TTS-160 Panther PRO Telescope Mount



Instruction Manual

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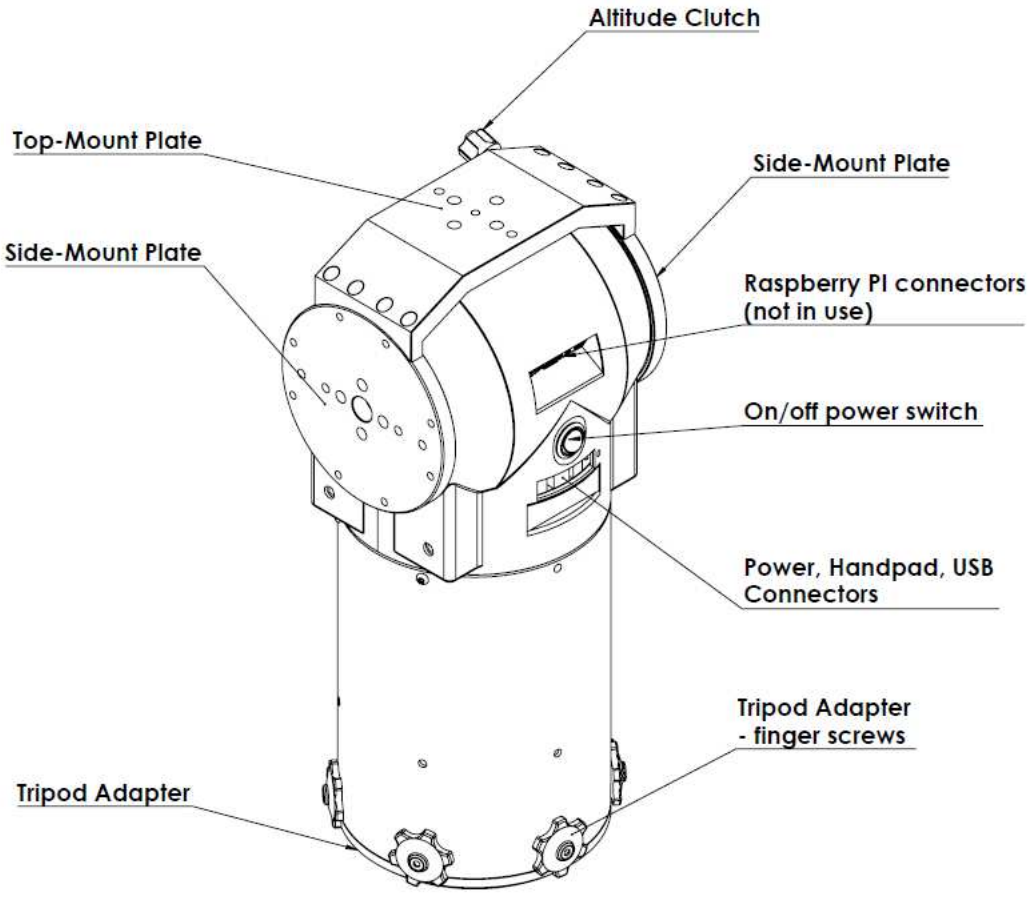
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1. Introduction

Congratulations on your purchase of the TTS-160 Panther PRO Hybrid telescope mount! This mount is designed to provide a stable and reliable base for your telescopes, ensuring a smooth and enjoyable stargazing experience. This manual will guide you through the safe and efficient use of your mount.



2. Safety Guidelines

To ensure your safety and the longevity of your TTS-160 Panther PRO telescope mount, please follow these precautions:

- **Stability:** Always set up the mount on a stable, flat surface to prevent tipping. If the mount is loaded with a large telescope on the side, the tripod may tip over when rotating the telescope in azimuth. Check stability during the first use by rotating a full turn in azimuth while testing the tripod's tilt resistance.
- **Weight Limits:** Do not exceed the maximum weight capacity specified for your mount.
- **Secure Attachments:** Ensure all components are securely fastened before use.
- **Dovetail Saddle Use:** Always fit a safety stop at each end of the dovetail plate to prevent it from sliding out if the saddle is insufficiently tightened.
- **Avoid Excessive Force:** Adjust and push the mount with gentle force to avoid damaging the clutches or other components.
- **Electrical Safety**
  The mount operates on 12–15 V DC power.
  For safety reasons, operate the mount only from a suitable battery pack. A battery pack is not included with the product.
  Always disconnect the power supply before assembling, adjusting, or servicing the mount.
- **Shutdown computer via Handpad or webpage**

  Always shutdown the mount from the handpad before powering off to avoid problems with the Mini Sd-card.

---

3. Unpacking and Checking Components

The TTS-160 Panther PRO package contains the following parts:

1. Telescope mount head
2. Handpad with coiled cable and magnetic holder.
3. Power cable with cigarette lighter connector
4. Two counterweight arms
5. One vertical counterweight bracket
6. One tripod adapter
7. Allen Keys (3mm, 5mm, 6mm)
8. Screws for installation of counterweight arms and dovetail saddles:
   - 8 pcs M5x16 Countersunk screws for counterweight arms and vertical counterweight bracket
   - 8 pcs M6x12 Cylinderhead screws for dovetail saddles
   - 8 pcs M8x12 Cylinderhead screws for dovetail saddles

If any components are missing or damaged, contact the retailer immediately.

4. Possible Configurations of the Mount

The TTS-160 Panther PRO can be mechanically configured to suit different observational needs. Appendix A lists the possible configurations. Choose your desired configuration and prepare it indoors. The mount head is lightweight, and it is easy to set up with any configuration already assembled.

5. Setup Instructions

The mount head is designed for use with the TTS-160 Folding Pier. It is also possible to use the mount on other piers and tripods.

Step 1: Assemble the Tripod or Pier

- Follow the instructions provided with your tripod or pier.
- Attach the tripod adapter:
    - For the TTS-160 Folding Pier, use the included M8x40 bolt with washer. Tighten securely but avoid overtightening.
    - For other flat-top tripods or piers, use a 3/8" 16TPI bolt from below. The bolt must extend at least 15mm into the tripod adapter.
    - **Note:** Leave the tripod adapter attached to the tripod or pier permanently.

