Operating Manual

AOK DirectDrive Mount (DDM)

HERKULES (Equatorial)
and
ATLAS (Altazimuthal)

Version 1.4.2
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Translated by the help of www.deepl.com

With the DirectDrive mount you have a technologically very advanced device in your possession which, despite its relatively simple operation, still requires a few points of attention. Please read these instructions carefully and keep them in a safe place.

Installation of the mount

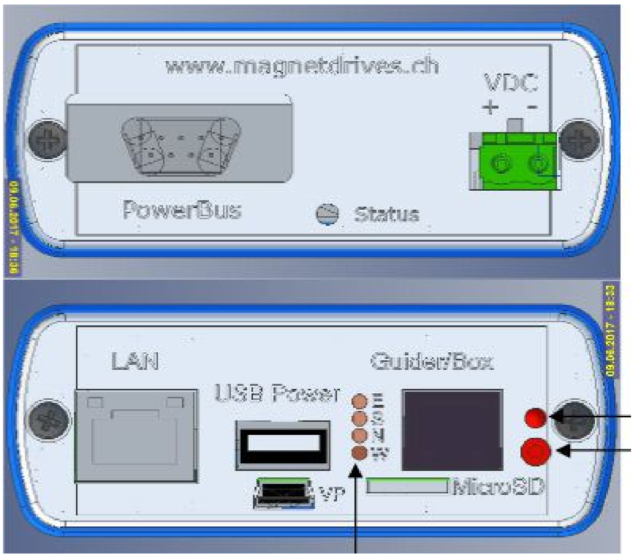
Like any other mount, the mount must be firmly anchored on a suitably stable base (column or tripod) before use so that it cannot tip over. This is particularly important when installing the alt-azimuthal ATLAS mount if it is used without a counterweight. Make sure that you have fixed the mount securely to the tripod or column before attaching a telescope or counterweights! Make sure that the tripod or column flange is as horizontal as possible before placing the mount on it. Also make sure that the mount can be aligned in the north-south axis. This is especially important with the equatorial version, as this is the only way to prevent rotation of the image field during tracking. Ideally, place the altazimuthal ATLAS mount so that the cover of the on-board electronics of the mount is aligned to the north. This is usually easier for operation.

Setting up the mount

At the mount it has different connections. On the one hand there is a 9pin RS232 connector at the bottom. This must be connected to the axis controller TCS (**T**elescope **C**ontroll **S**ystem - the actual brain of the mount). Further down you will find a black and a red „banana“ plug sleeve. At this socket you can connect a power supply (make sure to reverse the polarity! *red is plus*) in order to be able to supply power to peripheral devices on the telescope (e.g. the cooling system of a CCD camera). However, this may only amount to max. 48V! There are also two USB ports, each of which can be connected to your PC with a regular extension cable to control peripheral devices on the telescope.

On the housing of the upper axis (declination or height axis) there is also a plug housing on which there are also connection sockets. Here you will find two USB connectors (internal cable length approx. >1 m) and two power supply plugs (connected to the „banana“ plugs at the foot of the mount). For these two suitable cables are supplied which can be used for the power supply of peripheral devices. Further you will find another RS232 socket. This serves ONLY to control a system-internal derotator and focus motor and is directly connected to the motor bus of the mounting control. **DO NOT connect any older PC peripheral device to this socket which should still be equipped with this connector system.**

The connectors and LED's on the Telescope Control System (TCS):



You will find various connections on the housing of the control unit:

On one side is the plug for the power bus (drive of the motors) and the power supply plug, as well as a status LED. It lights green when the mount is controlled without a pointing model and red when a pointing model is used.

On the other side you will find the Ethernet socket (LAN connector) with a small green and yellow LED indicating the active communication, two USB sockets for powering external devices or service tasks and one ST4 socket for connecting an autoguider. Four small red LEDs indicate the presence of a correction signal.

Preparing the TCS for your network

Basically, you can at best connect the TCS directly to your modem with a LAN cable and start working immediately. This is of course possible if you have a standard home network. If you have no idea, your modem will usually have the IP address "192.168.1.1" and all peripherals will have a number between "2" and "255" at the last position. This also reflects the number of devices that can be connected to a modem. Most devices have a variable last number, but for you to be able to access the TCS securely, the various of programs at your PC must know the number of the TCS. Because this, the number of the TCS must not be variable. By default, the TCS therefore has the number "99". You can also change this number if necessary.

> *Notice:*
> *If you have a network that has a number other than "1" at the third position, you must first change the IP of the TCS accordingly so that you can access it accordingly in the network:*

Simply connect the TCS with a LAN cable directly to the computer and go to the Control Panel to "Network" and then "Ethernet", or "LAN". The network program will display the connection with the TCS, connected with the message that there is no connection to the Internet. The IP number of the TCS attached to the housing of the TCS. Then select "DHCP with manual address" and set a number as follows: the first three positions must be the same as for the TCS, the last must be a different number between 1 and 255. It will take a moment for the system to report that it is not connected to the Internet. But that doesn't matter - you can be connected to the Internet via WLAN at the PC at the same time if necessary.
Now type the IP of the TCS into the address line of the browser and select the menu item "IP". Change the IP of the TCS to the required number (third digit according to your network and/or fourth digit if desired).

Now set the numbers you need (e.g. 192.168.0.15), do not change the two values "254" and "5004" unless there is a higher weighted reason in network operation. So change only the third and even the fourth value of the IP address if necessary and then press [Restore].

Disconnect the TCS from the PC and connect it via the network. In the programs with which you want to access the mount, set the corresponding IP number as the address so that the programs can connect to the mount.

Notice:
Avoid writing all numbers in the first block! Do not use a point! The individual values must be written separately in the small windows. If you have typed in an impossible IP address and pressed Restore, you can no longer establish contact with the device. You must then reset this: Press the small button next to the Guiderport for at least 5 seconds and restart the device. It is then back to the default setting as at the beginning. Now you can change the IP address again.

Notice:
If you are no longer able to determine the IP of your TCS, you still have the following option: Connect the TCS to your PC and start the "Viewort" program (application described under "Appendix 2"). Press [F7] and then [Enter]; press [F9] immediately: A connection protocol will be displayed with this process, including the IP.

Mounting the telescopes

The **HERKULES** mount has a 3" wide prism clamp (Losmandy® format) for the mounting of the telescope(s). The counterweight axle rotates with the telescope, so it is possible to mount additional accessories instead of counterweights.

Before placing a telescope on the mount, it is essential that you attach sufficient counterweights to the extended declination shaft of the mount. Only then should the telescope be attached to the mounting flange using a suitable dovetail. Make sure that the two Allen screws of the clamp are tightened firmly when the tube on his dovetail is into the saddle. Also make sure that the telescope is well balanced in the declination axis (longitudinal axis of the prism guide). Then make sure that the right ascension axis is also balanced by positioning the counterweights appropriately. The aim is to ensure that the telescope does not move automatically in any position when the electronics are switched off.

> *Notice:*
> *In the service homepage of the TCS (normally accessible under 192.168.1.99 in any browser, see also below under "Setting mounting parameters") the performance status of the motors can be read: Under Drive, the deviation of the axes in arc seconds is continuously displayed for each axis. The color of the display also indicates how much current the motor needs to maintain its position: Red means that only a minimum current is needed (so the telescope is optimally balanced), if more current is flowing this is indicated by the changing color: Orange for rather little, yellow for much and white for very much power consumption. This is interesting because it shows you how much you are using e.g. a battery when photographing and helps you to rebalance one or the other axis without switching off the controls. By the way, a balance weight system is optimally used to compensate the heavy astro camera in relation to the light eyepiece equipment.*

> *Notice:*
> *If the load on the telescope is too unbalanced, the corresponding motor will stop because of the danger of overheating! In this case the telescope will oscillate freely at least temporarily! Make absolutely sure that the telescope remains reasonably balanced. Of course this is not the case with every eyepiece change - depending on the lever length of the tube a certain mass is needed. Nevertheless, pay attention to this point and try it out with a new configuration and also check the status display on the Serve website of the controller until you understand the system better. At the top the total current consumption and the available voltage are also displayed.*

The **ATLAS** mount has a 3" prism clamp (Losmandy® format) on each side of the vertical axis for mounting telescopes. The mounting can be equipped with telescopes on one or both sides. The left flange can also be turned to the right flange by loosening the lateral stud bolts to align the two tubes. Mount the first telescope on the right flange so that it does not move automatically in the height axis when the electronics are switched off. If you mount a telescope on both sides, this must also be balanced on the left flange. This is the only way to loosen the left flange for alignment! Then only the overall centre of gravity of the two devices must be correct. It is therefore possible to balance one device with the other. This is done, for example, to coordinate the viewing positions of the two units.

> *Notice:*
> *A clamp suitable for the Losmandys rail can be supplied as an accessory, which serves to safely move a heavy telescope in the prism guide and thus adjust the centre of gravity more precisely. If the telescope is over perhaps 40 kg, experience has shown that this is difficult without tools.*

> *Notice:*
> *Please note that a mounting with direct drive does not have a large holding torque when switched off. This means that the axes can be moved relatively freely. In order to reduce this condition, the mounting has a friction inhibition in both axes, so that the axes are not completely freely rotating, although high-precision, easily rotating*

ball bearings are installed.

Notice:
The ATLAS mount has an additional manual clamp in the height axis. If this is tightened, it is difficult to rotate the axis. However, the mount cannot be started in this way. A damage can not result - only the initialization process has to be repeated if you forgot to loosen the screw again.

Notice:
Like any equatorial mount, the HERKULES mount has a fine adjustment for the alignment of the mount according to the earth axis. These can be adjusted very easily and finely even under full load. To adjust the respective axis (azimuth or height), first loosen the clamping screws a little, so that the whole mount can be adjusted with the adjusting screw. Please note that the height adjustment can also be easily adjusted even with a full payload. It must never be strangled when the mount is being set to the north. Since the mount does not have a pole finder, you either have to use the classic calibration or an electronic calibration program. There is also the possibility to use the Polemaster from Alccd.

Notice:
Both mounts can be quickly and accurately "aligned" electronically with a highly developed three-star pointing model, so that you can find the desired objects right away. Six parameters are calculated in a mathematical model and the actual coordinates are continuously corrected (goto and tracking). Please keep in mind that an active pointing model must be deactivated if you want to place a parallactic mount! Otherwise useless results will be achieved.

Once the mount has been set up, you can connect it to the small axis controller (TCS). Use the RS232 bus plug on the mount. It is also necessary to connect the axis controller to a network. If you have a network in the observatory or at home, the easiest way to connect it to your router is with a LAN cable. Otherwise you can also create a temporary network with the help of a small router (e.g. TL-Link) and work completely autonomously. Depending on the router, you will simply not have an Internet connection for your PC. However, the connection to the Internet is not absolutely necessary for operation, but it can be indispensable for various applications, especially in photography (e.g. plate solving, satellite tracking). Now connect the controller to the mains adapter or the battery. The mount will make short movements in both directions in both axes and then return to the position before switching on. *If these movements are not made, you will have to find out why. This could be: too little current with battery operation, jammed axle(s), telescope not balanced). In this case you have to switch off the control unit again, repair the ground and restart!*

This procedure is the actual initialization process for controlling the motors. When the mount stands still again it is ready to be started e.g. with the star chart program "Sky Safari". This is usually done from the parking position with an observatory mount. In the default setting, this position is south on the horizon on the west side. With a transportable setup, it is easier to calibrate directly on a brighter object. The start position as well as the parking position, however, can be freely selected. Depending on the situation, you can manually align the telescope in this direction before or after switching on (= connecting) SkySafari. Only if you connect the controller with SkySafari the motors are activated and hold the telescope on position or you can move the axes with the direction keys.

