

Utah State University

DigitalCommons@USU

Physics Capstone Projects

Physics Student Research

5-2023

Engineering Lab Building Telescope Manual

Aidan L. Tueller

Utah State University

Follow this and additional works at: https://digitalcommons.usu.edu/phys_capstoneproject



Part of the [Physics Commons](#)

Recommended Citation

Tueller, Aidan L., "Engineering Lab Building Telescope Manual" (2023). *Physics Capstone Projects*. Paper 108.

https://digitalcommons.usu.edu/phys_capstoneproject/108

This Article is brought to you for free and open access by the Physics Student Research at DigitalCommons@USU. It has been accepted for inclusion in Physics Capstone Projects by an authorized administrator of DigitalCommons@USU. For more information, please contact digitalcommons@usu.edu.



Engineering Lab Building Telescope Manual

Aidan L. Tueller

Physics 4900 Research Project

Physics Department, Utah State University, Logan, Utah

Mentor Dr. Jan Sojka, head of the Physics Department

In partnership with Dr. Jan Sojka, head of the Physics Department, a plan was created to make the telescope on top of the Engineering Lab building operational again for either staff, students, classes, or labs to use. The telescope was purchased through funds by Utah NASA Space Grant Consortium. This paper will contain basic information about how to operate the telescope and use its equipment. There is an online manual from Meade that is much longer but goes into much more detail about individual pieces and specific parts of the telescope.

Access to the Telescope

The first step in gaining access to the dome will start with getting permission from one of 3 different people. Jacob Gunther is the head of the electrical and computer engineering department. You will be able to contact Dr. Gunther through this phone number, [435-797-8340](tel:435-797-8340). Dr Jan Sojka, head of the physics department, will be a second contact to gain permission into the telescope. He will be contacted through the physics department phone number [\(435\) 797-2857](tel:435-797-2857). Reyhan Baktur, a professor in the college of electrical and computer engineering will be your third contact. Her phone number is [435-797-2955](tel:435-797-2955). These contacts will give you the door codes to one of the two entry ways into room with ladder access to the dome. The first door is located in the northwest corner of the Engineering lab building at the top of the staircase and the other is located next to the GAS lab on the third floor as well. Figure 1 shows the path, in red, that should be used by a person entering the first floor. Figure 2 shows the second and third floor plans, on the second floor the green line shows how a person would get to the north-west staircase from the Physics Lab Building. The blue line on the second level floor plan shows how to get to the entrance next to the GAS lab. On the third level floor plan it shows the room in which the ladder is housed. Due to the dome, in which the telescope is housed, being accessed by ladder there is no handicap access into the dome.



Figure 3: Third floor layout



Figure 4: In this photo is the ladder used to gain access into the dome.

Safety in Dome

Once you are inside the room, with the black ladder attached to the wall, climb up and into the dome. When you are close to the top of the ladder you should be able to reach the light switch, located up and to your right. The easiest way to get off the ladder and onto the floor of the dome is to have a hand on the top rung of the ladder and the other on the floor to help lift yourself up. After you, and/or everyone in your group, are in the dome the hatch above the ladder should be closed to prevent anyone from falling through! When closing the hatch, the inner half is shut first then the outer piece, the hatch won't be flush with the floor, step down on it so there isn't a large piece sticking up this will reduce the risk



Figure 5: The photo above shows the cluster in which the light switch for the dome is located. This is up and to your right while on the ladder. The Red level directly down and to the left of the light switch is the sliding door controller.