Step 2: Attach the Mount head to the tripod or Pier

- Loosen the six finger screws so there is space for the mount head base under the screw handles
- Place the mount head on the Tripod adapter aligning the vertical slots with the finger screws
- Rotate the mount head clockwise until the finger screws are positioned in the horizontal slots.
- Tighten the finger screws.



Step 3: Install the Counterweights

- Install the counterweights onto the arms and secure them with the locking knobs. Position the weights at the bottom of the arm for the initial setup.
- Side-mounted telescopes weighing less than 15 kg do not require a counterweight.

Step 4: Mount the Telescope

- Tighten (lock) the **Altitude clutch** and the **Azimuth clutch** before attaching the telescope.
- Carefully place the telescope onto the dovetail saddle and secure it with the locking knobs. Ensure everything is tightly fastened before letting go of the telescope.
- TELESCOPE POINTING DIRECTION: The electric connectors must point in the viewing direction.

---

6. Balancing the Mount

Proper balance ensures smooth operation and prevents unnecessary strain on the mount.

IMPORTANT: The motors can drive the mount even when the telescope is out of balance. However, careful balancing provides smoother manual movement.

Step 1: Balance the Altitude Axis

- Keep the telescope in a horizontal position
- Loosen the altitude clutch. Hold on to the telescope as you do this.
- Adjust the position of the telescope forward or backward in the dovetail saddle until balanced. Tighten the dovetail saddle locks securely.
- Point the telescope high in the sky and adjust the counterweights on the counterweight arms or on the vertical counterweight bracket until balanced.
- Set the altitude clutch just tight enough to hold the telescope in position.

***Comfort Balance* for optimal Eyepiece Comfort**

- The Comfort Balance counterweight is used to easily balance different eyepieces or other interchangeable equipment
- Simply slide/rotate the counterweight on the arm to achieve perfect balance.

Step 2: Balance the Azimuth Axis

- Install a counterweight on the opposite side of a heavy telescope to prevent tripod instability.
    - For an OTA weighing up to 15 kg, no counterweight is needed.
    - For an OTA weighing more than 15 kg, we recommend an 8 kg counterweight.
- There is no actual balancing of the Azimuth axis movement.

7. Adjusting the Clutches – Orange finger screws.

The adjustable clutches control how much force is needed to move the mount by hand.

- Altitude clutch: Adjust with the top finger screw
- Azimuth clutch: Adjust with the bottom finger screw

Tips for Optimal Adjustment:

- Ensure the telescope is precisely balanced in altitude.
- To get the overall best performance of the mount the clutches must be set lightly. It should be possible to move the telescope with a light push of a finger.
- Try different settings to find the optimal position. Damping time can also be optimized when setting the clutches.

Important Note – goto and slewing may stop if the clutches are set too loose

If the movement of the telescope is blocked the motors will immediately stop. This is an important safety feature if the telescope strikes the tripod or cables become wrapped.
If the clutches are set very loose, the motors might stop because limited telescope movement is detected.

How to recognize this issue

If a manual slew is in progress, it will just stop.

If a go-to is in progress the motors will stop, then retry the go-to. This will happen 3 times before this screen is displayed:

Go-to interrupted, Tracking Stopped

8. Connection of handpad and auxiliary devices

Attach all cables:
Before powering up the mount **all cables** must be attached.

- Connect the handpad to the connector marked HP
  - The current firmware requires the handpad to be connected, including when controlling the mount via Wi-Fi.
- If a wired Ascom/alpaca device – typically a PC or MAC – is to be used, connect the USB cable now to the connector marked USB
- NOTE: No cables are to be connected to the 4 USB ports or the Ethernet connector on the upper connector plate.

Warning: Do not plug in or unplug the handpad when the mount is powered up.

---

9. Powering up the mount

Before powering up the mount set the telescope in the start-up position:

- Point the telescope directly south in Azimuth
- Set the telescope OTA in a horizontal position pointing at the horizon.

Now the mount is ready to be powered up!

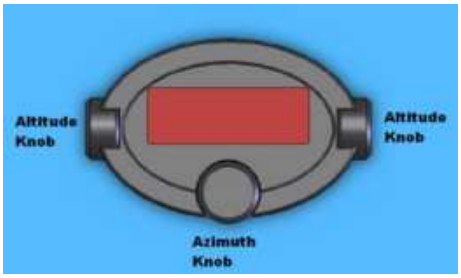
The mount must be powered from a suitable power bank/battery pack:

- Voltage: 12-15V DC (centre-positive) 
- Current: 3 A

Use the Power cable that comes with the Mount.

When the mount is powered up the computer system boots up. Allow the mount 30 seconds to start up.

10.Using the handpad



The handpad contains a display and 3 knobs. Each knob can be used as both a rotary encoder and a pushbutton.

The main functionality of the knobs is:

Altitude knobs (side knobs):
Rotating either of the two knobs adjusts movement in altitude direction or scrolls in the menus.

Pushing the **left knob** toggles between the operation screen and the menu system.

Pushing the **right knob** stops both motors slewing (except tracking).

Pushing the **right knob** when in the Menu System jumps to the upper-level menu.

Azimuth knob (centre knob):
Rotating the knob adjusts movement in azimuth.

Pushing the **centre knob** switches between two movement modes (Speed/Step)

Pushing the **centre knob** works as ENTER when in the menu system.

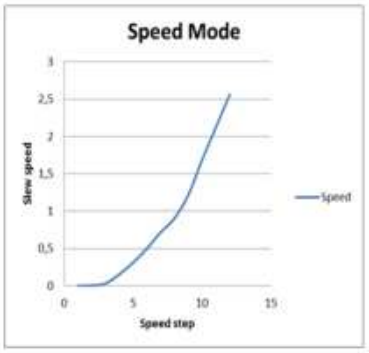
Movement control

When the handpad is in the operation screen the mount can be moved by turning the knobs. The azimuth knob controls movement in azimuth and both altitude knobs controls movement in altitude. In this mode the left and right altitude knobs have the same function.