If you operate the mount in an observatory you will have defined a parking position. The default factory setting is the point where meridian and horizontal meet (position virtually on the east side of the meridian / the telescope is on the west side of the mount). Ideally, you can use a marker on both axes that defines the parking position. This way you can move the telescope freely when it is switched off and still calibrate it reliably during the day and approach the bright planets or stars.

Important notice:

An mount with direct drive has only a small holding torque of the axes when switched off. For this reason, the Atlas mount has an additional clamping screw in the vertical axis to brake this axis. So you have to make sure that the telescope is balanced in the "bearing position". If this were not the case, it would turn away when switched off. Although the friction inhibition creates a certain inhibition of the axles, it cannot compensate for much imbalance.

It is possible to leave the mounting simply under power after approaching the parking position, the axes are then held in position by motor if necessary. However, this also means that some power is always consumed. It should be noted that in the event of a power failure, the telescope is no longer held. This method is therefore less recommended for continuous operation

Working with Sky Safari

Ideally the mount is started with SkySafari. The software automatically transmits location and time to the mount controller (TCS) when connecting, which greatly simplifies the process. You can use a program version on a smartphone or tablet as well as a version for the PC. To be able to connect the program, however, you must use the correct settings of the software, for this a few settings are necessary:

Network Setup in SkySafari

Factory set IP settings (these can be changed at any time on the mounting homepage):

Mount's IP :	192.168.1.99	(this is the IP of the controller in the network)
(LX200)-Server Port:	5004	
Homepage Port:	80	
Gate Away IP	192.168.1.1	(this is usually the usual device IP of the router / modem and usually does not need to be set or changed)

The values listed above can be set in the respective program as required, e.g. in the SkySafari app at → Setup and then → Telescope.

If the PC (or mobile phone) and the controller are connected to the network, the connection should be established immediately. If you are setting up a network, there are small helpers that allow you to scan the network you are using, such as "Fing" (in the App Store or Google Play). This allows you to scan a network easily and without knowledge and see the device IP's of the connected devices. If the mount controller is switched on and connected to the network, you will see the current IP (usually 192.168.1.99). The TCS also appears with the name "Generic".

Furthermore you can set the readout rate in SkySafari. This should be rather long, since this relieves the battery of your device, 1 to 2 per second is sufficient for most applications. At higher rates, however, the mount reacts more directly to driving commands from the program!

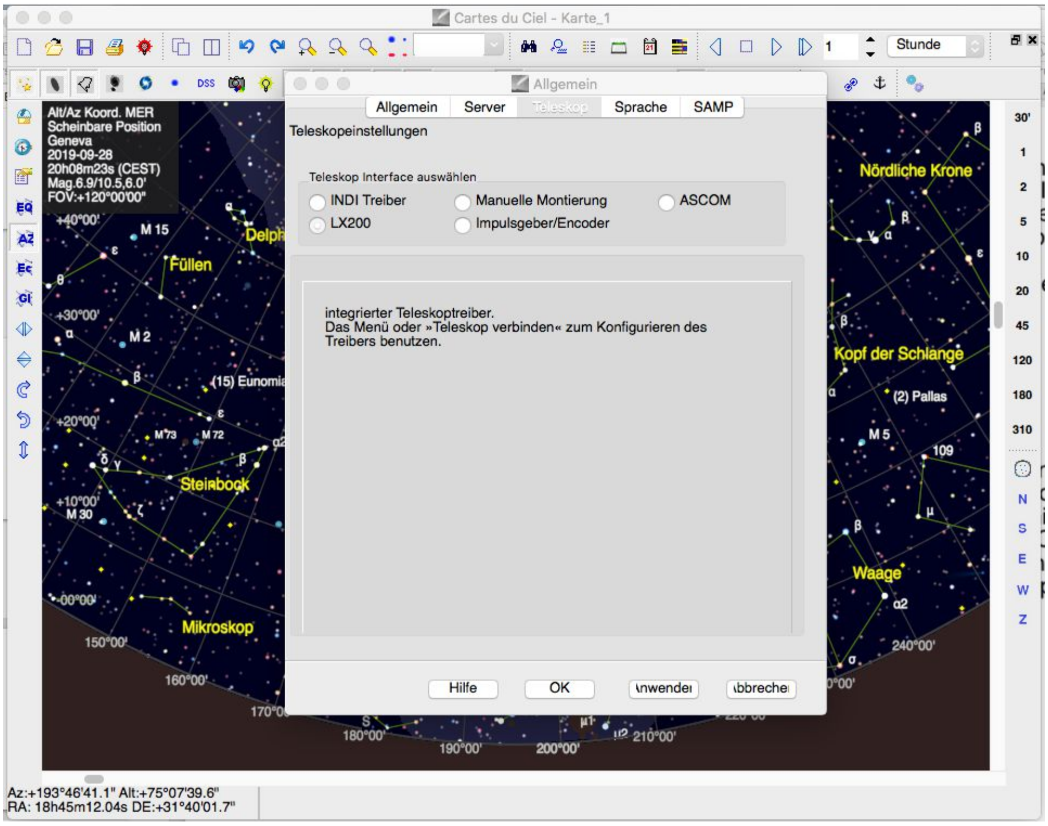
If the settings are correct, you can connect SkySafari to the mount with the [Connect] command. After a short time the direction keys will appear on the star map screen, indicating that the telescope can now be controlled directly via the app. You are now ready to start the mount. If there is a connection problem the message "connection failure" will appear. Try to connect again at that moment (many mobile phones switch off the WLAN when not in use and save power and a new connection often takes a little time). Otherwise, check the settings in the setup of the program as described above.
Make yourself familiar with the function of the App SkySafari, at the beginning it can still come to unexpected functions of the mount because of unconscious wrong manipulations because you e.g. unconsciously touched the display and had triggered a function which you did not want at all.

Notice:
Remember that the control unit is network-capable and can be controlled from any location with an Internet connection. Make sure you activate the firewall of your modem and secure your network!

Working with a PC and a star chart program

(using the example of "Cartes du Ciel" (https://www.ap-i.net/skychart/en/start)

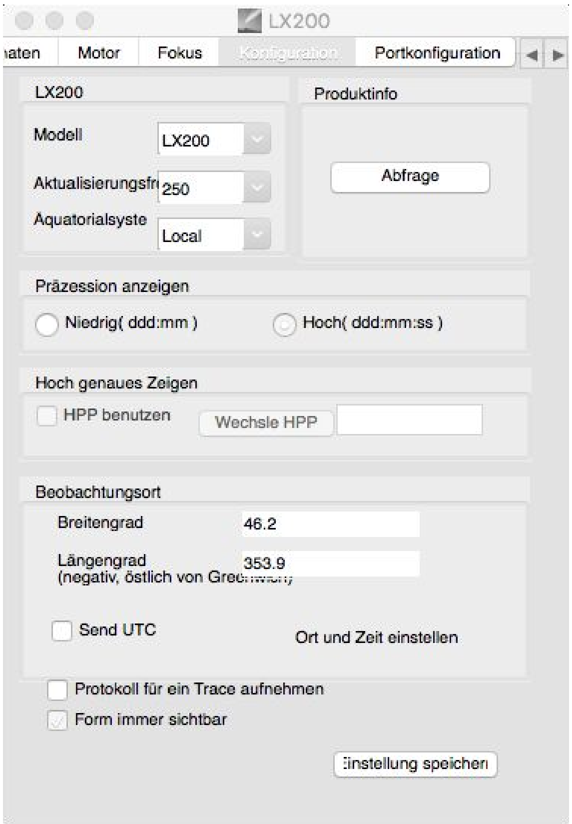
Start the program. Locate in the menu-point "Telescope" at the command dialog and then the pull-down menu „Telescope settings“



Set the communication language to "LX200" (or maybe INDI if you have), but not ASCOM. Press [OK] and find the pull-down command "telescope connect" at the main-menu "Telescope"; the following dialog window for the LX200 communication appears.

First select "Port Configuration" as option and select "TCT/IP" as the connection type. Fill in the communication values the IP of your TCS (normally 192.168.1.99), than the value for the TCP port „5004“. You can leave the value "Timeout" as it is. Press [Save Settings].

Please note: Since Version 4.1, Carte Du Ciel no longer has an LX 200 connection. Whether this will be changed again is currently unknown to us.



At the "Configuration" option, set the following values:

Model: select "LX200".

Update frequency: if the PC is connected to a power supply choice a rather small value (in milliseconds), the data transfer is faster, optimal can be e.g. the value "250". However, if you work with battery power, it's rather a bit longitudinal, e.g. "1000" which is not so fast, but also saves power.

Equatorial system: Set "Local".

Show precision: You have to set "high definition"!

Under the "Coordinates" option, select the [Connect] command and under the "Configuration" option, select [Set Location and Time].

Notice:
You can always contact and control the TCS with any LX200 capable program. However, you can only start the TCS with a program if you can send time and place. Usually this can be found under the mounting type "LX200 GPS" or higher or is set at the command "Set time and place" as shown in this example.

If you have successfully connected to the mount control, you can now control the mount from the star chart program as well as from other programs such as Astroart, Maxim DL or Voyager (e.g. plate solving, puls-guiding etc.).

Notice:
You can see whether you have started correctly with the control if the marker where the telescope is currently pointing is on the parking position, i.e. in the default setting of the TCS on the horizon in the south. If the procedure fails, the marker show's somewehre at the map.

Simple Startup Procedure:

1. Connect the mounting controller (TCS) to the WLAN or LAN router.
2. Connect your smartphone or PC to the network
3. Switch on the power for the TCS (mains transformer or battery).
4. Wait until the mount makes short movements in both axes and then swivels back to the starting position and stands still
5. Check the position of the mount whether it is on the parking position.

   Notice:
   The easiest way is to mark them with a sticker, so that you can also drive directly to objects during the day in any case.
6. Start SkySafari and press the command [connect] connect

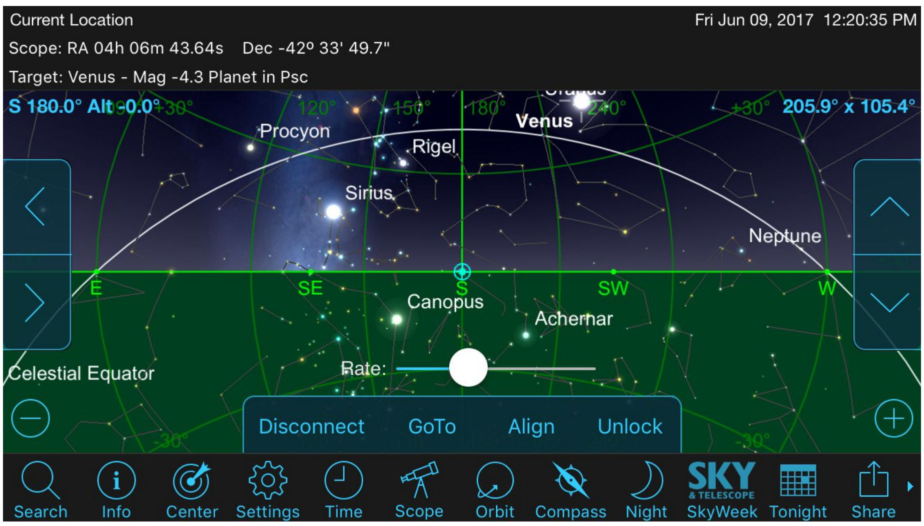
   Notice:
   You will hear a slight "pop" indicating that the motors are holding the axles.
7. Make sure that the virtual telescope icon is on the parking position on the screen.

