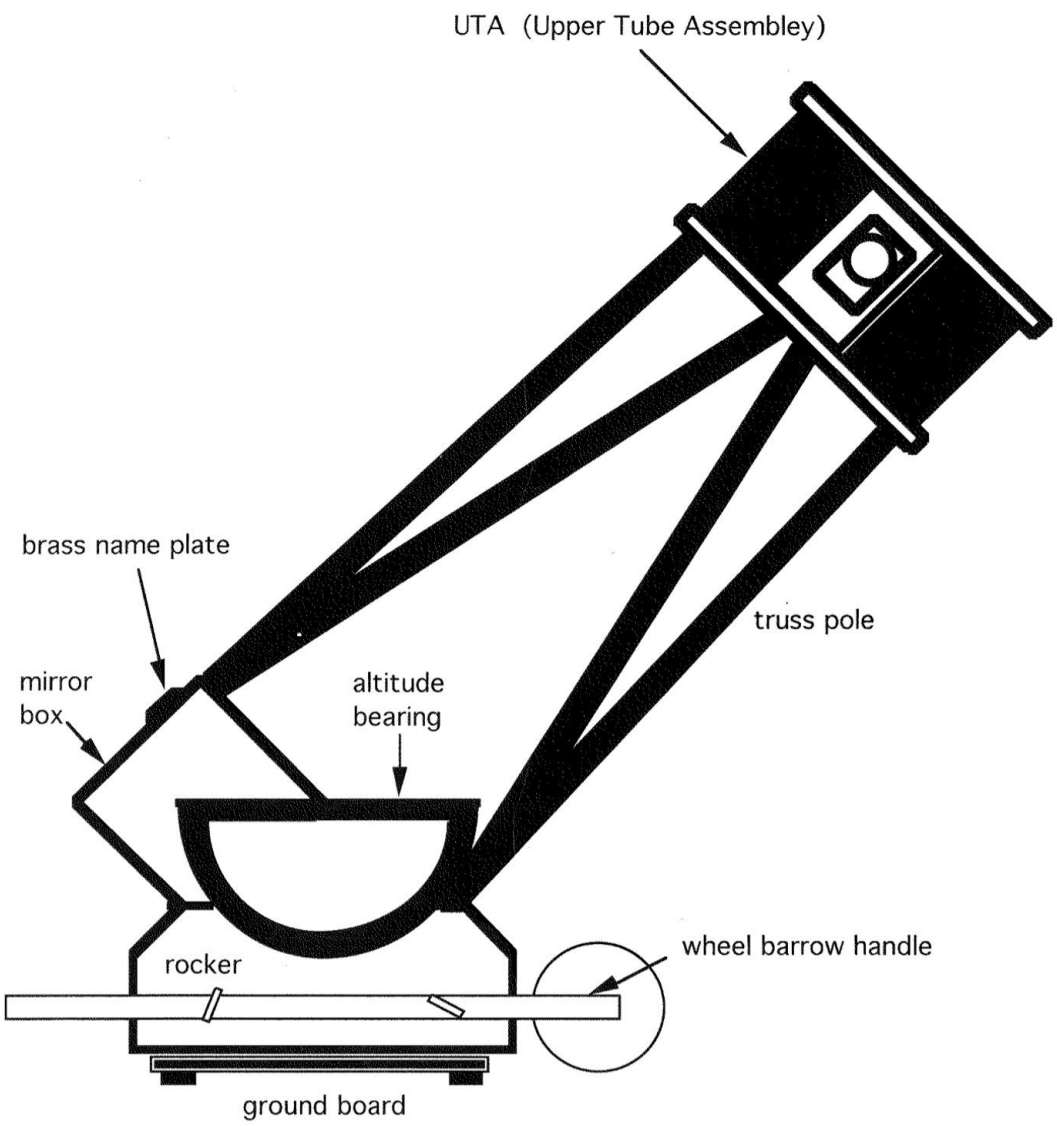


Figure 2: Basic terminology[1].

[1] Image taken from the original manual for the Obsession 12.5" Dobsonian Telescope.