The mount can be set to move in two modes: ***Speed Mode*** or **Step *Mode***. Pushing the azimuth knob switches between the two modes. An Icon indicates the selected mode

Speed Mode

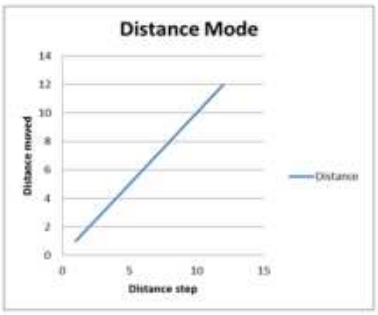
In speed mode the speed is controlled by rotating the knobs. The motor has 12 speed steps. Each click of a rotary knob changes the speed one step up or down. The motor is stopped by turning the knob until speed step zero is reached or alternatively, by turning the knob controlling the other motor by one click.



NOTE:
The mount continues to slew until ordered to stop. An arrow in the top right corner is shown when the mount is moving. STOP all slewing by pressing the right button.

Step Mode (distance mode)

In Step mode the mount moves a certain distance for each click from a rotational knob. When a click is received the relevant motor speeds up – moves a distance – and slows down again. The distance travelled is set in the operation menu.



Adjustment of display brightness:

When the mount is powered up the text "*Track The Stars"* is displayed. At this point the display brightness can be adjusted by turning the Altitude knobs. Press *ENTER* (Azimuth knob) to continue.

Daytime use of Handpad

For daytime use the red glass in front of the display can be removed. It's held by four magnets and can be tilted out by inserting a small lever in the hole at the end of the glass.



11. Setting up geographical location

Before using the mount for the first time the geographic location must be set up.

This can be done via the handpad or via the web interface.

Using the handpad

Go to the Setup menu and select “Locations”

```
Date and time
Locations
Set goto speed
Set step direction
```

The 5 available locations are shown (here you can add your favourite observing locations)

```
Location1
Location2
Location3
Location4
```

Press <centre button - Enter>. The location data for the selected location is displayed

```
Location1
Longitude: +000°0’00”
latitude:   +60°00’00”
edit    select   back
```

Press <left button – edit> to edit the data

```
Name:Location1
Timezone:        0:00
Longitude: +000°00’00”
Latitude:   +60°00’00”
Goto horizon:      0°
Next     Enter    ESC
```

Enter the following information:

- ***Name:*** Spell the location name by scrolling through the alphabet and selecting each letter by pressing ENTER. When the name is completed press NEXT (left knob) to leave the field.

- ***Time zone:*** Enter the local time zone. The time zone is the difference between local time and UT. Note that it is necessary to handle daylight saving time when entering the time zone. The time zone is positive east of Greenwich. Examples of time zones:

    - Berlin, København, Paris: 1 (2 if daylight saving time)
    - London: 0
    - Moscow: 3
    - New York: -5 (-4 if daylight saving time)
    - Los Angeles: -8
    - Sydney: 11
    - Tokyo: 9

    NOTE: On www.time.is you can search for your city and find its current time zone.

- ***Longitude:*** Enter longitude in degrees, arcminutes and arcseconds. Western longitudes are negative.

- ***Latitude:*** Enter latitude in degrees, arcminutes and arcseconds. Northern latitudes are positive.

- ***Go-to horizon:*** Enter the desired local go-to horizon. This is the lowest altitude the mount will go-to automatically. Can be left unchanged at 0°

Using the web interface

The geographical location, date and time can be setup using the web interface. If you use your mobile phone, it is possible to get the necessary data from the GPS system.

Power up the mount and wait for the mount to display time and date.

First connect your device (pc, mac, phone, tablet) to the Wi-Fi hotspot created by the mount:

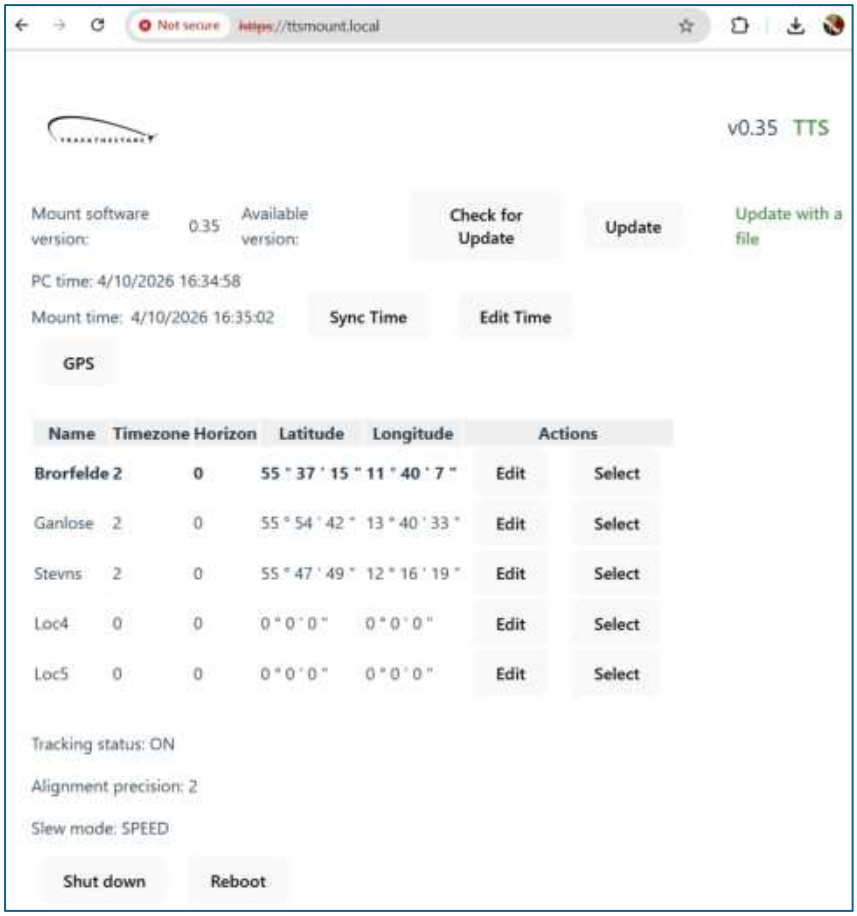
SSID: Panther_PRO_XXX

Password: 12345678

When connected open the web browser.

Type in URL: https://10.20.1.1 or https://ttsmount.local

SECURITY ALERT: Typically, there will be a warning against going to this webpage. As the mount is not connected to the internet just disregard this message.



Setup time via browser

The device time and the mount time are displayed. If <Sync time> is clicked the time from your phone or PC will be synced to the mount.