   Notice:
   This is not the case, for example, if the mount was not moved to the parking position before it was switched off and / or was simply switched off for some other reason. In this case a known object in the sky is approached and calibrated.

   It can also mean that time and place are not correctly known at the handheld device and therefore an exact setup is not possible.
8. Select any desired object and press [goto].
9. The telescope is now basically ready to approach any object in the sky.
10. If necessary, center the first object in the telescope and press [align] to calibrate the control exactly. If a pointing model has been taken, it is automatically active with every movement of the telescope and corrects the measured errors.

Typical screen of SkySafari after connecting to the mount controller (TCS).

Notice:



It

may happen that the connection does not work at first attempt. This may be due to the following reasons:

- *The mobile phone / tablet has interrupted the WLAN connection due to temporary non-use for energy-saving reasons.*
- *The phone / tablet has no current position to send it to the mount*

Both processes sometimes take a few seconds and the app doesn't wait that long depending on the version, so it indicates a failed attempt. Usually a second attempt works without any problems.

Another reason could be that the mobile phone has automatically logged on to another WLAN network in the meantime because otherwise it does not get a connection to the Internet for which the connection was developed. You can usually deactivate this function in the operating control of the mobile phone.

Alternatively, you can aim directly at any object in the sky by hand or motorically (e.g. the moon) and then directly align this object. Of course, this also works and is otherwise the same. This procedure is recommended if a mount is not stationary and therefore has no defined parking position.

Notice:
The Atlas mount is also in this case able to follow the first star immediately without pointing model. This is under the condition that the mount is as horizontal as possible on the tripod / on the column.

Photographically you can carry out a plate solving directly after the startup at any place instead of the follow-up inspection by means of an eyepiece and thus start. Follow the instructions to point 8 and drive with a "goto" to any position, preferably between about 30 and 80 degrees above the horizon and take an image for evaluation. Then simply calibrate with the acquired data and center the desired object directly, e.g. with a plate solving of the image series obtained from the last image. If you have integrated an image field rotator into the system, you can also immediately set the identical position angle (both with an equatorial and with an alt/az mount) and continue the acquisition series without losing the image field.

You can now control the mount freely. For example, select an object in the program and then select the command "goto" and the telescope will move to the desired position. Basically, certain parameters can be set in each program, e.g. to prevent an object from moving below the horizon, etc. However, the control interprets of its own accord whether the mount must be turned over or not when approaching. With Tracking and Guiding, or with manual movement commands with the direction keys, you can, however, move "arbitrarily" over the meridian without the mount turning over. However, with a parallactic mount (Hercules) it is to be considered absolutely that never on an object on the other side of the meridian an Align command may take place! The interpretation would then be that the control would assume the mount has already turned over! In this case it is absolutely important to align only objects that are on the "right side" of the meridian. If it should become necessary for some reason to align at the meridian, then you must drive this on the "correct side" over the meridian back and align at a near object there. Due to the very precise position control this is no problem to find the object exactly again. However, you cannot drive a "goto" to the "other side" of the meridian without turning it over. In this case you have to approach the position manually.

Notice:
Note that an Alt-Azimuthal mount also flips. Only this point is at the extended meridian line in the north. So, if you have set an object slightly north-east and then want to approach an object slightly north-west, the mount will turn and move to the other side, even if the objects are only a few degrees apart.

For example, if you have a visual demonstration evening, it is advisable to start with objects in the west and then move as far east as possible, rather than moving back and forth in the sky. This makes the operation quieter and more pleasant for the guests although high "Goto" speeds are possible.

Notice:
With the altazimuthal mount version, the tracking of objects at the zenith is naturally associated with complications: if the mount has to track exactly over the zenith, for example, it has to turn quickly in the area with the azimuth axis. This can lead to very high theoretical speeds. Basically, the mount can also travel at very high speeds, which can lead to fast swiveling movements in the azimuth axis of up to 80 degrees. This is problematic for the demonstration operation (visual observation) as well as for the photographic operation. Avoid such conditions if possible or observe the telescope in the time so that no problems can arise e.g. with the camera and the PC because of the unexpected movement of the telescope. In this situation the image can not be held for a limited moment which leads to an interruption e.g. of the guide signal so that it will stop the recording program under certain circumstances. Also consider that the image field rotator has a more limited maximum speed than the axis motors.

Notice:
Although this condition is disturbing for visual operation, the intelligent axis control prevents damage from occurring: You can also hold the telescope by hand and prevent any movement - the power supply to the motors is automatically interrupted or reduced.

Basically, however, it is the case that this state does not suddenly emerge "out of nowhere" but that the axes gradually become faster when approaching the zenith. A dangerous situation cannot arise, it is rather unpleasant if the eyepiece moves away faster and faster. However, in this case you may simply hold the telescope by hand should this become necessary.

Set mounting parameters

There is a simple way to quickly set the mounting parameters, even if you do not have a PC at hand. The TCS (Telescope Control System) has its own website. Start in your browser the website of the TCS by simply typing the IP in the address bar (usually 192.168.1.99). This can be on a smartphone, a tablet or a PC. The device simply needs to be on the same network as the TCS. At least the first time, you must have access to the Internet at the same time as the TCS. The page loads some display elements from an external server that are used for the correct display. Once these are stored in the device, the page can be displayed correctly even without direct Internet access.

The following is displayed on the home page:

In the top row you will find links to a button that serves to refresh the page. This may be necessary after a longer interruption (working with other programs in the meantime). In the middle you will find a display of the (star) time and the voltage of the power supply. If this display is with white letters, the device has not (yet) been started with SkySafari and/or there is a connection problem. The voltage display helps e.g. to monitor the battery operation and to draw conclusions about the power consumption. In the upper right corner you will find a button to restart the TSC instead of switching it on and off.

Below you will find the four main menus.

Settings for telescope operation (Telescope)

To use these possibilities you have to open the TCS website in your browser by simply typing the IP of the TCS in the address bar (usually 192.168.1.99). This can be on a smartphone, a tablet or a PC. The device simply needs to be on the same network as the TCS. Then select the "Telescope" menu item and the following page appears:

The current position of the telescope in Equtorialsystem appears in the menu line during operation. Compare this e.g. with a coupling via ASCOM or INDI if you are not sure if the driver works correctly.

The control allows to set the following parameters directly on the website of the TCS:
MaxSpeed: the slider on the bar can be placed as desired, the value in degrees per second of time is displayed in a field on the left.

> *Notice:*
> *It seems tempting to set a very high drive speed. But keep in mind that in the dark observatory the movements appear much faster and under certain circumstances this can be dangerous to "beat" visitors.* ***Especially with large devices we recommend to choose a speed of about 4 - 12 degrees****.*

Below the drive speed setting range you will find four fields that allow you to make the following settings:

Look If the check mark is not set, the telescope can be moved freely by hand. This is sometimes convenient because you can quickly adjust an object by hand in the viewfinder and corresponds to the axis clamping of a conventional mount.

Notice:
It is important to note that when "Look" is switched off, the telescope immediately moves freely. If the equipment is not balanced, the mount will immediately turn downwards with the heavier side!

Tracking If the check mark is not set, the telescope can be moved by motor and the motors hold the telescope in position as usual, but the tracking is switched off. So the telescope stands still (e.g. for terrestrial observation, geostationary satellites).

Notice:
If you start the control with SkySafari, both check marks will be set automatically.

SParkPos You need this key if you want to set a parking position that deviates from the basic setting. Simply move the telescope to the desired position using a star map program or by hand and then press this button. You have now saved the new parking position.

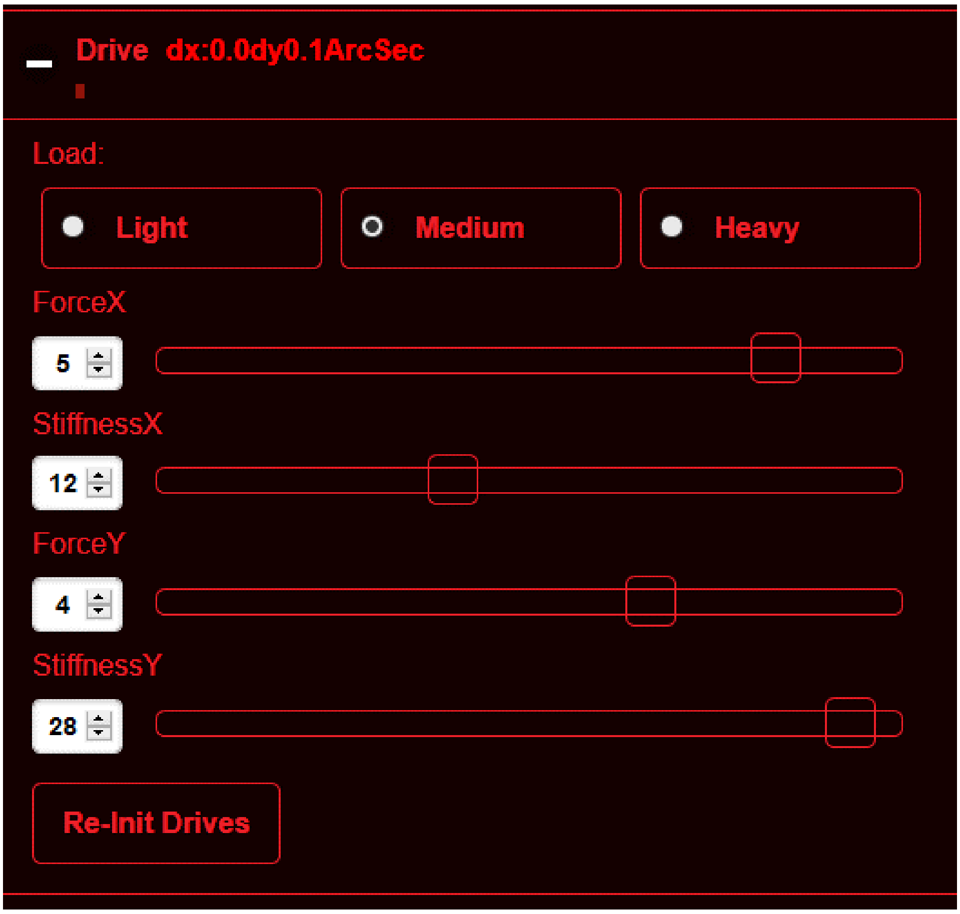
Park Press this button and the telescope automatically moves to the defined parking position (in the default setting just east of the meridian on the horizon (telescope is on the western side).

Notice:
You can also simply make a "Goto" three times in a row to the same position in the star chart program, then the control also moves to the parking position. This is provided that you do not make any other movement commands between the individual "Goto's".

Setting the motor parameters (Drive)

When using the mount for the first time or when fundamentally changing the equipment, direct drive motors must be set to the moment of inertia of the telescope. This means that force and stiffness must be regulated according to the weight, otherwise the motors will develop too little force or vibration.
At first sight this can seem a bit frightening, but in practice it is quite easy to handle. The simply designed control system allows anyone without specialist knowledge and without a PC to adjust the motors optimally. You can do this procedure from your PC as well as directly from your mobile phone and even see the deviations in arc seconds in numbers and graphics.

Start the TCS website in your browser by simply typing the IP in the address bar (usually 192.168.1.99). A menu list will appear in which you must tap [Drive]. The following page will then appear:



In the first line you see the deviation of the drive in AZ/Alt, or RA / DE in arc seconds, both in numbers and with a graphic bar (in the display practically non-existent because the position is almost correct).

> *Notice:*
> *The values set on the display can of course deviate in practice.*
>
> *Notice:*
> *These settings are protected with a password, so that you do not accidentally change the values.*

Then you have the choice of three weight classes, which you select according to your telescope. Often there are two different weight classes to find a good setting for the same telescope.