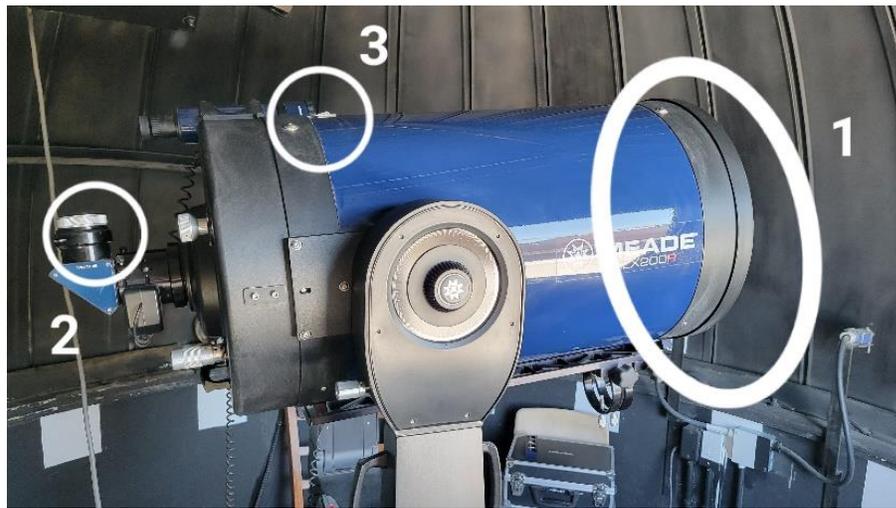


Figure 6: Circle #1 is the large entry lens cap, #2 is the eyepiece cap and #3 is the spotting scope cap.

of someone tripping on it while moving through the area. The dome in which the telescope is housed is very small in size and most of the room is taken up by the telescope and its tripod. For the safety of those using the telescope a maximum of around 4 people should be in the dome at one time. **No one is permitted to climb onto the roof of the Engineering Lab building!** While using the telescope the lights inside of the dome should be turned off for the best viewing results. In the smaller black case, that should remain inside the dome, there is a redlight flashlight that can be used when looking for eyepieces or moving around the dome.



Figure 7: The image above displays the bottom of the sliding door that opens on the dome roof.

Starting up/ Setup for use

To protect the telescope's lens from being scratched and dirty by outside dust and debris there are 3 different covers on the telescope, these will need to be removed to be able to view objects through the scope. The first is the cap covering the big entry lens, the second is cap covering where the eyepieces are attached and the third one is on the larger end of the spotting scope on the top left side of the telescopes tube. The 3 covers can be placed below the tripod so that they are out of the way. To remove caps 1 and 3 simply pull them off, to remove cap 2 the user may need to loosen a screw on the left hand side and pull up on the cap. **If correctly done the silver cap and the black sleeve should come out as one piece. Do not unscrew the silver piece and leave the protection cap as one piece.**

After removing the covers the next process would be turning on the telescope. All the correct cords should be in place already, so all the user has to do is flip the switch on the control panel to turn on the telescope. Once the switch is flipped on the telescope will begin its automatic start up process. During this process the telescope will move, finding its level position as well as true and magnetic north. After the telescope has completed its startup and it has stopped moving it is ready to be used and controlled by the hand remote. The dome does not have to be open while this start up process is being done. Due to the motor that controls the rotating movement of the dome being broken the person using the telescope will have to operate the movement of the dome by hand. When rotating the dome clockwise or counterclockwise

be wary of the power cord that hangs down from the motor that powers the sliding door. The lever with the dark red end in the bottom middle of figure 5 will open and close the sliding door that is pictured in figure 7. Depending on the object being viewed the very bottom of the door will have to be unlatched to allow objects higher in the sky to be seen. The easiest way to unlatch this part will be to open the door around 6 inches and then lift up on the bottom section while pulling the wood handle so that the latches come free from the bar that holds the bottom section on. After unlatching this piece, it can be lowered back down to the bottom and the top piece can be moved with the lever.

Equipment



Figure 8: Large black box containing 2 different deep sky cameras.