To input the time manually click <Edit time>
Refresh the browser window to see the updated time.

NOTE: Time Zone must be set up under the location settings

GPS – read from phone

Click the <GPS> button to read GPS coords from your phone.

Edit location data via browser

Click <Edit> on the location line you want to update:



Input all data as described in the section above. Click GPS to have the latitude and longitude filled in with the current location. Click save when finished.

Click <select> to activate the location. The selected location is shown in **bold**

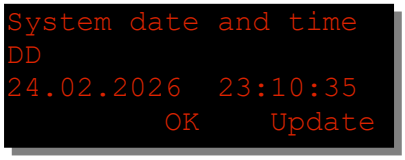
12. Start up procedure for an observing session

The mount can be started with or without the handpad: (NOTE: ONLY WITH HANDPAD CONNECTED IN CURRENT FIRMWARE VERSION)

With handpad connected

Verify the time and date setting.

This screen is displayed:



If Time and Date are correct <Press OK> (it generally will be correct as the clock is battery powered and continuous running also when the mount is not in use)

To adjust Time and date Press <right button - Update> and then change the values by rotating the Altitude knobs and move between values (DD, MM, YYYY HH,MM,SS) by rotating the Azimuth knob. When completed <Press OK> when time passes the set value.

Select Alignment principle

Now the alignment menu is displayed:



The alignment principles are:

***1 Not aligned:**
Starts the process of aligning on one star. You select a known star from the *Bright stars* catalogue and centre it. When star 1 is aligned observations can start or a second alignment star can be added.

Align with Alpaca (mobile/pc):
Prepares the system to receive alignment data over Ascom/Alpaca. This is used for a connected device such as a PC, Tablet or mobile phone. Can be used for 1-star or 2-star alignment. Once started from the handpad the complete process can be controlled via Ascom/Alpaca.

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13. Manual 1-star/2-star Alignment procedure

Select "*1 not aligned" from the Alignment Menu

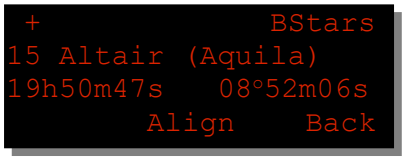
This screen is displayed:



Select the Bright stars catalogue.

The objects are displayed in a scrollable list

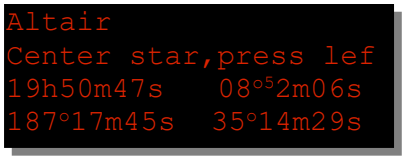
(To jump 10 lines when scrolling move + sign to the tens position by rotating central AZ knob)



Select a visible star at an altitude of 30-50 degrees.

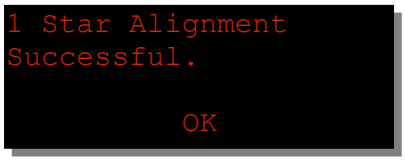
When <Align – central knob> is pressed the mount will begin to slew to the star. The slew can be stopped by pressing the right button if needed.

The operation screen is displayed

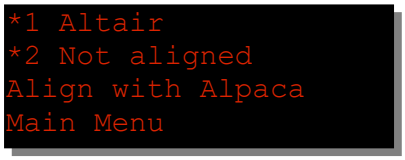


Now centre the star. This can be done manually by pushing the telescope or by slewing with the motors. Using STEP mode is highly recommended. When centred press the <LEFT button>. For best alignment the star must be centred precisely.

This screen is displayed



<Press OK>. The alignment Menu is displayed



This completes a 1-star alignment. If the mount is levelled this is enough for most visual observations. Press <LEFT button> to get to the operation screen and start observing.

2-star alignment

For higher precision a second alignment star can be added. The procedure is identical to alignment star 1.

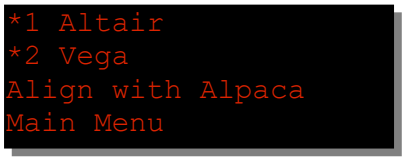
- Select “*2 not aligned”

- Select bright stars catalogue
- Select align star 2 (note: choose a star some 60-90 degrees away in Azimuth from align star 1 and at a similar altitude between 30-50°)
- Centre align star 2 and press <LEFT button>

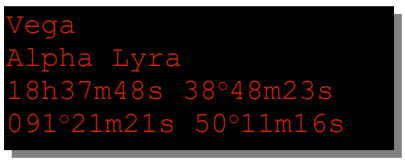
The resulting approximate latitude is displayed. If the mount is levelled this is normally within 0.1-0.5 degrees of the actual geographical latitude.



The Alignment Star names are visible in the alignment menu:



Press the <LEFT button> to go to the Operation Screen



2 Star Alignment completed. Ready to observe!

---

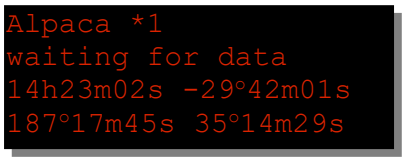
14. Align with Alpaca (mobile/PC)

Select “Align via Alpaca” from the Alignment Menu

Then select if you want to start a 1-star or a 2-star alignment. For visual observations and with a levelled mount 1-star is enough.



When a 1- or 2-stars alignment has been selected the operation screen is displayed with information on the alignment procedure

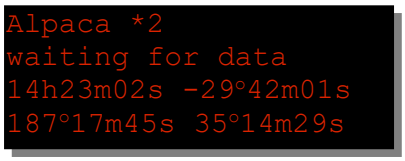


Now the mount is ready to receive alignment data for star 1.
The mount can be moved by hand, be slewed by the handpad knobs or slewed from a connected mobile app or PC.
When an object is centred the alignment can be made directly from an app such as Skysafari. If desired, alignment can also be performed using plate solve.

When the mount receives the data the first alignment star is set.

If “with 1 star” was selected the mount is now aligned and ready to use.

If “with 2 stars” was selected the operation screen will change to



Now the mount is ready to receive alignment data for star 2.

When the mount receives the data the second alignment star is set.

If “with 2 stars” was selected the mount is now aligned and ready to use.

---

15. Observing with the mount (after alignment is completed)

The following examples describe typical uses.

Manual push-to objects

The mount can be pushed by hand, and the tracking will start immediately when the user lets go of the telescope. The unique adjustable clutches mean very precise pointing is very easy even at high power. This functionality is perfect for panning the sky.
If a planetarium app is connected the sky map will be continuously updated with the pointing position.