You also have one slider for each motor to adjust the force and stiffness. The aim is for the mount to be able to perform fast, stable swiveling movements without swinging. With the stiffness control you control how fast the motor tries to stabilize: too little means long (re-)swinging, too much means "swinging up" until the telescope starts singing.

The two bars at the top of the error display help you to quickly set the motor parameters so that the telescope stands still (errors in both axes must indicate 0.0" each with optimum setting). The forces must be set in such a way that the telescope moves smoothly and quickly during fast swings. If it is set too high, the motor will swing up (singing sound), if it is too low, the telescope will hardly move or not move at all. This would lead to a situation where the motor would not be able to hold the eyepiece anymore. So it needs enough power, but not too much. To keep the motor in one position it has to be stabilized which is set with "Stiffness". If the value is too high, the motor will vibrate up (singing sound), the stiffness too "hard" and the telescope will not come to rest. If the value is too low, or if it is too weak, the telescope (too) will not rest for a long time after a swivel or a mechanical impact. The telescope then swings back and forth for a long time (values of the error display do not go to "0").

> *Notice:*
> *If a new setting is made, i.e. the values are rewritten in the controller, the display is shown in white. This indicates that no correct values can be sent at that moment. After a short time the display changes back to red and the motors are controlled with the new values. The result can be seen on the error display or a singing indicates that a value is completely wrong.*

Once you have found a setting you will notice that this is quite robust, i.e. load changes on the telescope are hardly a problem.
Further there is a button "Re-Init Drives" in the lower left corner. With this button you can re-initialize the motors during operation (as in the start procedure) without having to switch off immediately. This may be necessary e.g. for more complex motor adjustment work... Please note, however, that the telescope must be reasonably balanced for this function. On the other hand, you will not lose any aligment.

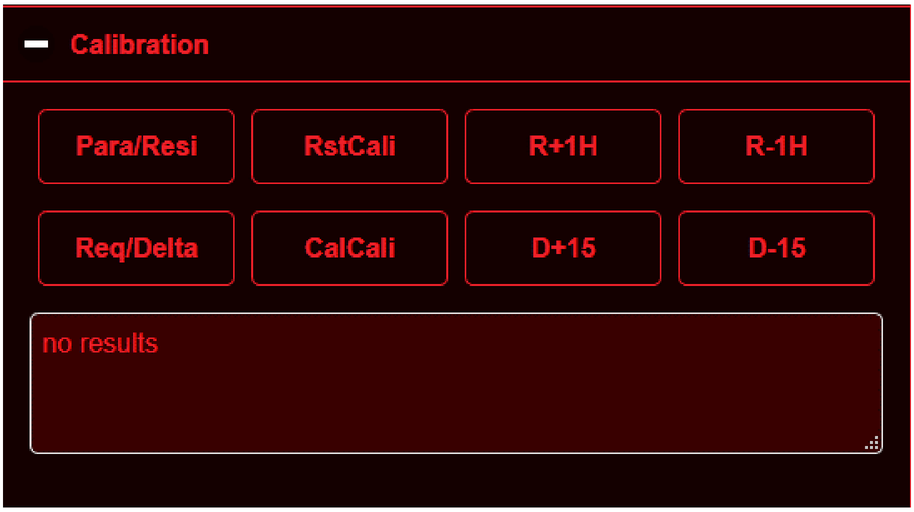
> *Notice:*
> *A reinitialization may be necessary, for example, because you have moved the telescope too far / too fast from the target position by hand or have moved it too fast during a manual correction (function "loked" deactivated). Remember that although the encoders are read out extremely quickly, a resolution of 1/100 arc second also produces an extremely large amount of data.*

Pointingmodel (Calibration)

The very easy and fast to create three-star pointing model is probably the strongest pointing method currently on the market for amateur equipment. It does not only allow a simple electronic alignment of the mount but contains several correction parameters which are automatically captured in a mathematical model and from now on are automatically available at every position and function continuously, so not only at "goto" but also at tracking. Although only three stars / positions have to be captured, it is often more accurate than complicated pointing models with maybe 25 positions or comparable. *And the best thing about it: **You don't need a PC**!*

> *Notice:*
> *In the case of stationary operation, a pointing model can only be recreated if you make some fundamental changes to the mount and/or telescope (e.g. readjust the optics). For a transportable application, a pointing model must always be recreated each time.*

To use these possibilities you have to open the TCS website in your browser by simply typing the IP of the TCS in the address bar (usually 192.168.1.99). This can be on a smartphone, a tablet or a PC. The device simply needs to be on the same network as the TCS. Then select the [Calibration] menu item and the following page appears:



There are eight keys that have the following function:

Para/Resi — **Parameter / Residue**
Shows the current parameters and/or residual data of previous models / inputs.

RstCali — **Reset Calibration**
Deletes existing entries or old pointing models

Req/Delta — **Require Delta**
Accepts the current position of the coodinate calibrated by a star chart program or Plate Solving.

CalCali — **Calculate Calibration**
If enough coordinates are stored, a calibration calculation can be started with this key whereby the result is also stored immediately and used automatically until deletion (RstCali).

Notice:

A pointing model is automatically used after a restart unless you delete it with the command "RstCali". This means that you do not have to do this every time you set up a stationary model.

R+1H	By pressing this button the RA axis moves 15 degrees westwards.
R-1H	By pressing this key the RA axis moves 15 degrees eastwards.
D+15	By pressing this key, the DE axis moves 15 degrees in the direction of the pole.
D-15	Press this key to move the DE axis 15 degrees in the direction of the ecliptic.

Notice:
In azimuthal operation (Atlas mount) the telescope follows the celestial coordinates, so it usually moves in both axes! So the azimuth axis and the elevation axis are not moved separately.

Procedure with crosshair eyepiece:

- ➔ Press [RstCal] (delete old data) and then [Para/Resi] to display the current data. Of course there should be nothing left in the display field. (no results“).
- ➔ Approach a bright, easily identifiable star and, at high magnification, place it exactly in the middle of the crosshair eyepiece. Align the mount using the star chart program.
- ➔ Then press [Req/Delta] The display shows the confirmation of the entry, e.g. "1 of 3".
- ➔ Then, for example, use "goto" to set another star at about the same height (declination) and about 30 to 60 degrees distance from the sky and center it again in the crosshairs and align the mount again.
- ➔ Press [Req/Delta] again.
- ➔ Set a third star with about 15 to 45 degrees higher declination between the first two stars relative to the right ascension and center and align it as well. Make sure that the stars are all ideally about 40 and 75 degrees (azimuth mount), or 85 degrees above the horizon.
- ➔ Press [Req/Delta]; you have now measured three measurement points in a more or less optimal triangle in the sky.
- ➔ Now press [CalCali] and the control calculates with the help of a mathematical model different positioning and angle errors of the mount and saves them automatically.
- ➔ The display shows six numerical values that indicate the individual errors considered. If these are "0,0,0,0,0,0" then you have either a absolute perfect setup or the values are so contradictory that it makes no sense (e.g. if you have centered a wrong star and the deviations simply to are larger than they can be (see also below).

Notice:
Keep in mind that with the crosshair method the pointing model can't be as accurate as it should be, because even if you center the star position as accurately as possible, the stored positions of the stars are not stored with as high a resolution as it would be necessary for perfect pointing. This inevitably results in a slightly worse model than with Plate Solving (+ ~10").

Procedure with a camera (plate solving)

What you need:

- ➔ a PC connected to the TCS.
- ➔ a camera connected to AstroArt, Maxim DL or a comparable program
- ➔ the DDM ASCOM driver or the INDI driver
- ➔ the ASCOM Poth, also connected to the TCS

Start all programs and connect them. Depending on the program and the field size of the camera in the sky, it is necessary that the initial coordinates are more or less accurate.

Move to the first position and take an image which you evaluate with the help of the camera control program, so the exact coordinates of the image center can be calculated (Plate Solving) and align the control. Accept this as with the crosshair eyepiece method.

Notice:
Avoid star fields with many stars of approximately the same brightness at the first picture! The Plate Solving program can also calculate a wrong position! It is best to start with a bright, prominent star.

Now use the key [R+1H] or [R-1H] to move 30 to max. 60 degrees in the recess to the next position and repeat the procedure.

Now use the keys [D+15] or [D-15] to move about 15 to 45 degrees in declination and repeat the procedure again.

At the end press [CalCali] and the control calculates with the help of a mathematical model different positioning and angle errors of the mount and saves them automatically.

Notice*:*
It makes little sense if you select too large a distance between the individual positions. This should be at least 15 degrees and max. 60 degrees.

Notice:
Do not use star fields near the horizon and near the zenith (azimuth mount) or near the pole (parallactic mount).

Notice:
There is also the strategy to record the three positions along a line of the object to be photographed, especially when using a transportable altazimuthal mount. This is advantageous for an object that has been photographed for a long time without a guide. When positioning on completely different sky positions, however, deviations may occur.

Interpretation of the displayed error values:

Sometimes it is interesting to take a closer look at the displayed error values. These can also be used for parallactic mounts. These are given in 1/10 arc minutes and can look like the following:

{564,436;199,456;-257,29}

The values are broken down as follows:

{ xoffset,yoffset, dNS, dEW, dO, dV}

These values may be important to us:

dNS:
Tilting of the RA axis in height (always in arc minutes), a positive value indicates a too flat orientation, a negative value a too high orientation.

dEW:
Rotation of the RA axis in azimuth, a positive value shows the deviation in western direction, a negative value the deviation in eastern direction.

dO:
Tilting of the optical axis to the vertical axis (deviation from the 90° angle)

dV:
Distortion: should not be greater than 100, a higher value may indicate an incorrect measurement.

> *Notice:*
> *If all values are close to 0, the result should be taken with caution.*
>
> *Notice:*
> *If "xoffset" is >1000 something is wrong with the stardate (e.g. an error in the clock of the initializing calculator / the location information)*
>
> *Notice:*
> *If all values are between approx. 500 and 1000, the system of equations is poorly conditioned. This often also indicates a measuring error or not optimal measuring points (too close to the horizon / zenith (=azimuth mounting), or pole (=equatorial mounting), i.e. error due to strong refraction).*

Not to be forgotten:

After successful pointing on a stationary mount, it is recommended to move to the parking position (or to define and move to it if necessary) and then to mark both axes. The best way to do this is to use an adhesive mark which you stick half over the axle housing and the other half over the telescopic flange and then cut through at the dividing line with a sharp knife. This enables you to start the mount quite accurately during the day even after moving the telescope when it is switched off, and to search for objects during the day.

North of the parallactic mount (Scheinern):

There are different possibilities of a parallactic mount to adjust to the north. Of course you can do this with the classical method at the crosshair eyepiece. Various programs simplify this work. With programs in which you have to bring a star in the image field of the camera after some measurements the mount to a certain position by alignment work in azimuth and height are to be taken with caution in so far as the angle between DE axis and optical axis is rarely exactly 90 degrees and thus influences the result more or less. However, such programs often require sensors with a large field of view in the sky, which can be a problem with larger optics.

We think that the best results are shown by programs in which the deviation of the star in one axis is observed and interpreted in a similar way to classical shining. One such would be PemPro (the function "Polar align wizzard").

http://www.ccdware.com/products/pempro/

but to run it you need a version of Maxim DL on your computer. Another very functional tool is integrated in PHD2 (known as Autoguider for a long time).

https://openphdguiding.org/manual/?section=Tutorials.htm#Drift_Align

This is a very widespread freeware program and is highly recommended.

Important note:

It is of course absolutely important that any existing pointing model is ***deleted*** *before you run a calibration routine! The pointing model would compensate for the misalignment and follow the correct run of the stars which would either make it impossible or lead to undefined errors.*

So make sure that you check that no pointing model is active before you start to move north.