Housed within the dome there are 3 different hard cases. In the smallest black case, there are only a few pieces of equipment, starting on the far-right side there is the red-light flashlight. Above the flashlight is the Cannon camera adapter piece, that connects your camera to the piece in the middle which holds an eyepiece and is what couples the camera to the telescope. The middle piece is length adjustable which helps you focus your camera on the object you are trying to photograph. The final piece on the far left is a mount for a phone, the circle piece at the top clamps onto an eyepiece and the brackets at the bottom attach to your phone. The second, bigger black box, houses the deep sky cameras. The black circular camera is from Orion, there isn't a way to get the software to run it from a computer. On the right, the square blue camera is from Meade, the black cables at the top left and the rectangular piece above the camera go with it. The

black cables connect the camera to a laptop via usb and the rectangular piece slides over the front of the camera and filters different light from the objects being photographed. Figure 8 below shows the different sized eyepieces used for viewing different objects. In the silver case there is a black adapter that is the connection between the telescope and the eyepieces, shown on the right-hand side of figure 9.



Figure 9: The photo above shows the contents of the large silver case inside the dome. This case houses the eyepieces for the telescope.



Figure 10: Small black case contents.

Navigation of Hand Remote Menu

Mounted on the left arm of the telescope is the hand controller, this device is the heart of the telescope. This controller is how all movement, tracking and focusing is done. In the table on the next page, figure 12, shows how to navigate through the different modes inside the menu. To get there the mode button has to be pressed first and then using the enter key to move through each of the subcategories. If

you want to view and track an object you've located with the telescope, from the menu, you will press the "GO TO" button. Two other buttons that will be frequently used are the speed and focus button, which are labeled but are also the 1 and 4 buttons on the number pad. The speed button is used to adjust the slew speed which is the rate at which the telescope will move left, right up and down. To change the speeds, use the arrow keys at the bottom of the remote. 3 arc second slew rate is a good speed to move larger distances while the 0.25 arc second or x16 speeds are good for more fine tune adjustments to get the desired object into the center of the eyepiece. The focus button will control the micro focuser which is the fine tune focusing of the telescope. When auto tracking an object, the user will not have to use the controller to keep the object centered in the eyepiece. Auto tracking will start when an object is selected through the options given by the hand controller.



Figure 11: Hand controller for the telescope.