Go-to objects

Select an object in one of the object catalogues to have the mount slew to the target.

Press <LEFT button> to open the Menu system



Select one of the object catalogues:

- Popular Objects (selected popular objects)
- Messier Catalogue (110 deep sky objects)
- NGC (New General Catalogue, 7840 deep sky objects)
- IC (Index Catalogue, 5386 deep sky objects)
- Bright Stars
- Solar system (Sun, Moon and planets)

16. Using the Panther PRO with Skysafari

The Panther PRO can be connected to different devices like mobile phones, tablets, PCs and Macs. The interface used is a subset of the ASCOM and ALPACA commands.

The following instructions explain how to connect a mobile phone with Skysafari installed to control the mount. The principles explained here can be used for similar apps.

Connect to the mounts Wi-Fi hotspot.

Connect your device to the Wi-Fi hotspot created by the mount:

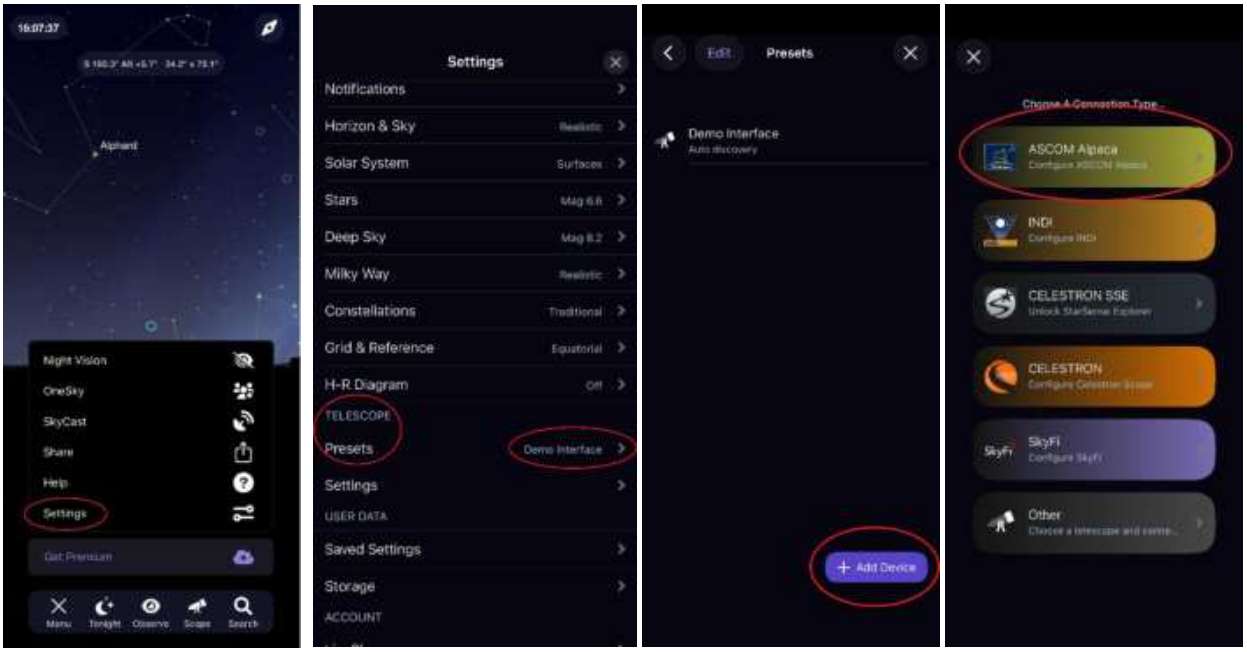
SSID: Panther_PRO_XXX

Password: 12345678

Setting up the Skysafari telescope interface

Go to the settings page in Skysafari.

Select *Presets* – then *+Add Device,* then *ASCOM/Alpaca*





Enter the following data in the telescope preset:

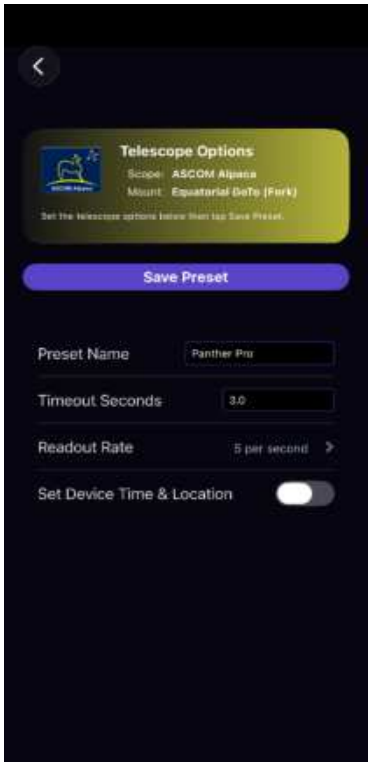
IP Address: 10.20.1.1

Port number: 8083

Click "*Check IP and Port for devices"*

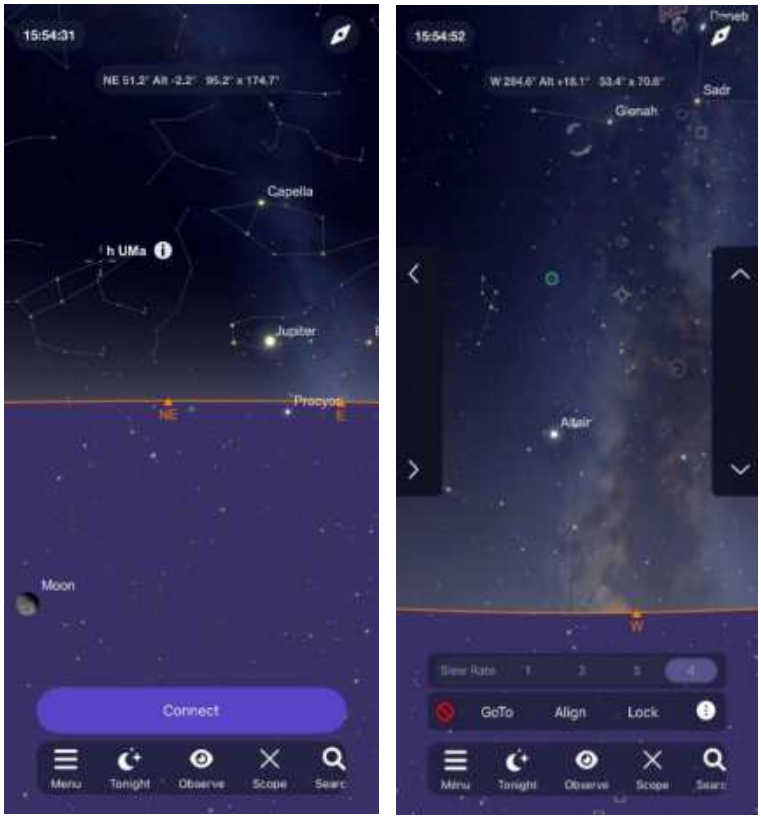
Device "Panther Pro" will be found.