But there is also the possibility to optimize the alignment with the pointing model of the mount:

With the above display, the error in azimuth would be "456", which corresponds to 45.6 arc minutes in the western direction. The azimuth screws rotate the mount quite exactly by 1 degree / revolution (0.9913°). In this case the left screw of the azimuth setting should be turned inwards by ¾ turns if you look at the mount from north to south. The mount then shows ¾ degrees more to the east.

Notice:
The counter screw and the clamping screws must of course be loosened beforehand.

In our example, the value for the height shows "199", i.e. an alignment that is 19.9 arc minutes too flat in height. With the large adjustment screw, the mount can be set about 0.6 degrees steeper or flatter per revolution. In our case, the large adjustment wheel would have to be tightened by 1/3 turn so that the RA axis would be somewhat steeper.

Notice:
Since the adjusting screws must have some mechanical play, this must always be turned first to the play stop (tension or pressure adjustment).

Notice:
The four clamping screws that fix the RA case on the side are to be loosened as follows: the two screws that serve as an axle only slightly, the two screws in the oblong holes a little more, but only so far that the mounting can be moved with the large hand screw for adjusting the height.

After adjusting the correct height these screws have to be tightened again.

Notice:
Just as it is absolutely important to delete a pointing model before the mount is placed in the north, after the mount has been mechanically placed in the north it is of course necessary to recreate the pointing model. The third and fourth value should then move to a very small value. In practice you will hardly come under about 2 arc minutes, or notice that the substructure / column / construction will move measurably in the course of the year.

Not to forget:

After successful pointing on a stationary mount, it is recommended to move to the parking position (or to define and move to it if necessary) and then to mark both axes. The best way to do this is to use an adhesive mark which you stick half over the axle housing and the other half over the telescopic flange and then cut through at the dividing line with a sharp knife. This enables you to start the mount quite accurately during the day even after moving the telescope when it is switched off, and to search for objects during the day.

Drift guides with a auto-guider camera

In principle, a direct drive runs very precisely through the use of high-precision encoders, although not absolutely error-free. In addition, positioning errors (azimuth and height) as well as angular errors of the axes (RA - DE - optical axis) and of course the refraction together cause small residual errors in the tracking which cannot always be absolutely compensated by the pointing model. The remaining errors are at a very low level - at 5 min. exposure time and less than about 2 meters focal length you can work unguided. However, if you want to achieve a photographic resolution in the range of one arc second or less, the easiest way is to use a guide. But the good thing is that you only have to correct a very slow drift. To want to follow the air turbulence is not possible with the current Guidernkamera's, vice versa you will image the air turbulence with long exposure times at the Guider with e.g. about 10 sec. smoothed so far that a very calm guiding is realized.

> *Notice:*
> *Avoid autoguide systems that take pictures every second and evaluate them. With such a system you will only jump after the air turbulence and worsen the running of the mount depending on the seeing! Trust that the mount will run much quieter than these results seem to show. If necessary, use a gray filter for the guide camera!*

In principle, both correction variants are possible: pulse guides via ASCOM interface or with a ST4 guide cable which can be plugged directly into the TSC. Which method you choose is up to you, with both you can achieve the desired results. It is important, however, that you control the settings in such a way that after the image acquisition with the guide a pause is switched in which the control of the autoguider sends the signal to the mount and this time executes the command. Of course, no recording may be started during this time! This is not automatically tacked correctly for all programs via pulse guiding.

> *Notice:*
> *You can track the meridian until the telescope is ready. However, you must never reposition over the meridian because otherwise the control will go to the wrong side! However, if you instead place a Goto command on the same object, the telescope will automatically switch.*

Photographic work with a PC

Please note that to start the mount you need a star chart program with LX 200 interface, which can send time and location to the mount controller when establishing the connection. Different programs can do this, some not. However, you can also communicate successfully with any other star chart program that has a standard LX200 interface. So some programs are better suited for certain processes than others.... but important is that the star chart program allows a high resolution of the coordinates because otherwise no reasonable communication can take place. The control unit cannot do anything with insufficiently exact coordinates under circumstances.

The ASCOM driver can be found here:

http://www.magnetdrives.ch/telescope/ASCOMDrivers/

> *Notice:*
> *A driver for INDI cn download here:*
>
> https://www.indilib.org/telescopes/aok-skywalker.html

> *Notice:*
> *Since a direct drive has no backlash, any corrections in the subarc second range can be made in both directions in declination. The mount will follow these exactly what no mount with mechanical drive can really do, even if it has high-resolution encoders installed.*

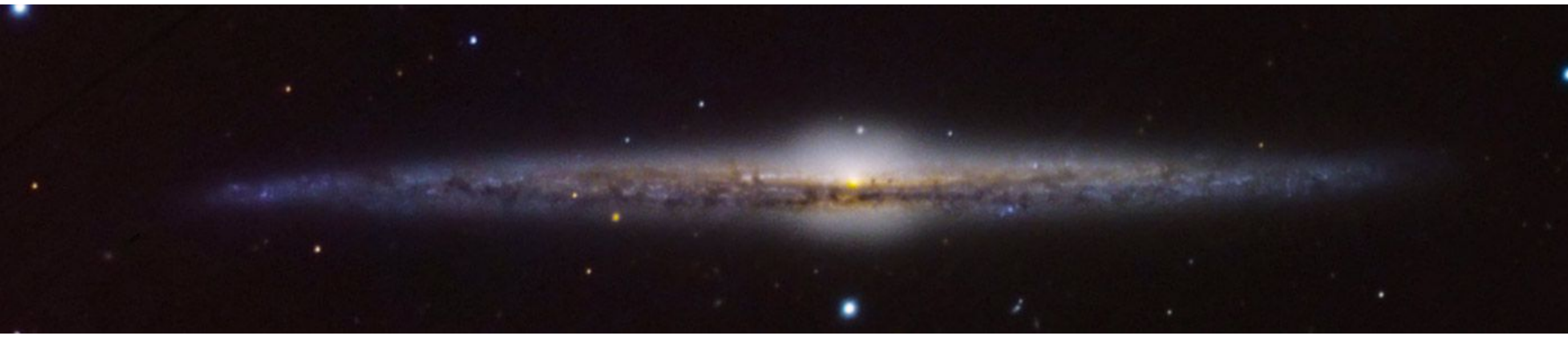
> *Notice:*
> *You can drive to almost any brighter stars in the environment for precise focusing and almost pixel-accurate back again. Residual errors in the range of seconds result from the distortion of the entire mechanics (deflection in the range of 1/000 millimeters).*

> *Notice:*
> *Although it is possible to establish all communication with the TCS via WLAN, we recommend using the LAN port for high-resolution photographic work, because it always reacts immediately even after minutes of interruption.*

It is advisable to attach a barrel weight to the telescope in a fixed position in order to compensate for the usually heavier photographic equipment.

Please note that a conventional camera bayonet connection, for example, can cause a greater error due to mechanical play than the remaining tracking errors of the drive.

> *Notice:*
> *You may rethink: in contrast to a mount with a gearbox, you may really drive without hesitation when guiding over the meridian with the telescope simply into the column / mount. The drive notices this immediately and stops the drive - there can be no damage to the drive and tube/camera! So you can simply track over the meridian until the telescope is ready and only then have to move to another object with a Goto command and expose further.*



Satelliten – Tracking (with ASCOM and LX200 Interface)

What you need:
The first time, if possible, two Windows laptops, the network router (if a link router is set up in the field that can be connected to the TCS with USB-B cable), two LAN cables and a smartphone with SkySafari if no suitable program is available on one of the PCs.

How it is organized:
The one laptop has the SatelliteTracker
http://www.heavenscape.com/
and the COM2TCP software
http://astrogeeks.com/AstroGeeks/COM2TCP/download.html
and is connected to the telescopic router with the LAN cable.

The other laptop has the service software Viewport
http://onerobot.org/#ViewPort
and is connected to the USB port "VP" of the telescope control box and is also connected to the telescope router with the LAN cable to connect the browser to the telescope's homepage.

Start-Up:
1) Switch on the PC's and start all programs. Compare and synchronize the programs "SkySafari" and SatelliteTracker with respect to time and observation position.

2) Starten Sie die Montierung
3) Connect:
   a. Skysafari (= transfer of time and exact place for the mount)
   b. Your browser to see that the stardate is set.
   c. Compare it with the sidereal time of SkySafari; the error should be in the range of seconds.

4) Align the mount as accurately as possible in the sky.

5) Start COM2TCP if not already done and follow the instructions for setting up the USB port. Note that with Windows you must always use the same USB socket on the PC.

6) If available and if not already done, start the "Viewport" program on the second computer and/or the mount page in the browser to see the error or the desired position in real time (select AC input for the Viewport oscilloscope).

7) Set the telescope interface of the SatelliteTracker program to "LX200 compatible".

8) Select a suitable or desired satellite and start tracking and see what's going on. For this purpose, the "Viewport" program with the Viewport oscilloscope is an excellent way to follow the movements of the two motors in real time and to understand exactly what is happening or what is not working and to intervene.

9) In the "Satellite Tracker" program, under "Options" and then "Settings", you will find the "Tracking Factor" setting for optimizing the timing of the positioning. Keep in mind that with faster running satellites, a few time seconds of error will make it disappear from the field of view.

Depending on the time, type, location and orientation of the mount and orbit in the sky, you can track moving satellites all over the sky.

> *Notice:*
> *If you want to travel to geostationary satellites, you must switch off tracking on the*

satellite after reaching the position! This can be done in the service homepage. Alternatively, geostationary satellites can of course also be approached directly from SkySafari and then the tracking must be switched off on the service homepage of the TCS.

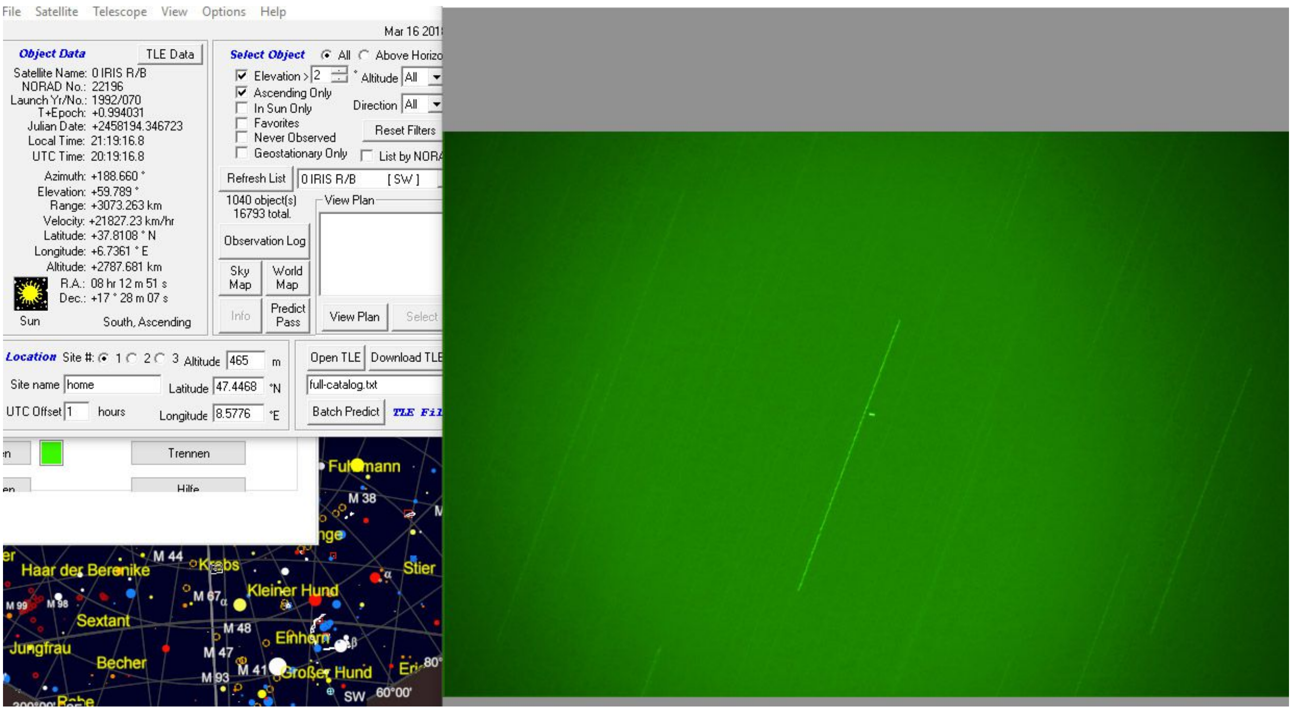
Notice:
In any case, a successful pointing model that has been created beforehand is a prerequisite for success.