AUTOSTAR II'S MENUS

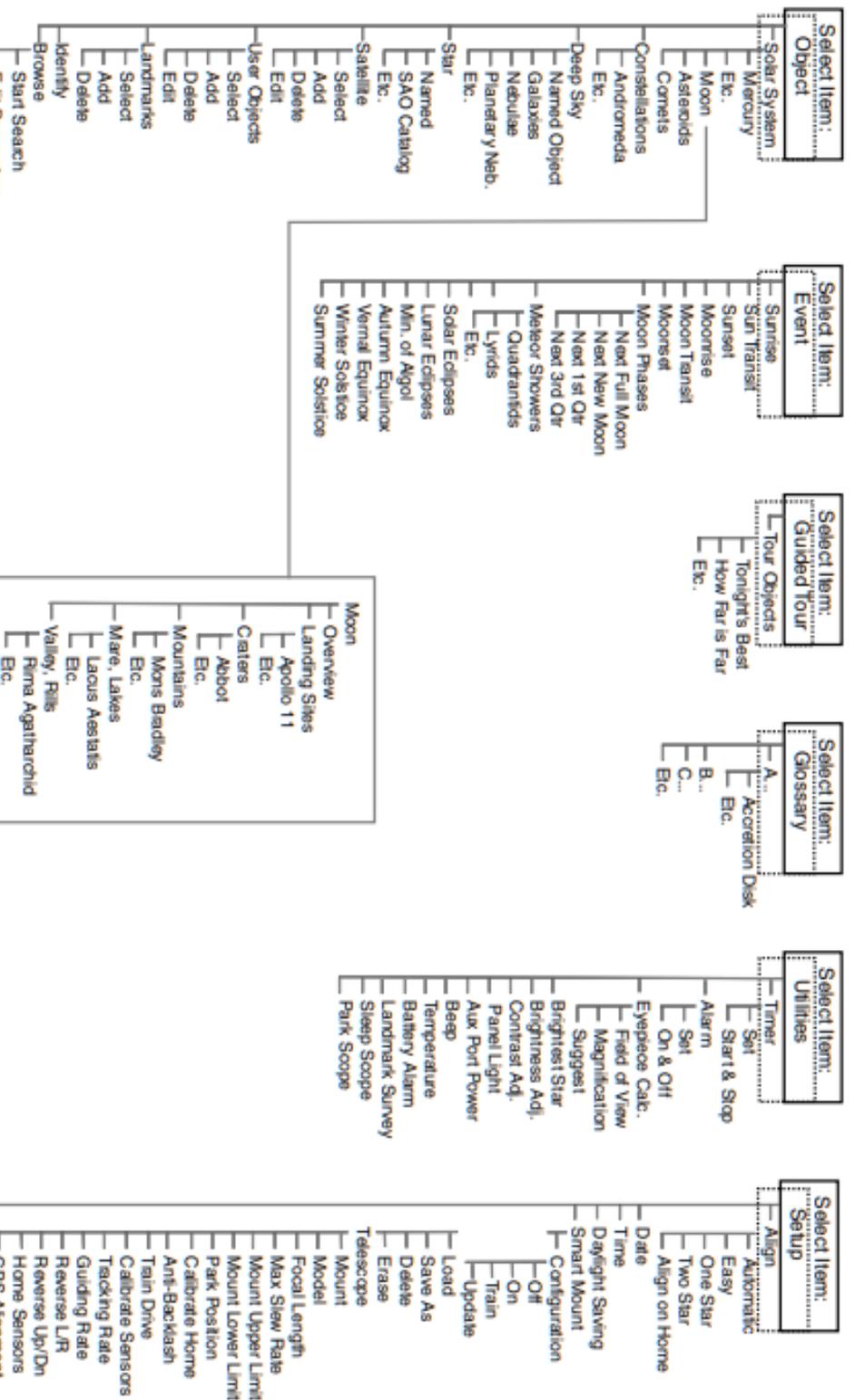


Figure 12: Table for menu options in the hand controller.

Operating the Telescope



Figure 13: The flat silver piece, circled, in the center is the locking mechanism for the bottom gear of the telescope. When that lever is to the left the gear is locked and when it is flipped to the right the gear is free.



Figure 14: The dial in the center of the arm is the locking mechanism for the tube of the telescope.

After completing the initial steps of setting up and turning on the telescope, it is time to start viewing the night sky. Once a user has decided on an object to view there are 2 ways of moving the scope to that object in the sky. The first is manually by unlocking the bottom gear and spinning the telescope by hand. Unlocking this gear lets the telescope move clockwise and counterclockwise freely. There is a second gear lock on the right arm of the telescope mount, looking at it from where the eyepiece is put in, this gear will allow the main tube of the telescope to move freely up and down. **Turning the lock, pictured in figure 14, counterclockwise will loosen the tube of the telescope; the user must be very careful when doing this since there is nothing supporting the tube once the lock is loosened.** The operator of the telescope should have one hand under the tube or holding the handle at the back of the scope to ensure that the front does not fall and break the front lens. When tightening the gear back up it doesn't have to be torqued down tight but just until it is snug. If the user uses this manual method to look at an object, they should move the telescope to the general vicinity and then use the spotting scope, mounted on the top left side of the scope to bring the object into view in the eyepiece. This will be easier since the telescope looks at a very narrow region of sky and the spotter scope allows for a wider field of view. A second option of moving the telescope to the user's target is by using the hand controller and the arrow keys. If this is the way the user would like to move the scope to the object, they are looking at the first step will be to press the speed button on the hand controller, which can be seen in figure 11. After the speed button is pressed the user use the two arrow keys at the very bottom of the controller to adjust the speed at which the scope will move. 3 arc seconds is a good speed that will allow the user to the object quickly. Once a speed is selected the user will use the up, down, left and right arrow keys in the center of the controller to move the telescope. **The gears mentioned in the previous option should both be locked when moving the scope with the hand controller, this will ensure that there isn't any premature damage to the gears and motors.** After the telescope has been moved so the desired object is in the eyepiece the next step is to focus the lens so that the object being viewed is clear. To start focusing the telescope on the object is to adjust the main mirror. With the eyepiece out the