Click "*Next"*



Save the Preset.

On the map screen select Scope and click connect



When the mount is connected the crosshair will show the telescopes pointing position (if the crosshair is not displayed enable it under *Observe*).

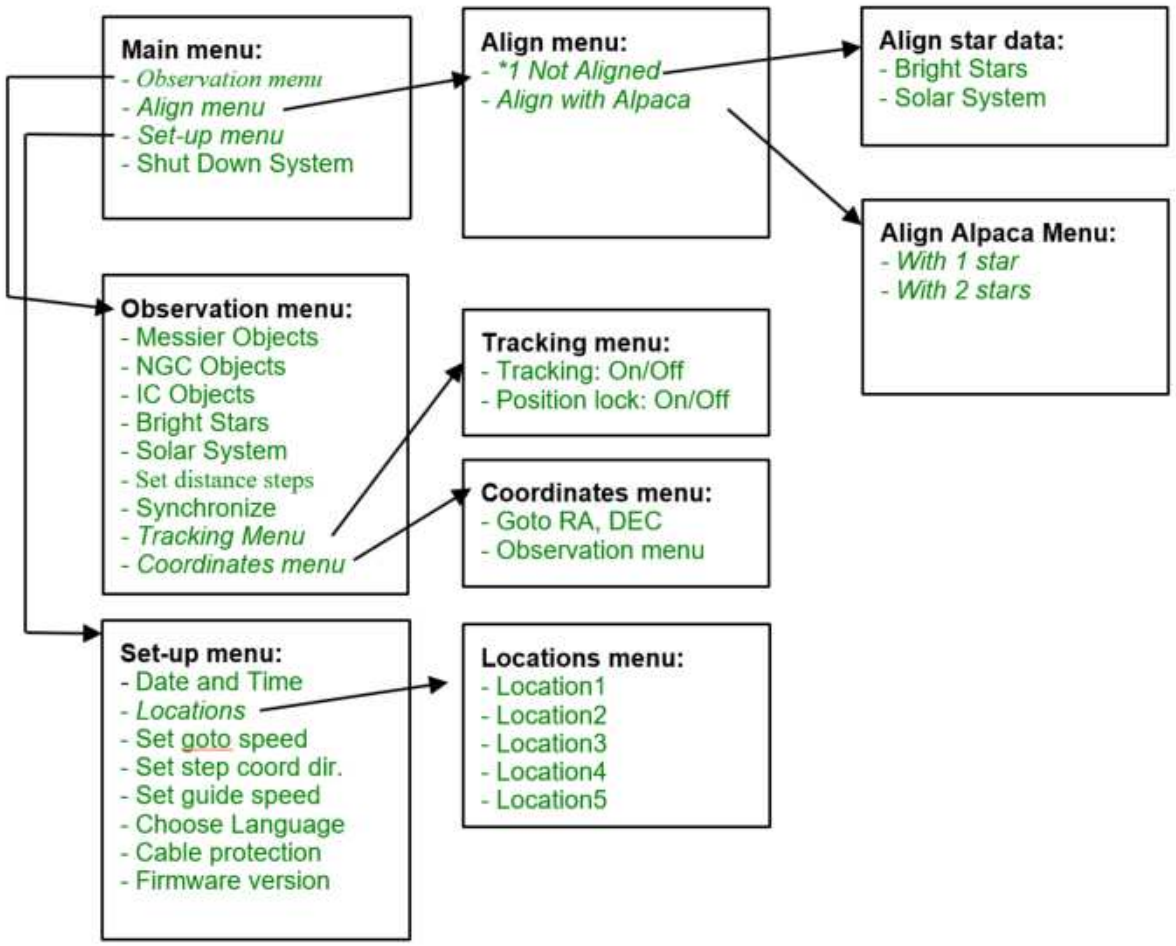
The crosshair will follow any movement made by manual push-to, by go-to or slewing performed via the handpad or go-to or slewing performed from Skysafari. Everything is seamlessly integrated.

17. Panther PRO control software overview

This section describes the software in detail. It is suited for looking up specific functions.

Menu tree

The lines written in *italics* open another menu. The other lines selects a function performing an action.



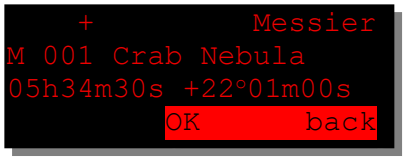
Function overview

The following is an overview of the functions available from the menu system.

Align Menu functions:

Alignment is described in sections 12-14.

Observation Menu functions:



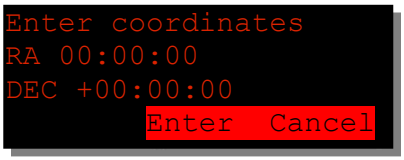
Object catalogues

The mount has the following object catalogues:

- Popular Objects
- Messier
- NGC
- IC
- Bright Stars
- Solar System

The + is an indicator pointing to the “active” digit of the number. Rotate the centre knob to position the + over the ones, tens or hundreds. To change the value of the selected digit, rotate either side knob.

The object description is updated on the fly.
When the desired object has been found press <Centre button – OK> to start the Go-to.



Go-to RA, DEC

Select this function to make a go-to to a set of celestial coordinates. When the coordinates have been entered the system checks if the position is above the defined local horizon. If that is the case the mount will go to the position. Otherwise, a message is given that the object is below the local horizon. The local horizon is set under location. The entered coordinates are treated as J2000 coordinates and converted to JNOW before the go-to is made.