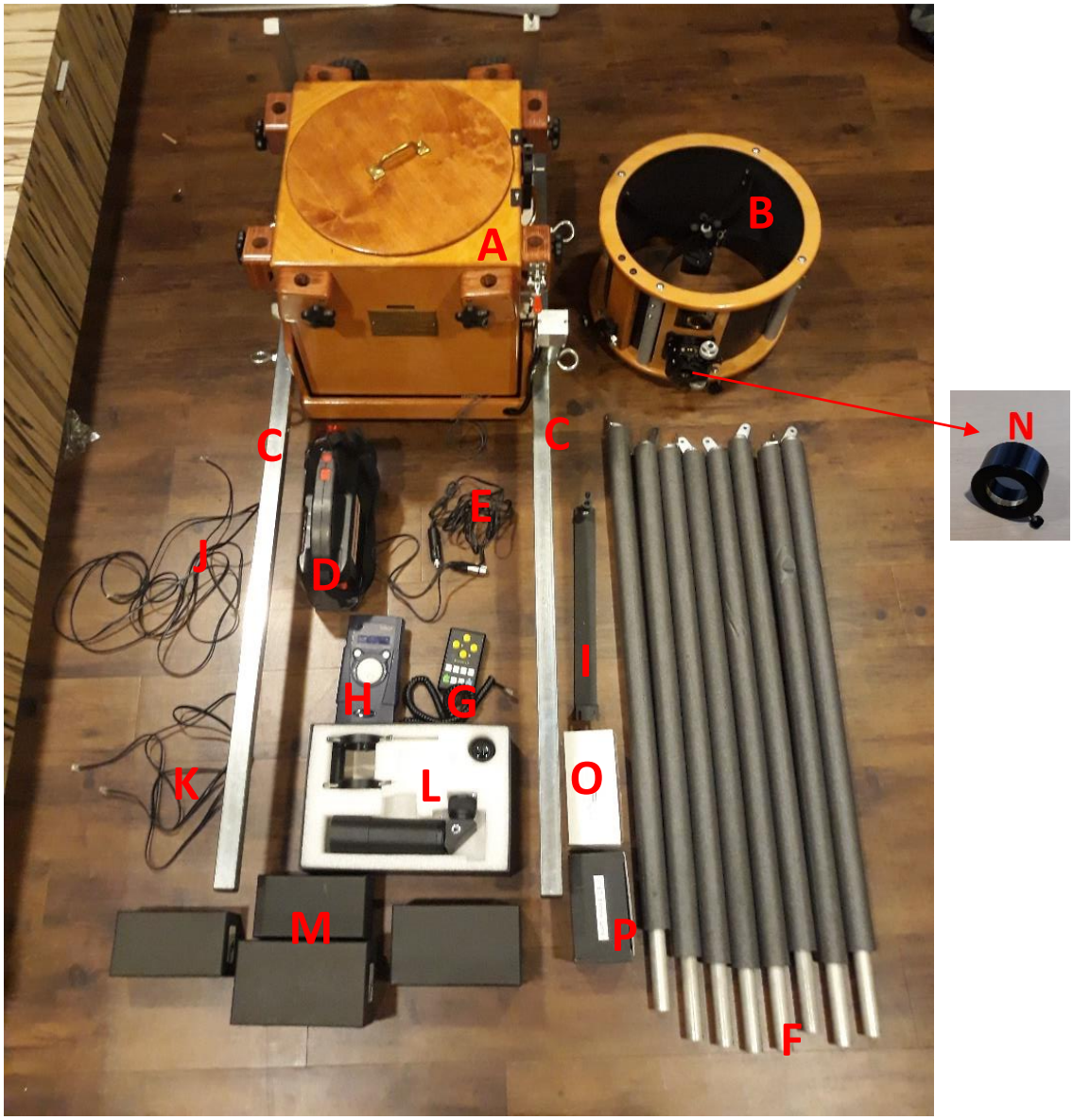


Figure 3(a): Main components and accessories for the telescope.

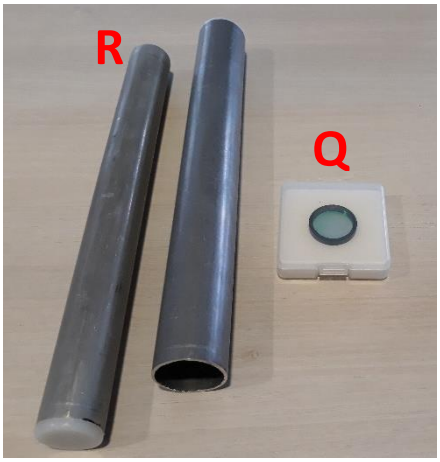


Figure 3(b): Additional components and accessories for the telescope.