user will turn the top dial to the unlock side until it is loose. Next the user will look through the open hole where the eyepiece will sit and turn the bottom dial in figure 15 either counterclockwise to widen the image being viewed or clockwise to bring the object closer. For smaller objects like Jupiter or Saturn the lens should be moved closer so the clearest image can be achieved. For viewing an object like the whole moon and not a specific crater or area the mirror should be moved further back. After a position is found for the mirror, the top dial should be turned back to the locked position. **This adjustment will have to be made for each different object being viewed.** After the main mirror is set an eye piece will be chosen. The higher the number of the



Figure 15: Pictured above are the 2 dials used to adjust the focus of the primary mirror inside the telescope.

eyepiece will result in a wider field of view while a lower number will have a smaller field of view. After the eyepiece is chosen and inserted the micro focuser will need to be used to fine tune the image seen in the eyepiece. This will be done using the hand controller using the steps in the previous section. If using blue Meade camera, while viewing, it will need to be attached to the scope where the eyepieces are placed. There is a black ring that screws onto the front of the camera which will be used to connect the camera to the telescope. A laptop with the camera's software will be needed to run the camera and take pictures. This software will be downloaded from Mead's website. Scrolling down to the bottom of the home page under the "More Info" tab, click the linked called "manuals & software". Once on the manuals & software page the Autostar Suite version 5.53 software needs to be downloaded along with everything it suggests. Pictures and walkthroughs for downloading this software and the telescopes manufacturer manual will be provided in Appendix B.

Shut down/ Clean up

After the viewing session is done using the dome there are a few tasks that ensure the telescope and dome is left in a state ready for the next user. The most important task to be done is to put the telescope into its parked position. Doing so will leave it in a state the is easy to use for the next

person, there is a detailed description of how to put the telescope into the park position in Appendix A. First is to return all the used eyepieces into their white containers and place them back in the silver Meade case. Second would be shutting down the telescope; turn it off using the same switch used to turn it on. Replace all of the lens covers on the scope, refer back to Figure 6. If any of the photography attachments or cameras are used, they should be placed back into their respective cases and securely closed. One of the last tasks that needs to be done while in the dome is shutting the sliding door of the dome. Using the lever mentioned in Figure 4 the door should be closed all the way, and the lower section should be reattached if it was disconnected while viewing. Once all these tasks are completed the floor hatch can be opened, and the user can exit the dome remembering to turn off the light as they exit. The easiest way to get down the ladder is to have both hands on the top handle and lower the left foot down onto the ladder. After exiting the dome, the lights in the room below should be turned off. Finally make sure the room is completely shut and locked.

Appendix A

When the user has finished their session, the telescope should be put into the parked position before it is turned off. Putting the telescope into its park mode will ensure the telescope remembers its alignment and won't make the next user perform another alignment procedure once turned on again. Using the hand controller, the operator will press the "MODE" button, using the arrow keys at the bottom of the control, they will scroll through the menu until "SETUP" appears on the screen when it does press the "ENTER" key. Continuing to use the arrow keys the user will scroll until the word "TELESCOPE" appears again pressing the "ENTER" key. Once in the telescope menu the user will scroll until "PARK POSITION" is displayed and then finally they will press the "GO TO" button on the top right of the controller. This will move the telescope to its parked position, once it has finished moving the user will then be able to power down the telescope using the power switch on the base.

Appendix B

If the user wishes to have the manufacturer’s manual on hand while using the telescope, they can find it on Meade’s website. Going to meade.com and scrolling to the bottom of the webpage there will be a section called More Info in there will be a bullet point labeled Manuals & Software which the user will click on. Once onto that page the user will be able to find the download link for both the camera software and the telescopes manual. If the user wants the camera software the Autostar Suite version 5.53 (full DVD) link, under the Meade Product Software column, will start the download for that software. When prompts from the download appear asking if the user would like certain packages to be downloaded, it is recommended that the user agrees to all if not the camera may not connect to the user’s computer and software. **Warning this package is quite large in its download size, so make sure the laptop being used has sufficient space for the download.** If the user is looking for the manufacturer’s manual for the telescope, they should look under the Meade Telescope Manuals column for the LX200-R Manual. This link will download the 76-page manual produced by Meade for the specific telescope that will be used.