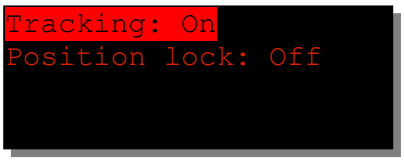
Synchronize

This function synchronizes the mount coordinates with the coordinates of the latest go-to target.
Example: You make the mount perform a go-to an object. If the object is not precisely centred after the go-to, you manually centre it. If *synchronize* is then selected the mount coordinates will be updated to the correct value. This will improve pointing in the local area but not across the entire sky.



Set Distance Step size

Use this function to set the size of the steps the mount makes when STEP mode is selected.



Tracking on/Off

Select this menu item to toggle tracking on/off

Position Lock

Select this menu item to toggle position lock on/off

When position lock is on the mount will automatically return to the latest go-to target if manually pushed away from the object. If slewed via the handpad the new position is locked.

Perfect when doing outreach where the viewer might accidentally push the telescope. Can also be activated when replacing heavy eyepieces to keep the target centred at all times.

Set-Up Menu functions

Date and Time and **Locations** is described in section 11-12.



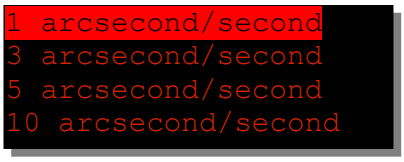
Select language

Use this function to select the displayed language.



Set go-to speed

Use this function to select go-to speed.
If you use manual push-to a slow go-to speed can be selected for whispering mode.



Set guide speed

Use this function to select guide speed
(when pulse guiding is used).



Firmware Version

Use this function to display the firmware version number

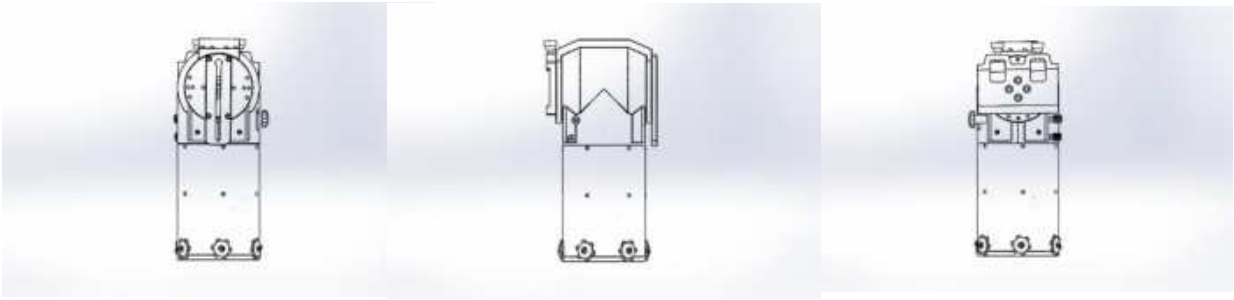
Thank you for choosing the TTS-160 Panther Pro telescope mount. Happy stargazing!

APPENDIX A: MOUNT CONFIGURATIONS

1: Basic side-mounted telescope - one telescope with vertical balancing bracket on the opposite side



- **Prepare the mount head indoors:** Install the parts as shown in the drawings.



Vertical balancing bracket
on one side mount plate.
(4 pcs countersunk M5x16)

Dovetail saddle (Vixen or Losmandy)
on the other side mount plate
(4 pcs cylinder head M8x12)

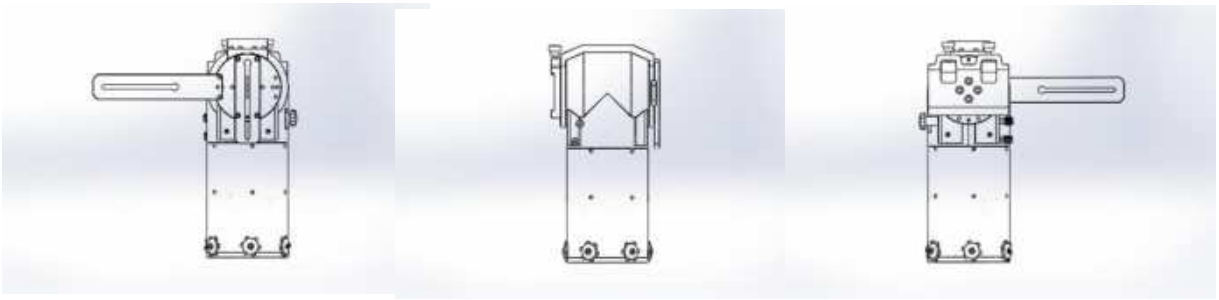
Configuration 1 capacity:

- Telescope 15kg with no counterweight
- Telescope 25 kg with 8kg counterweight

2: Side-mounted with comfort balancing – One telescope



- **Prepare the mount head indoors:** Install the parts as shown in the drawings.



Counterweight arm and vertical balancing bracket on the side mount plate. (6 pcs countersunk head M5x16)

Dovetail saddle (Vixen or Losmandy) on the opposite side plate. (4 pcs cylinder head M8x12)

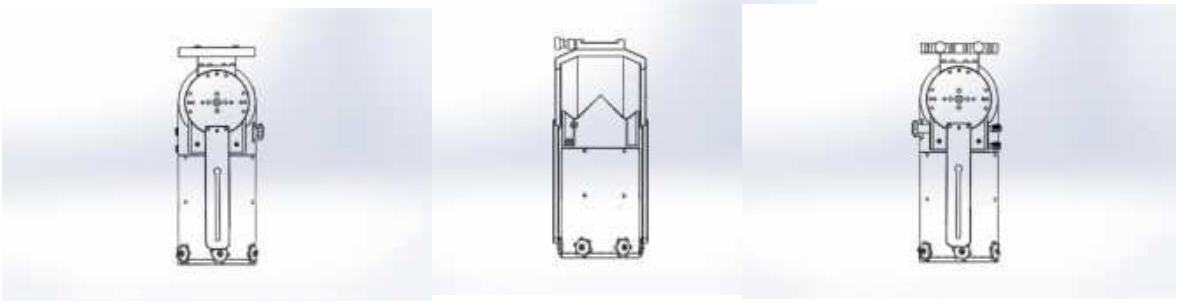
Configuration 2 capacity:

- Telescope 15kg with no counterweight on vertical bracket. 4 or 8kg counterweight for back balancing.
- Telescope 25 kg with 8kg counterweight on vertical bracket. 4 or 8kg counterweight for back balancing.