Transporting the Telescope

PRECAUTION: Do NOT transport over long distances with the truss poles and upper assembly installed.

1. Keep the dust cover closed over the primary mirror box.
2. Engage the altitude axis (Figure 4).
3. Disengage the azimuthal axis (Figure 5).
4. Screw the wheelbarrow handles onto the primary mirror box. Make sure:
    a. The sides of the handles with the wheels face inward.
    b. Imagine lifting the handles. The bronze nameplate on the box should face you (Figure 6).
5. Check inventory and make sure your power tank is charged before moving off.

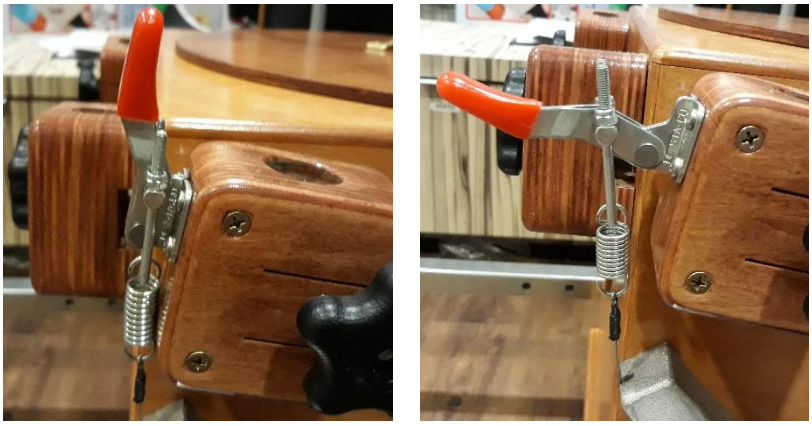


Figure 4: The engaged (left) and disengaged (right) positions of the altitude axis. (**SAFETY:** Never have this red knob pointing fully downwards as the connected tin cable would go slack and derail from its track; stop at 90° when disengaging as shown in the right of the figure.)

Figure 5: The engaged (left) and disengaged (right) positions of the azimuth axis. The disengaged position allows the azimuth angle to be changed manually, while the engaged position allows the angle to be changed with the ServoCAT controls.

Figure 6: Attaching the wheelbarrow handles in the correct orientation.

Assembling the Telescope

1. Detach the wheelbarrow handles (if attached).
2. Open the dust cover to check if the primary mirror is intact. Close it after you are done.
3. Install the 8 truss poles into the lower assembly. Make sure they are slotted in the correct orientation all the way into the holes on the lower assembly. The holes on the metal plates at the tips of two connected poles should align (Figure 7). Screw the black knob tight at the base of each pole after inserting the pole.
4. Install the upper assembly according to the following steps:

PRECAUTION: It is strongly recommended to have at least 2 people for this step to protect yourself and the equipment.

   a. Unscrew the 4 black knobs on the bottom circumference of the upper assembly to expose the 4 bolts (if the knobs are attached in the first place) (Figure 8).
   b. Insert the 4 bolts on the upper assembly into the holes at the tips of the truss poles. The focuser should be roughly in the 9 o'clock direction (the 12 o'clock reference point is at the brass nameplate).
   c. Screw the 4 black knobs back onto the inserted bolts.
   d. Make sure the metal plates on the tips of any two connected truss poles are lying flat against each other.
5. Attach the frame of the finder scope to the telescope.
6. Attach the eyepiece in the finder scope box to the finder scope.
7. Attach the finder scope to the mounting bracket on the telescope.
8. You may now proceed to the collimation (details in the next section).

Figure 7: The 8 truss poles installed in the correct orientation.

Figure 8: Removing the black knobs on the bottom circumference of the upper assembly to expose the bolts.

Figure 9: Appearance of the telescope after installation of the upper assembly.

Collimation

This step ensures that the two mirrors are aligned properly with respect to each other.

1. Make sure both axes are disengaged (Figure 4 and Figure 5).
2. Move the telescope to a comfortable position for you to reach the upper assembly.
3. Insert the collimation laser into the focuser (Figure 10). Tighten the black knob on the focuser to keep it in place.

PRECAUTION: Do NOT look directly at the laser or the reflected beam. Do NOT point the laser at other people.

4. Make sure all the parts of the upper assembly are securely installed before opening the dust cover on the primary mirror.