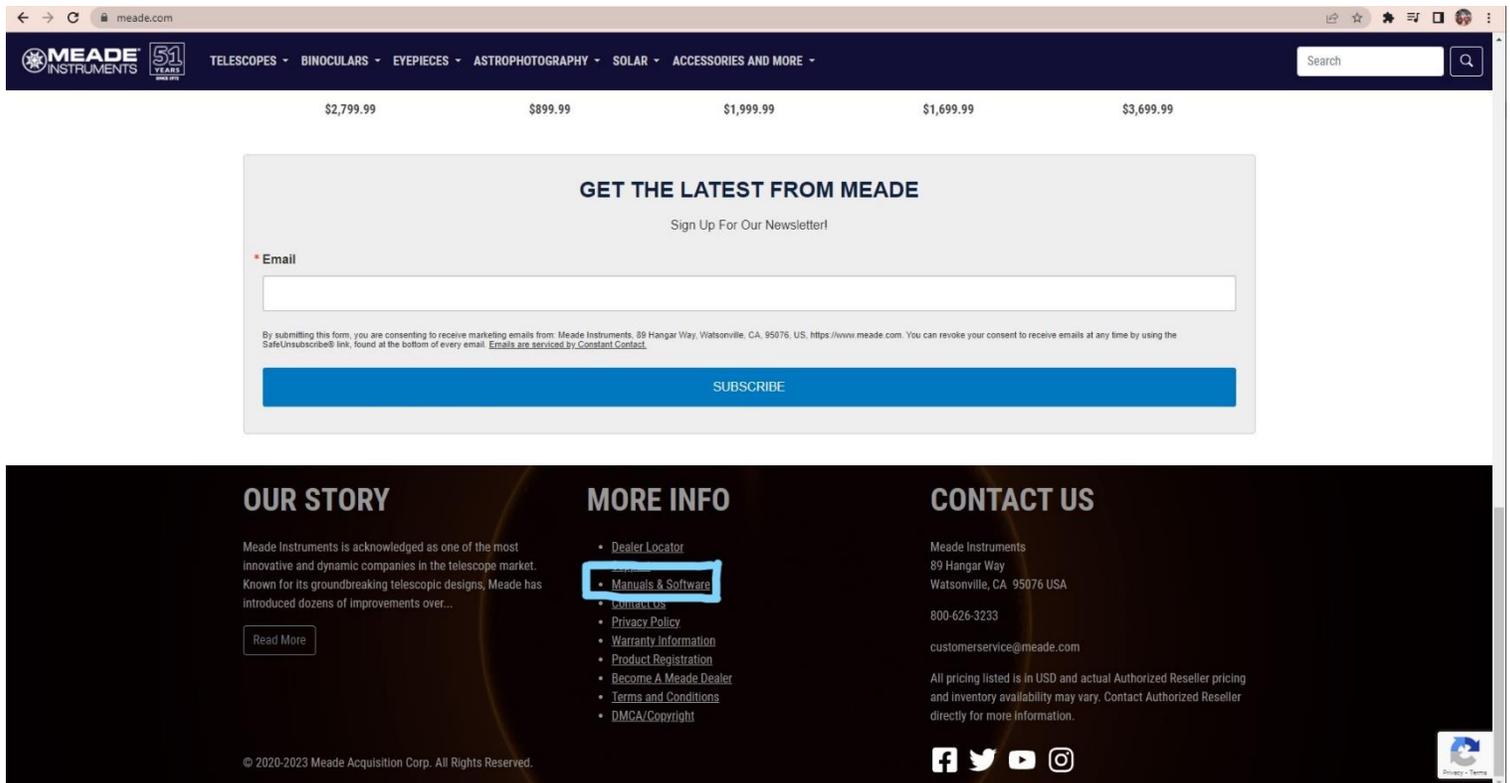
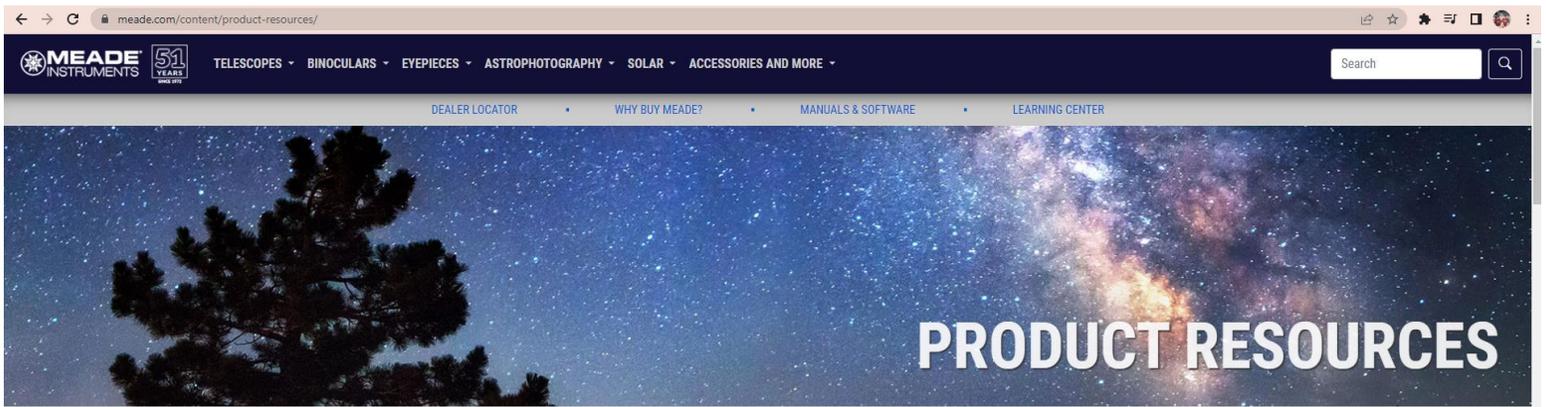