Notice:
Of course, it would also work on a computer, but experience shows that the individual programs usually do not work / react quickly enough and there is no homogeneous process. But if you have it under control you can of course do without the second computer with viewport. It is simply a good way to monitor and understand the process better and to make corrections in the application accordingly.

Notice:
It is also possible to start a satellite interpoaltion program in the service homepage of the controller, which refines a homogeneous movement of the individual "goto" commands of the satellite tracker program Heavenscape from the last three "goto" positions. This function also allows you to follow fast satellites such as the ISS. ***Please note, however, that this function must be switched off again after satellite tracking****, otherwise strange movements will be made during normal "goto" operation.*

Have fun and let us know your experiences [berchten@magnetdrives.ch].

Example: Here is the current image of IRIS R/B after correcting the system time of the PC, the satellite is in the middle of the image.



Accessories (Function "Aux Drivers" of the TCS)

Derotators of different sizes are also available for mounting control, the control unit of which can have various other functions. The control and power supply is provided by the mounting bus and can be plugged into the connection housing on top of the azimuth/declination housing. No additional cables for mounting or telescope and no additional power supply are needed.

Control screen of the control of the additional functions in the service homepage of the TCS of the mount. The functions of the service homepage are limited in comparison to the possibilities that are possible via ASCOM interface with connected astro programs such as AstroArt or Maxim DL. This is understandable, because the TCS cannot do an autofocus function or Plate Solving to calculate the effective position angle of the camera. In order to be able to use the full range of functions, you need appropriate photographic programs on your PC. The description of the functions via PC can be found in the corresponding programs.

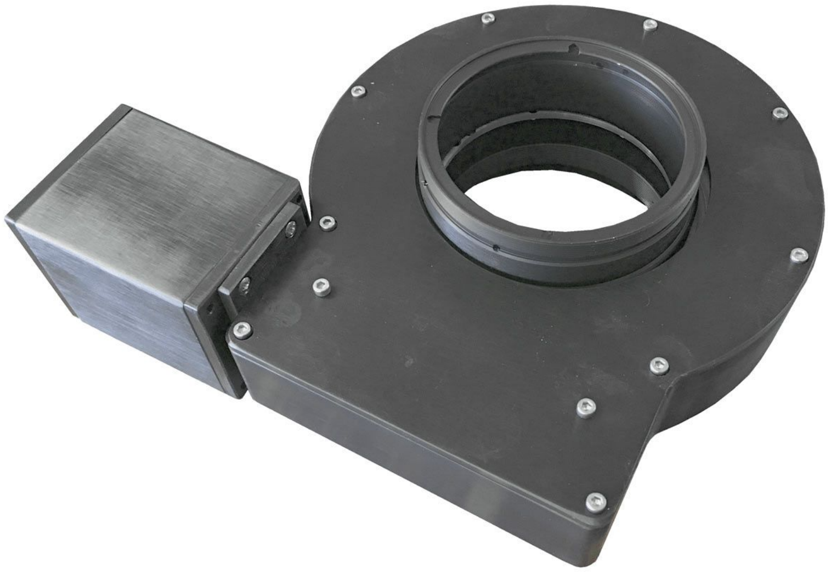
Derotator

Especially for an azimuth mounting it is indispensable to have the image field automatically derotated in order to do long-term photography. But also on a parallactic mount, the position angle of the camera can be controlled without having to touch the telescope.

Without connection to a PC program, the service homepage of the TCS allows a rotation to any position, whereby the feed resolution is 3600 steps per revolution. Either the control starts without calibration with a PC program like AstroArt or Maxim DL with the value "0°" or with the last position angle which can make sense in a fixed position observatory.

On the service homepage you can enter a value in degrees x 10 (e.g. at 84.3° the value "843" must be entered) and the derotator moves to the desired position or a displayed value can be reset to "zero".

> *Notice:*
> ***For automatic derotation, you do not need to enter anything else****. This is done automatically during tracking and also includes all corrections calculated from a pointing model. The step resolution during automatic derotation is of course higher than 1/10 degree!*



Currently two models with different sizes are available. The connections to the telescope / corrector and the camera are made according to your wishes.

Focus motor control

The focusing motor control, which can be integrated in the control box of the derotator, can control practically any stepper motor of an eyepiece slide and can also be addressed via ASCOM with a PC program. In the service homepage, the motor can be controlled directly via keys.

In addition to the relative focus position display, a button can be used to move the focus either quickly or slowly in both directions. Of course, it is much more interesting to control the motor via ASCOM from a PC program in autofocus mode. The temperature measurement (measured via the heating function of the dew cap) also allows a temperature shift of the focus to be measured, if necessary. This function is available with an integrated dew control also without PC this is first read in.

Dew-protection control

The control box of the derotator can also be equipped with an automatic heating control. However, this is not designed to simply heat the optics, but allows a very finely resolved control of the air temperature in the area of the dew cap: a high-resolution measuring instrument continuously monitors the temperature and humidity and determines the dew point. The air temperature is now automatically kept approx. 0.5° to 1° above the dew point, so that a dew fog can be successfully prevented with as little energy consumption and air turbulence as possible. In addition, thermal effects on the focal point position are prevented.

The control operates fully automatically and the display shows temperature, relative humidity and the current (additional) power consumption.

> *Notice:*
> *A heating band with measuring probe is manufactured and supplied to order in the size required for your telescope.*

Annex 1:

Installing an update for the TCS (mounting controller)

If it should become necessary to load an update for the mounting control, this is possible as follows:

What you need:
- a current update file ending with *.eeprom.
- an uploader program (→ FTDI driver)
- one USB-USB-Mini cable

If necessary, you will receive the file from the supplier of the control/mounting system. The program you need for uploading must be downloaded from the network to your computer and installed:

https://www.parallax.com/downloads

The program is available for Windows, Linux and OSX (up to 10.9!). After loading you have to restart the computer in any case. Interestingly, this is also the case for Unix systems.

In most cases you will have to load the following USB driver:

https://www.parallax.com/downloads/parallax-ftdi-usb-drivers-windows

Notice:
If you are already using the "ViewPort" program, e.g. for satellite tracking, the USB driver is already installed. In this case you don't have to load it anymore. Make sure, however, that you always use the same USB port on your PC with Windows.

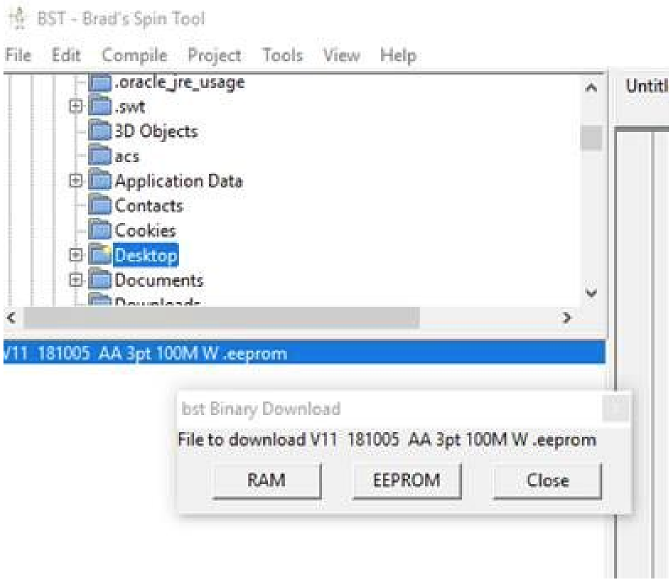
When you have loaded both programs/drivers you are ready for the update. You can comfortably take the control unit of the mount home and update it on your computer. You do not have to take the power supply with you. After installing the program and the USP driver simply connect the TCS to the PC with a mini-USB cable. Do not use the USB-A connector on the TCS, it is only intended for power supply of peripherals and does not provide data connection to the computer. The TCS is supplied with power via the Mini-USB cable, but the motors cannot be controlled in this way.

Updating procedure

Connect the TCS to the PC. Depending on the connection, an installation routine will be started for the first time. gestartet um den USB Serial Converter zu konfigurieren („neues USB Gerät erkannt“). Folgen Sie einfach den Anweisungen am Bildschirm.

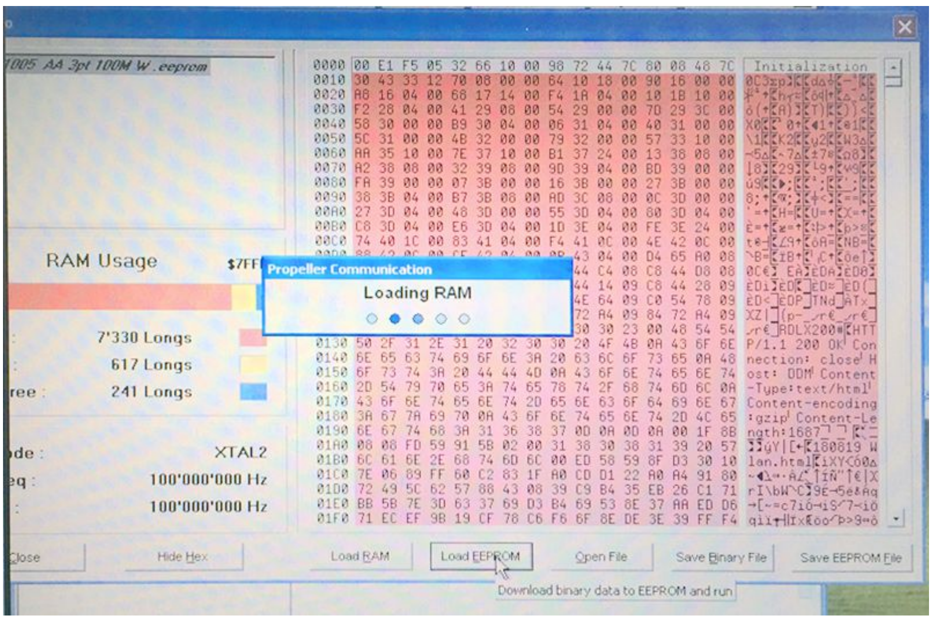
Start the program "Probeller Tool", you will normally find it under "All Programs" → "Parallax Inc" → "Propeller Tool" → "Propeller Tool".

The program starts and displays three fields in the window. Press "F7" (or the pull-down menu "RUN" → "Identify Hardware"), the TCS will be connected to the program.