PRECAUTION: Take care not to handle anything that might drop (watches, flashlight, etc.) once the dust cover is opened.

5. Check that the laser beam points at the black dot at the centre of the secondary mirror. If not, adjust the 5 black knobs on top of the secondary mirror until (Figure 11).
6. Look now at primary mirror. Adjust the same 5 black knobs on top of the secondary mirror (Figure 11) until the laser point falls on the centre of the primary mirror (Figure 12).
7. Snap the magnetic Barlow lens (a white disc with a lens in a hole at the centre) found in the collimator laser box onto the laser unit (on the side facing the interior of the telescope, where the laser emerges).
8. Sit behind the primary mirror box and look up at the bottom of the laser unit. Adjust the 3 silver knobs at the bottom of the box (Figure 13) until a circular shadow is centred on the hole on the Barlow lens (Figure 14).
9. Remove the laser after collimation is complete.
10. Connect the telescope to the power tank using the power tank cable (Figure 15).
11. Switch on the fan at the bottom of the mirror box (Figure 16). This helps to cool down the primary mirror, which might otherwise experience distortion due to a temperature difference with the environment. To allow for enough cooling time, you may want to take a short break before proceeding to the observation step. Note that the fan should be switched off before observation.

PRECAUTION: Replace the batteries in the laser if necessary. Remove the batteries before long-term storage.

PRECAUTION: Switch off the laser after use. Leaving it on may cause overheating and drain the battery.

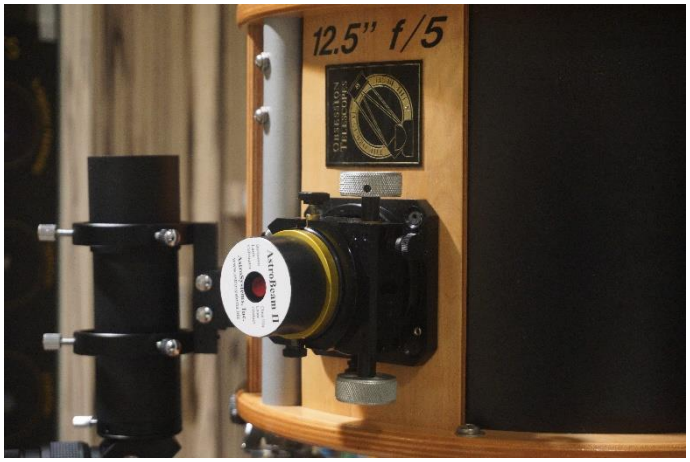


Figure 10: The upper assembly with the laser collimator inserted.

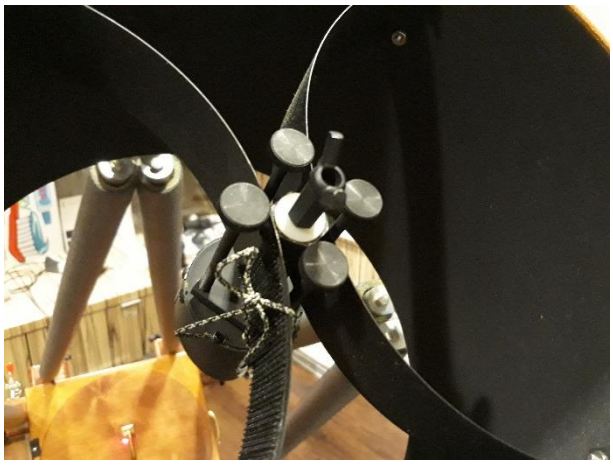


Figure 11: Top of the upper assembly, showing the 5 knobs for adjusting the secondary mirror.