Figure 16: The image above shows the Meade websites home page where the link to manuals & software’s page is located.



Product Resources

Product manuals and software for current Meade and Coronado products can be found under the Support tab on their product pages. If you are looking for manuals for older Meade and Coronado products, you can download them from the links below.

Meade Telescope Manuals

[114EQ](#)
[114EQ-ASB](#)
[LX85 Instruction Manual](#)
[LX85 QuickStart Guide](#)
[Adventure Scope 60mm & 80mm Manual](#)
[DS Gen 1 \(60, 70, 80, 90, 114, 127\)](#)
[DS-114AT Manual](#)
[DS-2000 \(2060, 2070, 2076, 2114, 2130\)](#)
[DS-2000 \(French Translation\)](#)
[DS-2000 Generation II Telescopes with LNT module](#)
[DS-2000 LNT Manual](#)
[DS-2000 MAK Generation II Maksutov-Cassegrain Telescopes](#)
[DS-2090AT-TC Manual](#)

Meade Product Software

[Autostar Updater Program v 6.1](#)
Program used to update telescope firmware and transfer data to and from the telescope.
[How to Update Telescope Firmware](#)
[Autostar Suite version 5.53 \(full DVD\)](#)
Full version of Autostar Suite Planetarium program. Includes Autostar Suite, Hubble Guide Star Catalog, Updater program, PEC Tool, Starlock PEC Tool, Autostar Remote Handbox, RS-232 USB drivers, Virtual Moon Atlas, Autostar program manuals.
[Autostar Suite Astronomers Edition \(Lite Version\)](#)
Lite version of Autostar Suite Planetarium program.
[Starlock Utility v 1.0m](#)

Figure 17: This is what the page should look like for the user when they are going to download the camera software or telescope's manual.