If the program is connected to the TCS, this is confirmed accordingly. In the upper left window select the path to the saved *.eeprom file and double-click on it (in our case **V11 181005 AA 3pt 100M W.eeprom**). The number "181005" indicates the software root version, "AA" indicates that it is for an AltAzimuthal mount ("AAEQ" stands for the equatorial mount) and "3pt" indicates that the software is equipped with a 3-point pointing model. Alternatively you can simply drag the file into the window of the uploader program.

Press the Buttom [EEPROM[in the window, the upload process is running.

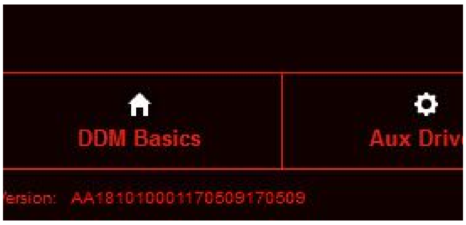


Wait until the process is finished, then disconnect the TCS from the PC.

Notice:

You can either save the update in the RAM or in the EPROM of the TCS. When *saving into RAM the new program is active, but it will be deleted after switching off the TCS and the old version will be loaded at the next start. When loading into the EPROM, the new version is permanently stored in the TCS and becomes active with the next start.*

You can now reconnect the TCS to the mount and start it as before. Observe whether the initialization process is running as usual. Start the service web page of the TCS as usual and check whether the new software version is displayed after the start. Compare the first six numbers with those in the file. The current version can be found at the bottom of the page:



Notice:
The entered values and data (calibration of the motors, pointing model data, etc.) are retained; you do not have to re-enter them. However, the IP address of the TCS is always set to the default value of 192.168.1.99. This value may have to be re-entered (see above).

Hinweis:
Ist das Update mit veränderten Motoransteuersoftware ausgestattet kann es sein dass Sie die Motorparameter anpassen müssen.

Annex 2:

Optimizing the motor parameters with the "ViewPort" program

You may not be able to optimally adjust the mount to your needs with the setting options available on the TCS service homepage. In this case you have the possibility to optimize the motors with this program in almost any case, but if you use the setting options of the service homepage (see above) you should not necessarily use the options described below. The options listed below are described for the sake of completeness. What you can't achieve with these options is e.g. to increase the running or positioning accuracy in tracking, therefore an exact pointing model is necessary. The most accurate results can be achieved with positions achieved by Plate Solving.

Load the "ViewPort" program

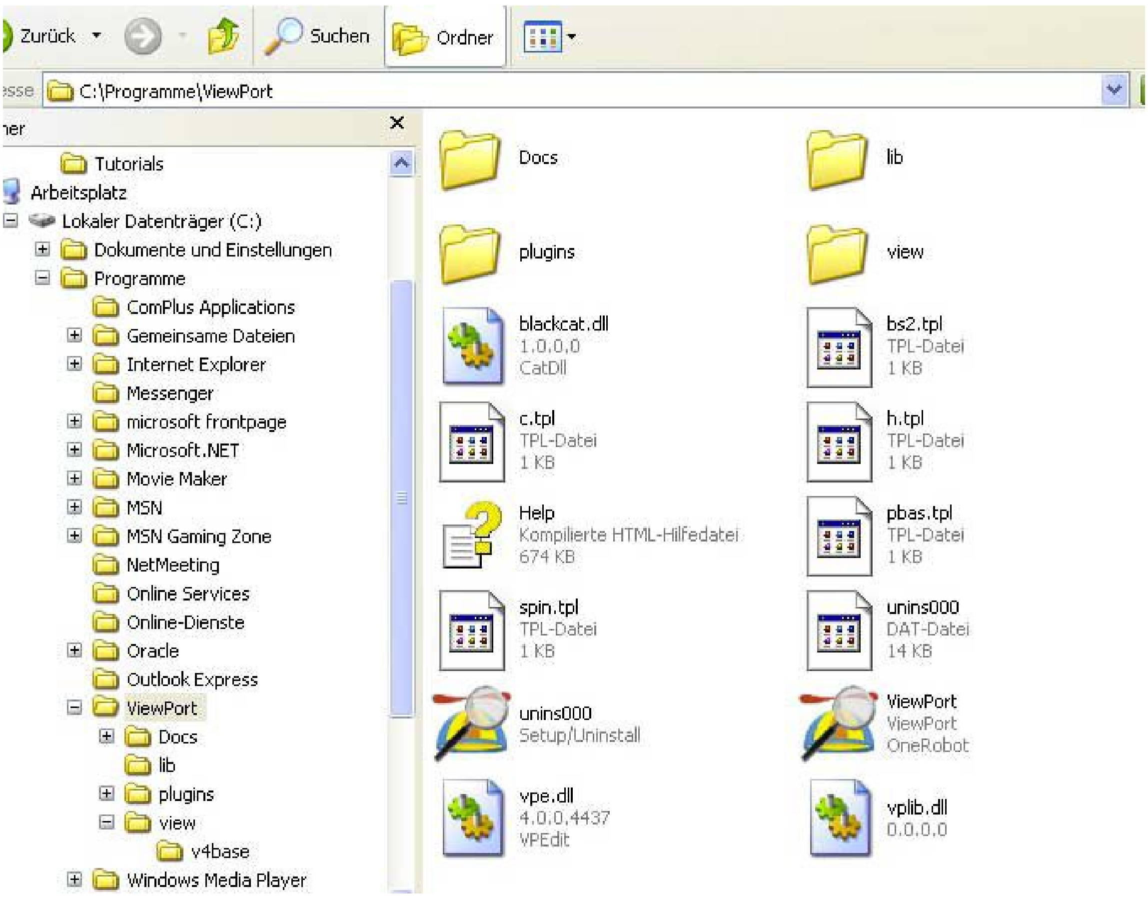
http://onerobot.org/#ViewPort

and install it on your computer (Windows). On a Unix system (OSX / Linux) you have to install a virtual machine with Windows (XP or higher).

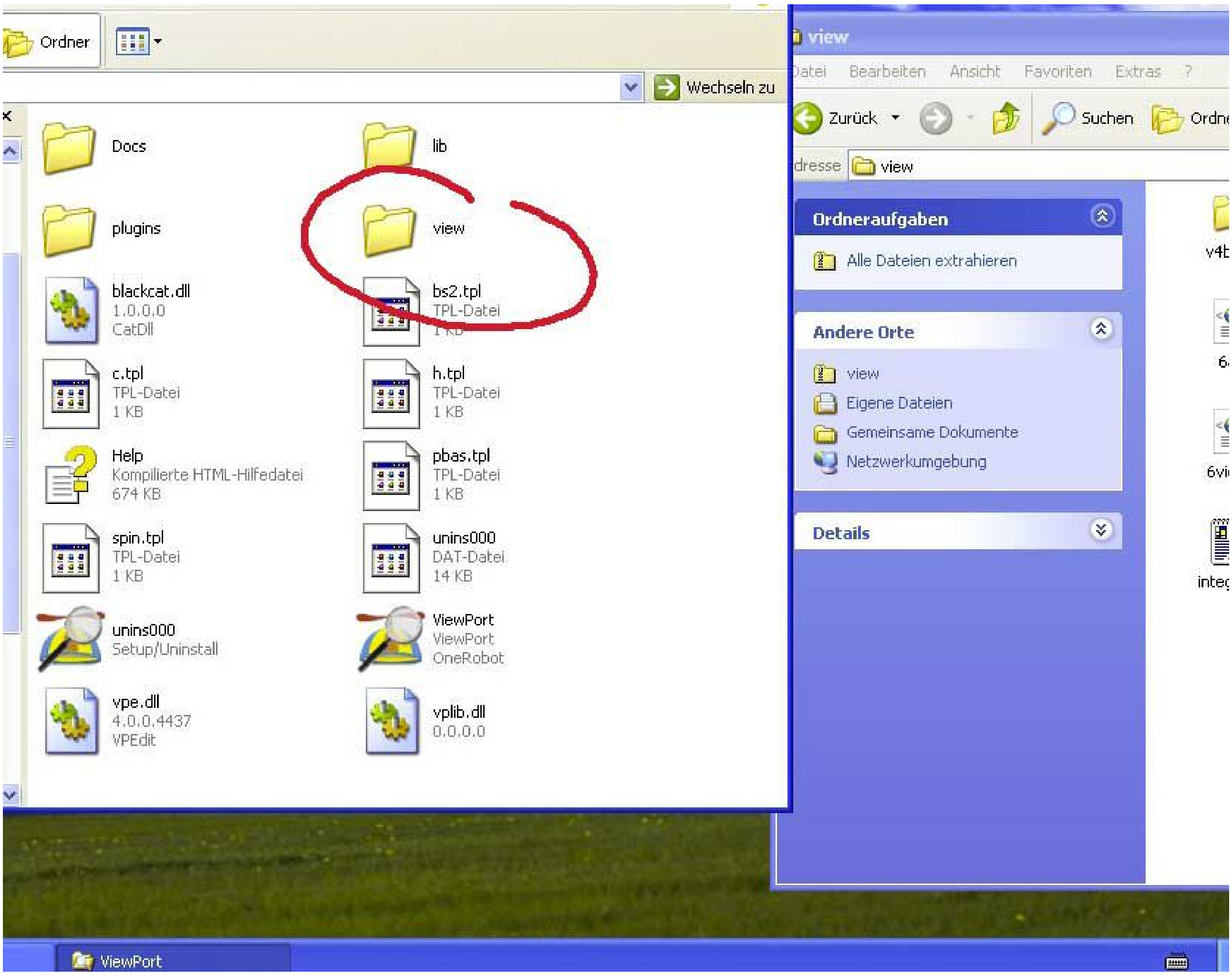
Also download this special extension library for the program:

http://aokswiss.ch/ASCOM/view.zip

Locate the program folder of "ViewPort" (usually on "C" and under "Programs") and open the folder of "ViewPort" in the file explorer.



Replace the subfolder "View" with the separately downloaded new folder "View". This folder contains a special library of setting options for the AOK DDM mounts.



Now start the "ViewPort" program. After opening the program, make sure that the button "telescope" is in the middle of the buttons above the yellow part of the screen. If this is not the case, you must move the extension library again correctly into the program folder and then restart the "ViewPort" program.