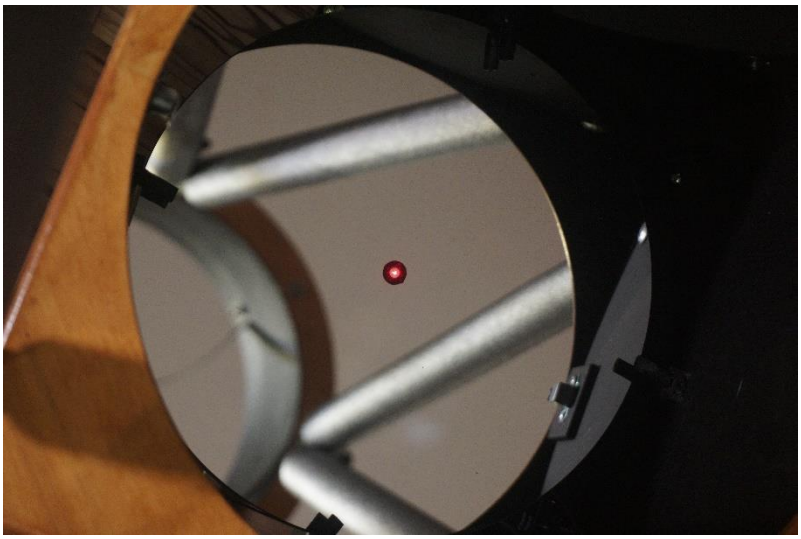


Figure 12: Correct adjustment of the secondary mirror during collimation, resulting in the laser point falling on the centre of the primary mirror.

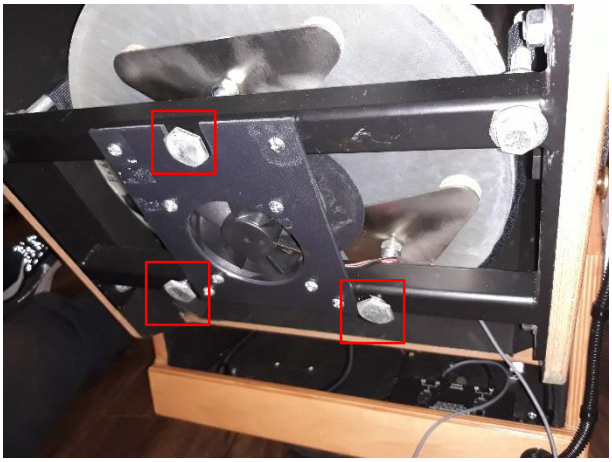


Figure 13: Bottom of the mirror box, showing the 3 knobs (marked with red squares) for adjusting the primary mirror during collimation.

Figure 14: Correct adjustment of the primary mirror during collimation, resulting in the circular shadow centred on the Barlow lens disc.

Figure 15: The power tank cable connected to the telescope (left) and to the power tank (right).

Figure 16: Position of the fan switch (marked by a red oval) inside the mirror box.

Aligning the finder scope

This step ensures that the finder scope and the telescope are aligned, i.e. pointing to the same direction.

1. Find an object a good distance away that is easy to recognise and does not move. Possible choices can be light posts, aerials and chimneys.
2. Insert a low magnification (which means long focal length and wide field of view) eyepiece into the focuser.
3. Point your telescope in the general direction of the object chosen and focus the view as sharp as possible.
4. Get the object as close to the centre of your view as you can. If you can't get it sharp, then you may need choose a further object.
5. Engage both axes (Figure 4 and Figure 5) to lock the telescope in position.
6. Look through the finder scope and adjust the knobs on the finder scope frame until the object is centred.
7. Look through the eyepiece again for a final check. If the object is still centred then you have successfully aligned the finder scope with the telescope.

Observing the Night Sky

At this point, you can choose to operate the telescope manually or with the Argo Navis system and the ServoCAT (Figure 17).

Manual observation

For readily visible objects in the sky, it is possible to operate the telescope manually to observe them. Do note, however, that the Argo Navis system combined with the ServoCAT provides a tracking feature that prevents the object from drifting out of view. Drifting of stars would be a challenge if you choose to operate the telescope manually.

1. Refer to the *Quick check before observation* box before proceeding.
2. Locate and identify the object of interest in the sky. A mobile application such as Sky View Free or Sky Map will be very helpful here.
3. Make sure both axes are disengaged (Figure 4 and Figure 5).
4. Looking through the finder scope, manoeuvre the telescope to aim at the object until the object can be seen at the centre of the finder scope.

Tip: You can also try crouching down and looking up along the body of the telescope to get a better idea of where the telescope is pointing at.

5. Looking through the eyepiece, the object should be somewhere in the field of view. If not, try shifting the telescope around slightly to find the object. If you still cannot find it and you are already using one of the eyepieces with a wider field of view, you might have to repeat the alignment of the finder scope before proceeding.
6. Adjust the telescope slightly to get the object to the centre of the eyepiece.
7. If the object is bright enough, you may replace the eyepiece with a camera to take a photo (refer to the section *Photography with the Telescope* for a brief guide). Remember that the object is drifting as you install the camera, so you might have to shift the telescope after a while to find it again.