3: Top-mounted telescope with 2 counterweights



- **Prepare the mount head indoors:** Install the parts as shown in the drawings.



Counterweight arm on the side mount plate. (2 pcs countersunk head M5x16)

Dovetail saddle (Vixen or Losmandy) on the top mount plate. (4 pcs cylinder head M8x12)

Counterweight arm on the side mount plate. (2 pcs countersunk head M5x16)

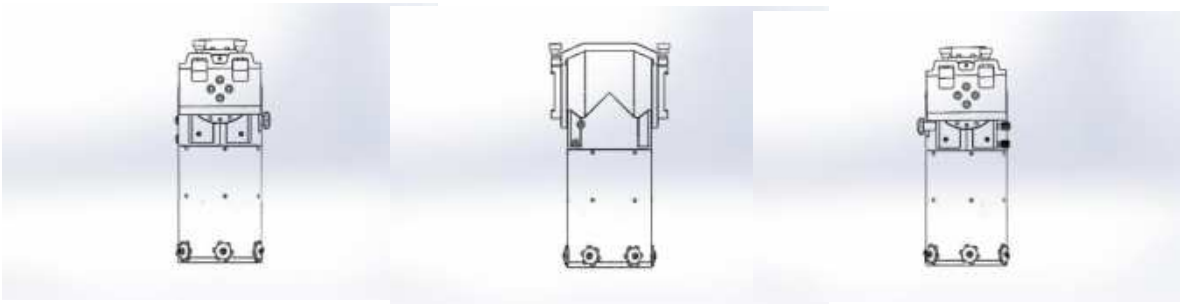
Configuration 3 capacity:

- Top-mounted Telescope 20 kg with matching counterweights

4: Basic side-mounted telescope - Two telescopes



- **Prepare the mount head indoors:** Install the parts as shown in the drawings.



Dovetail saddle (Vixen or Losmandy) on one side mount plate. (4 pcs cylinder head M8x12)

Dovetail saddle (Vixen or Losmandy) the opposite side mount plate (4 pcs cylinder head M8x12)

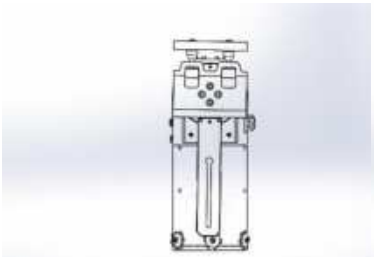
Configuration 4 capacity:

- Two telescopes up to 20 kg each
- Max weight difference between the two telescopes 15 kg

5: Top-mounted and side-mounted telescopes with two counterweights

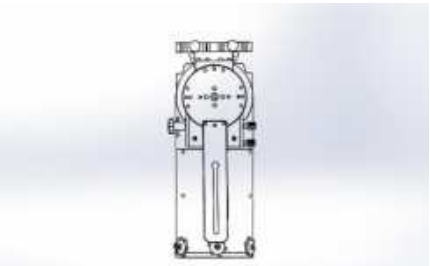


- **Prepare mount the head indoors:** Install the parts as shown in the drawings.



Counterweight arm on the side mount plate. (2 pcs countersunk head M5x16)

Dovetail saddle (Vixen or Losmandy) on the top mount plate. (4 pcs cylinder head M8x12)



Counterweight arm on the side mount plate. (2 pcs countersunk head M5x16)

Dovetail saddle (Vixen or Losmandy) on the side mount plate above the arm (4 pcs cylinder head M8x12)

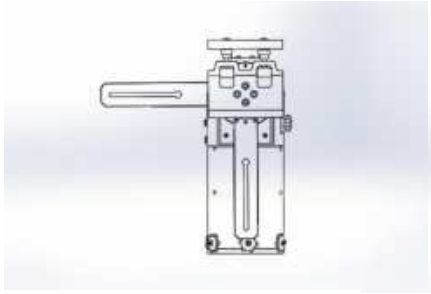
Configuration 5 capacity:

- Top-mounted Telescope 20kg with matching counterweights
- Side-mounted Telescope 15 kg

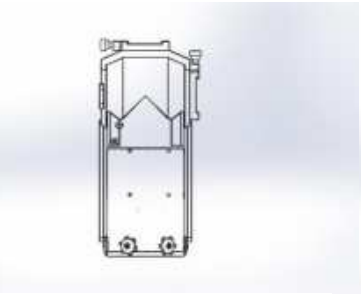
6: Top-mounted and side-mounted telescopes with two counterweights and comfort balancing



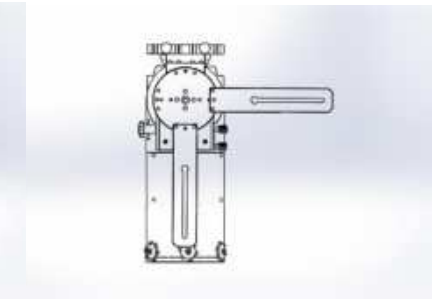
- **Prepare the mount head indoors:** Install the parts as shown in the drawings.



Counterweight arm on the side mount plate. (2 pcs countersunk head M5x16)



Dovetail saddle on the top plate. (4 pcs cylinder head M8x12)



Counterweight arms on the side plate. (4 pcs countersunk head M5x16)

Dovetail saddle (Vixen or Losmandy) on the side plate above the arm (4 pcs cylinder head M8x12)

Configuration 6 capacity:

- Top-mounted Telescope 20kg with matching counterweights
- Side-mounted Telescope 15 kg

APPENDIX B: FCC Compliance Information

Product: TTS-160 Panther Pro
Model: TTS160PRO

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

U.S. Responsible Party:
Americas Compliance Consulting LLC dba iCertifi
5809 US-2, Suite B, Albeni Plaza
Priest River, Idaho 83856, United States
Tel: +1 (866) 885-4575
Email: fccagent@icertifi.com

Contains FCC ID: 2ABCB-RPI4B

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules.

Changes or modifications not expressly approved by Track The Stars ApS could void the user's authority to operate the equipment.

APPENDIX C: Dimensional drawings