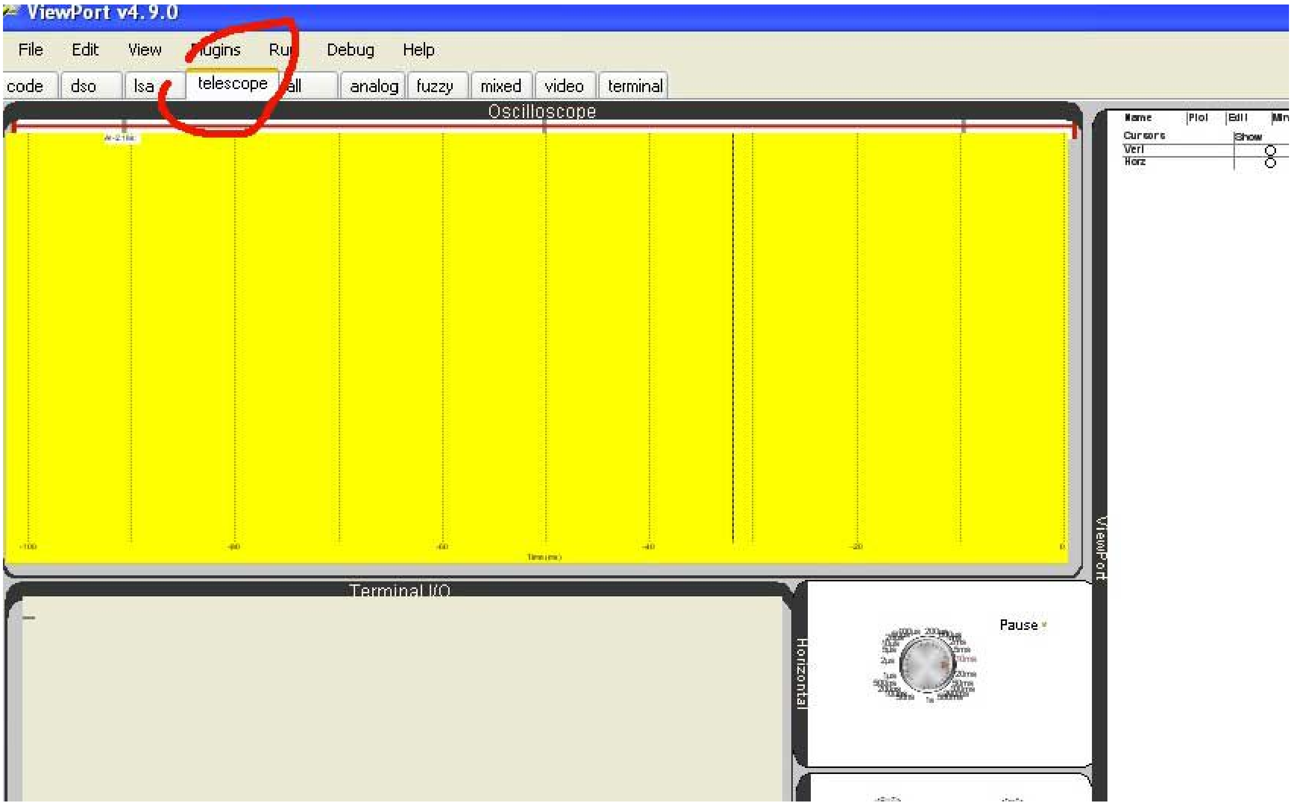
Start the mount as normal for operation. This can be during the night as well as during the day. It is only important that you have mounted the entire telescopic load for which you want to optimize the engine parameters and the mount can move freely (usually with the roof open in the observatory).

Connect the TCS to your PC using a USB cable.

> *Notice:*
> *Do not use the USB A socket on the TCS for this purpose. This is only intended for powering small external devices and cannot be used for data transfer. Only use the Mini-USB socket for data transfer.*

If both the controller is in operation and the PC is started and connected with the USB cable, you can start the coupling with the ViewPort program.

In the ViewPort program, select the "telescope" command. The following working screen is displayed:



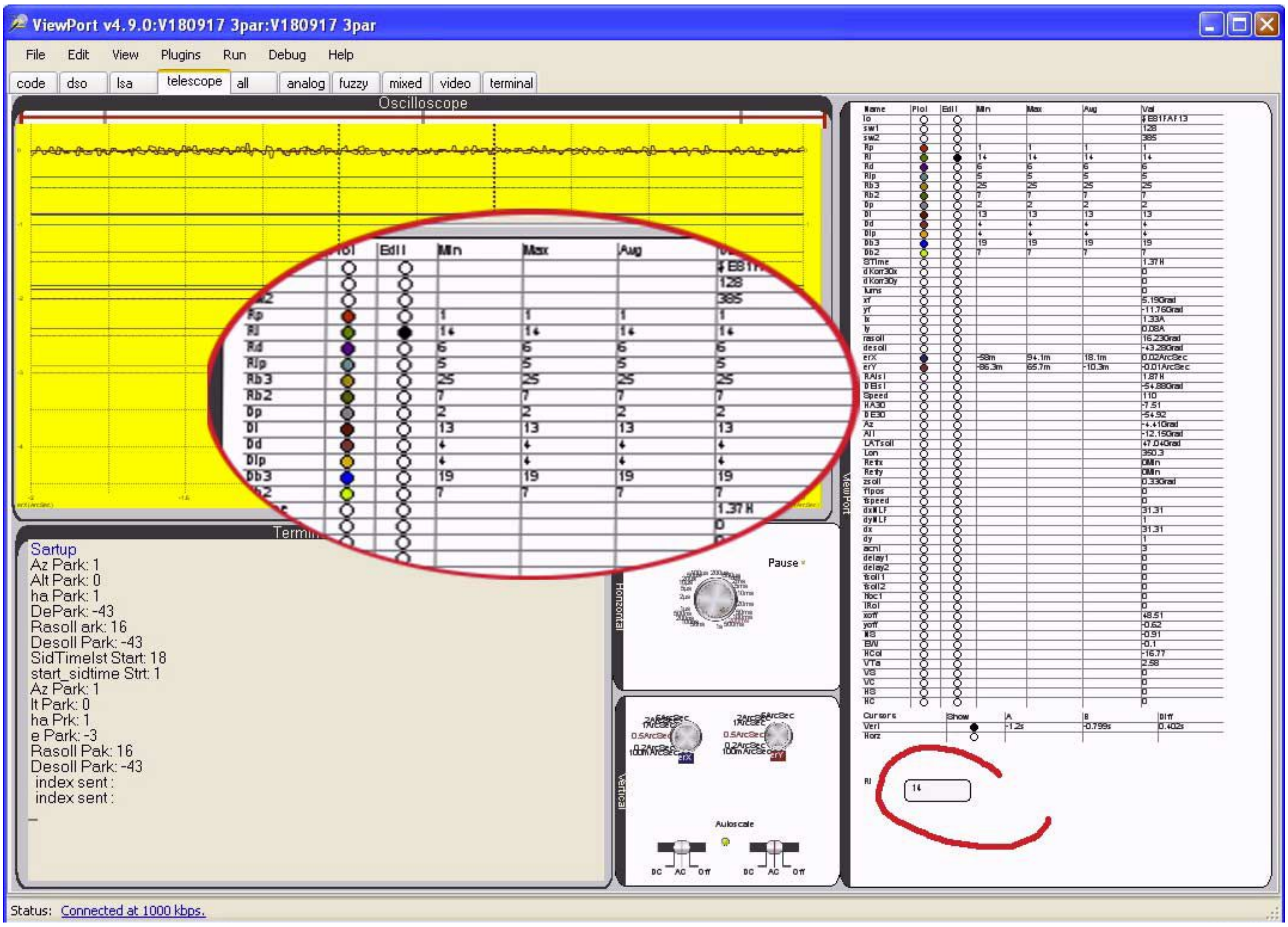
Then select the "run" command to connect the program to the TCS.

Notice:
If you are using the "ViewPort" program for the first time, in most cases you must first configure the USB interface. Download the COM2TCP software first.

http://astrogeeks.com/AstroGeeks/COM2TCP/download.html

Start COM2TCP if not already done and follow the instructions for setting up the USB port. Note that with Windows you must always use the same USB socket on the PC for this purpose.

After successful connection with the TCS, you can select various readout parameters on the right side of the window (button where colored dots are generated) whose values are displayed first. At the same time, a graphic representation of the values, i.e. the movement error of the mount, is displayed in the yellow screen area on the left side of the window. You can easily track deviations of up to 1/50 arc second and thus e.g. detect disturbances caused by vibrations of the ground, i.e. use the mount like a seismograph and of course track running disturbances accurately. But of course you will be more concerned with disturbances in the beginning, e.g. oscillations and buildup in the drive e.g. with high telescope masses. This is helpful because you can immediately see the reactions on the measurement screen before you can feel them on the telescope, even if you make small changes to values. This allows you to work more purposefully.



Notice:
Before changing this value, make sure to note the set values in order to be able to restore the previous state if necessary! *Presumably you will create settings the first time that can be completely wrong! But don't let it deter you. You will also quickly notice that you have a powerful tool at your disposal to sensitively optimize the engines.*

To change values mark the buttons where black points are generated. The changeable value is now displayed separately in a larger field at the bottom right. This field is writable and the set values can be transferred to the TCS (press [ENTER]).

If you want to learn more about the complex control technology, you can find out more about the principles here:

https://de.wikipedia.org/wiki/Regler#PI-Regler

The control electronics are a very complex PID control loop with additional options. These allow a reasonable control of the axes even with significantly different loads than those selected as the basis for the settings. This makes the control quite robust to changes (change of eyepieces and camera's also with longer tubes or a fundamental change of the used telescope).

Practical procedure

It is naturally more difficult to optimize the engine parameters if you have too many options. That's why you have to have a clear strategy to tackle this task, then you can do it successfully. So select only a limited group of values at a time and only one axis at the beginning! For each axis you can roughly divide the values into two groups. The values that can be set are either with an "R" (= azimuth or RA axis) or with a "D" (= DE or height axis) beginning and only belonging to this axis. In the further description these letters are therefore replaced by an "X".

With the first value ("Xp") you can eliminate the unpleasant long-period oscillations with heavy masses with swivels with large telescope mass or very long construction, which possibly cannot be controlled with the setting options in the service homepage. Please note that e.g. high values can lead to over-regulation and even cause the opposite. The value "Xp" will rarely bring good results with values above "6". But one can try it sometimes. Always make only small changes. However, it is also important to note that a too high P-value makes the axis more unsteady at standstill or during tracking and can therefore lead to vibrations in the range of a few arc seconds. It also leads to more power being consumed.

> *Notice:*
> *The two values "Xp" and "Xi" are roughly opposite, i.e. if you increase "Xp" you have to reduce "Xi" and vice versa.* ***Adjust only these two values and make a test movement of the telescope!***

To test the reaction, start a longer "goto" movement parallel to the control program at a rather slow speed and possibly change one of the values while driving and observe the reaction of the telescope. The longer the Goto movement lasts, the more adjustment attempts you have. If you have found a good setting, you can of course test it with a high Goto movement.

The value "Xd" is a delay variable and can lead to a good result with different settings. This can be different with every assembly or it can be the same. Another good strategy is to set the two values "Xd" and "Xb2" to the same value (if the controller does not set this itself).

With the value "Xip" you simply set the resistance, which the control opposes if you e.g. want to push away the telescope by hand at the eyepiece extension or change the eyepiece. Together with "Xb2" you can control high frequency vibrations (singing of the drive) or make the control stiffer. Xb2" also influences the time the control tries to reach zero oscillations. However, this also leads to the fact that if the setting is too high, it can react with overshooting (=singing of the drive). These two values are connected to a certain degree, i.e. a higher "Xip" value usually causes a lower "Xb2" value and vice versa.

> *Notice:*
> *The best way to test this setting is to give the telescope a little "blow" and test how it reacts and how quickly it rests.*

> *Notice:*
> *So it will be that if you set a high "Xp" value the "Xb1" or "Xb2" value must be lowered because otherwise the motor will start singing. This means that the axis control falls into an overreaction and overreacts which is indicated in mostly very short periodical oscillations with a bright tone.*

> *Notice:*
> *From the above mentioned peculiarities it can be concluded that the mount will feel a bit "equally stable" regardless of a relatively large range of telescope mass. So the mount appears to be equally stiff, no matter if you mount a tube of 10gk or 50kg.*

At first this adjustment is probably confusing. **So always change it in small steps and return to the original setting if it doesn't get better**. It is also helpful if you take notes in parallel which settings you change how and what happens. You will quickly get the hang of it.

> *Notice:*
> *On the yellow screen area you can continuously follow the effective engine accuracy in real time. The resolution of the display is variable, you can follow the*

telescope as you hit it or hit the ground. The lower the error, the better the resolution (automatic adjustment) until you can follow the oscillation in the range of 1/50 arc seconds. The screen therefore times the running accuracy variably and with very high spatial and temporal resolution. You can display only one axis or both axes. This makes sense depending on the type of mounting.

Notice:
It is basically the case that a "softer setting" will lead to a quieter tracking rate (deviation from the setpoint less than 0.1 arc second), but a harder setting will also result in errors of around or even over 0.1 arc second, but will be better suited for visual applications.