Observation with Argo Navis and ServoCAT

Two-star alignment with Argo Navis

In this step, we attempt to sync the locations of objects from the Argo Navis database with what the telescope actually sees. Once successfully aligned, the Argo Navis database can drive the telescope to aim at desired objects with the press of a few buttons.

1. Attach the tangent arm of the altitude encoder, as shown in Figure 18.

PRECAUTION: Both the ServoCAT main unit and the Argo Navis unit should be powered off for the following step.

2. Connect the Argo Navis and ServoCAT systems as follows (see Figure 19):
    a. Plug the cable on the ServoCAT hand controller to the HC (Hand Controller) port of the ServoCAT main unit

b. For the 8-conductor RJ-45 split cable, connect the end of longer strand to the azimuth encoder (bottom of the inner side of the lower assembly, Figure 20) and the end of the shorter strand to the altitude encoder (top of the lower assembly, Figure 20).

PRECAUTION: Beware of the running fan when you are connecting the cable. You may switch it off for this step.

c. Connect the plug before the split on the cable to the ENCODERS port of the Argo Navis unit.
d. For the 4-conductor RJ-11 cable, connect one end to the SERIAL 1 port of the Argo Navis unit and the other end to the DSC (Digital Setting Circles) port of the ServoCAT main unit.

3. Return the telescope to the vertical position.
4. Engage both axes.
5. Power on the ServoCAT main unit and the Argo Navis unit. If the connections are successful:
   a. The LED next to the HC port should light up yellow.
   b. The LED next to the DSC port should blink red.
6. Quick setup of Argo Navis:
   a. Upon booting up, the screen should show MODE FIX ALT REF. If not, use the dial to find this mode. Subsequently, press ENTER. Turn the dial to select ALT REF = 90° // AUTO ADJUST ON and press ENTER. This gives Argo Navis a reference point for the altitude angle.
7. Press EXIT to return to the main menu. Turn the dial to MODE ALIGN STAR. Press ENTER.
8. With your naked eye, locate and identify a bright star in the sky. For an effective calibration, the star chosen should not be too close to the zenith or the horizon.
9. Turn the dial on the Argo Navis unit to make sure your star is inside the catalogue for aligning. If it is not on the list of MODE ALIGN STAR, you can use MODE CATALOG to find this object and use MODE ALIGN for the alignment. (For details on the latter case, refer to the original manual of Argo Navis.)
10. Use the ServoCAT hand controller to aim the telescope at the chosen star. Centre it first in the finder scope and then in the eyepiece (see Table 2 for a description of the functions on the ServoCAT hand controller). Alternatively, you can disengage the axes and operate the telescope manually for this step.

PRECAUTION: You can use an emergency break to stop the motorised motion of the telescope by pressing simultaneously 3 or all 4 of the yellow buttons on the ServoCAT hand controller.)

11. Check that the star is still in the middle of the eyepiece before pressing ENTER to register the position of this star. You may ignore the WARP value shown on the screen for the first star. If you are performing a second or subsequent ALIGN STAR or ALIGN, the screen should show WARP= +0.00 (A) indicating that the system has automatically computed the ALT REF adjustment and that you have performed a second or subsequent alignment. If the designation (X) appears after a non-zero WARP value, this means that the alignment has failed.
12. Repeats steps 8 to 11 of this section for a second star. For the best calibration results, choose a star that is ~70-130 deg away in rotation and between 25-70 deg in elevation. The movement of the telescope from the first to the second star should involve the movement around both the altitude and azimuth axes of the telescope.
    Once the alignment is done, the red LED beside the DSC port should be solid on instead of blinking.
13. Refer to the *Quick check before observation* box before proceeding.

Figure 17: User interface of Argo Navis (left) and ServoCAT hand controller (right).

Figure 18: The tangent arm attached to the altitude encoder and the lower assembly.

Figure 19: Ports on Argo Navis unit (left) and ServoCAT main unit (right) after correct connection.

Figure 20: Position of the altitude encoder (left) and azimuth encoder (right).

Observation with Argo Navis

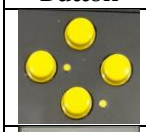
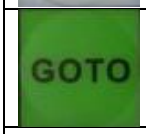
14. EXIT to the main menu on Argo Navis. Turn the dial to MODE CATALOG. Press ENTER.
15. Turn the dial to select the type of object you want to observe tonight. You can get started with BRIGHT STARS, PLANETS/SUN or POPULAR DEEP SKY. Press ENTER once you have chosen the catalogue.
16. Turn the dial to spell out the name of the object you want to observe. This is done by turning the dial and pressing ENTER to select a character and advance the cursor to the next editable field. **Make sure the object is currently in the sky and not below the horizon.** You could use a mobile application to check this.
17. Press ENTER again. If the alignment has not been successfully done, you might get a warning message NOT ALIGNED, in which case you need to perform two-star alignment again. In this case pressing ENTER again will give a further alignment warning message. If a valid alignment has been previously performed, the system will enter GUIDE mode. The display will show the offset between the telescope's position and the object selected.

PRECAUTION: Make sure the surroundings of the telescope are clear for it to start rotating.

18. Press GOTO on the ServoCAT hand controller for the telescope to automatically aim at the object.
19. Wait for the telescope to completely stop motion in both axes before moving in for observation through the eyepiece.
20. If the alignment has been properly performed, you should see the object in the eyepiece. You can make small adjustments with the 4 yellow buttons on the ServoCAT hand controller to make the object better centred.
21. You may replace the eyepiece with a camera (refer to the section *Photography with the Telescope*).

Other than the basic functions and default settings, Argo Navis and ServoCAT provide many features for optimising your observing experience. A brief guide to using the different buttons on the ServoCAT hand controller is shown in Table 2 below. You are strongly encouraged to consult the original manuals for more information by scanning the QR code at the end of this manual.

Table 2: Functionality of the different buttons on the ServoCAT hand controller.

Button	General function	Description
	Controls motorised movement of the mount	Moves the mount up, down, clockwise and counter clockwise Pressing 3 buttons or all 4 buttons activates an emergency brake
	Speed selection options	For moving the telescope fast over long distances when NOT looking into the eyepiece
		For moving the telescope moderately fast over short distances when NOT looking into the eyepiece
		For moving the telescope when looking into a wide-field eyepiece
		For moving the telescope when looking into a narrow-field eyepiece
	Moves the telescope to the object selected on Argo Navis	Obtains the offset between the current position of telescope's view and the position of the object from Argo Navis to move the telescope to the new position
	Spiral search wide field	For searching for an object not in the current field of view. The telescope will spiral outward from its current position, thus covering an area of the sky that would otherwise only be visible through a wider-field eyepiece. Once the object is within view, press any of the 4 yellow buttons to stop the telescope.
	Spiral search narrow field	Similar to 'Spiral search wide field' but covers a smaller area of the sky.
	Allow an offset to be added to the information from Argo Navis	Due to errors in performing two-star alignment or otherwise, there might be a constant difference between the position obtained from Argo Navis and what the telescope actually sees. From the position Argo Navis directs you to, use a spiral search and the yellow buttons to get the object to the centre of the eyepiece's view. Press 'Local Sync' to allow Argo Navis to use this offset on subsequent objects.

PRECAUTION: Replace the batteries in the Argo Navis unit if necessary. Remove the batteries before long-term storage.

PRECAUTION: Remember to switch off the Argo Navis after use.

Photography with the Telescope

While this telescope is great for visual observation, it allows you to take nice photos as well. Here we introduce the prime focus method, where the telescope functions as the lens of a camera. To perform this method on the Obsession 12.5" telescope, you will need (from left to right in Figure 21):

1) A camera with lens removed. In this example we use the SONY ILCE-6000 model.
2) A T-ring. This is usually specific to the camera model.
3) A camera-to-telescope adaptor.
4) The 2-to-1.25-inch eyepiece adapter.
5) The Barlow lens.

Figure 21: Camera and accessories for photography with the telescope.

We remark that 4) and 5) are required for this telescope in order for the camera to reach focus. It is possible that they may not be necessary for other telescopes.

By connecting these items in the order listed above and attaching the Barlow lens into the focuser of the telescope (Figure 22), you are ready to perform primary focus photography. Note that you may need to switch the camera to manual mode and enable shutter release without a lens. The focusing is done manually using the knob on the focuser in the same way as observing through an eyepiece.

Figure 22: A digital camera installed into the upper assembly.

Disassembling the Telescope

For safe storage or long-distance transportation, it is advisable to detach the upper assembly and store all the parts in their respective boxes. The parts are otherwise prone to being damaged or lost.

1. Put the dust cover on the mirror box.
2. Remove the eyepiece and the finder scope and anything else that may fall off.
3. Remove the light shroud if it is installed.
4. Rotate the telescope to a completely vertical position.
5. Remove the upper assembly according to the following steps:

PRECAUTION: It is strongly recommended to have at least 2 people for this step to protect yourself and the equipment.

   a. Unscrew the 4 black knobs on the bottom circumference of the upper assembly to expose the 4 bolts.
   b. Lift off the upper assembly from the truss poles. Take care not to bump the secondary mirror.
   c. After successful removal of the upper assembly, screw the 4 black knobs back to prevent possible loss.

6. Loosen the 8 black knobs at the base of each pole on the mirror box and remove the truss poles.

PRECAUTION: Make sure you have closed the dust cover of the mirror box. NEVER DISASSEMBLE THE TELESCOPE UNLESS IT IS IN A COMPLETELY VERTICAL POSITION. Otherwise the mirror box and the truss poles will rapidly rotate to vertical with possible injury to you or your optics!

Troubleshooting & Resources

Quick check before observation

General checklist

- ✓ All components on the upper assembly are securely installed so that they will not fall.
- ✓ The fan should be switched **off** before observation to avoid vibrations that would affect the image.
- ✓ The thin metal cable for motorised movement of the telescope is not derailed (Figure 23).
- ✓ The tangent arm for the altitude encoder is installed (if using Argo Navis) (Figure 18).

Troubleshooting

Assembly

I cannot attach an eyepiece/camera to the telescope.

If you are using an eyepiece, a camera or another part that requires a 2-to-1.25-inch adapter, make sure you have it attached to the focuser. Otherwise, perhaps the adapter is already installed in the focuser without you needing it there. Simply remove it and attach your eyepiece/camera.

Navigating

I'm pressing buttons on the ServoCAT hand controller, but the telescope is not moving?!?

This could be due to several reasons. Check that

- The ServoCAT hand controller is connected. The HC light should light up yellow on the ServoCAT main unit.
- Both axes are engaged.
- Your power tank is charged and connected.
- The thin metal cable of the altitude motor is not derailed (Figure 23).

Figure 23: Make sure the thin metal cable is securely in the troughs around the altitude bearing as shown.

The telescope seems to experience some resistance when I try to raise it using the ServoCAT hand controller.
This could happen due to imbalance, caused by installing a heavy eyepiece, camera or Barlow lens. The result is a large torque pulling down the top of the mount, making it difficult for the motor to lift it. Try attaching the counterweight to the bottom of the primary mirror box to rebalance.

Observing

After using the GOTO function to aim at an object with ServoCAT, I cannot see the object I want in the eyepiece/camera.
This could mean the two-star alignment step was not successful or could be due to other errors. You may want to perform a spiral search and use the local sync function (consult Table 2 of this document and the original ServoCAT manual, which can be accessed by scanning the QR code below). If the problem persists, you may have to perform two-star alignment again.

The object keeps moving out of the field of view of the eyepiece/camera.
If you are navigating manually, consider switching to using Argo Navis navigation, which provides a tracking feature that will automatically follow the object, preventing it from drifting out of view. If you are already using the motorised and automated tracking, perhaps the tracking feature is not working perfectly.

The object is too faint or indistinct in the eyepiece/camera.
You can try attaching the light pollution filter (Svbony UHC filter) to reduce the wavelengths prominent in terrestrial light sources. Depending on the type of object you are observing, using the filter may or may not improve the contrast. The object may truly be too faint for the telescope, given the conditions on the night of the observation.

There is some interfering light in the eyepiece/camera that makes viewing the object difficult.
If there are terrestrial light sources around you, you might want to cover the middle portion of the telescope (between the primary and secondary mirrors) with the black shroud as shown in Figure 24.

Figure 24: Using the black shroud to cover the telescope from surrounding light sources.

Resources

Finding the FAQs useless and feeling like giving up on astronomy? Remember, you can always consult the original manuals uploaded to a common SPS Google Drive folder for more information. In this folder, you may also view photos other SPS members have taken with the Obsession 12.5" telescope and share your own photos with the rest. Simply scan the QR code below to access the folder. **Please create your own subfolder before uploading your photos and protect your subfolder by only allowing others to view but not modify the content.**