ASCOM SkyWatcher Telescope Driver

Introduction.

This driver is intended to allow ASCOM control of all telescopes that use the SynScan controller. The driver will try to identify the mount type and mode and provide the appropriate functionality.

This driver will act as a hub and can connect to several applications at the same time. A hub such as POTH is not needed. *There is no mechanism to prevent conflicts between applications and if two applications try to send commands that affect the mount at the same time unexpected things may happen.*
If you have problems such as unexpected errors then please refer to the **Resolving Problems, Logging Data and Support** sections of this manual. There is a lot of information on what information is needed and how to collect this information. PLEASE read this and try to provide what is asked for. Experience shows that problems are resolved much more easily and rapidly if the data that is needed is available.
This driver is designed to work with HC versions 3.37.9 or 4.37.9 or more. These are identified in the notes below as x.37.9. Earlier versions should have some functionality but will not implement everything.

Installation

The ASCOM platform version 6.0 or better must be installed. The SkyWatcher installer will detect if it's not present and prompt you to install it before it will allow the installation to continue. The ASCOM platform can be downloaded from the [ASCOM standards site](#), click on the Download button to download the installer program, then run it.
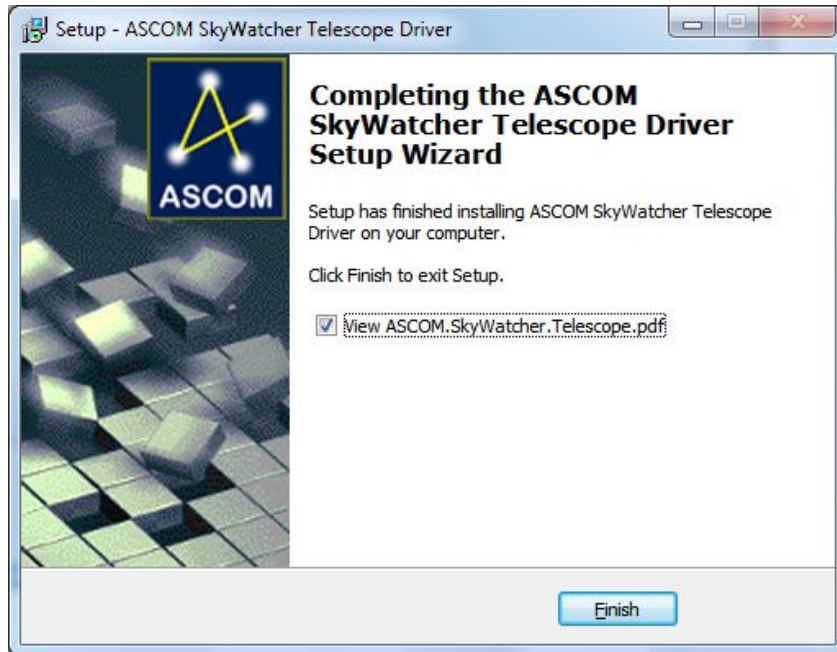
- The SkyWatcher ASCOM driver is installed by running the install program SkyWatcher Setup.exe:
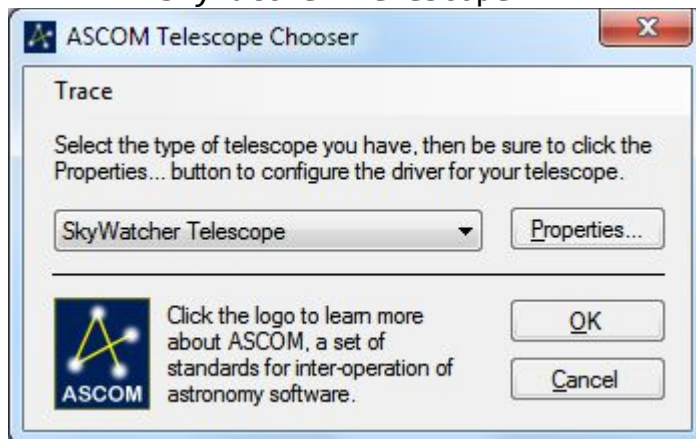

- Click on Next:
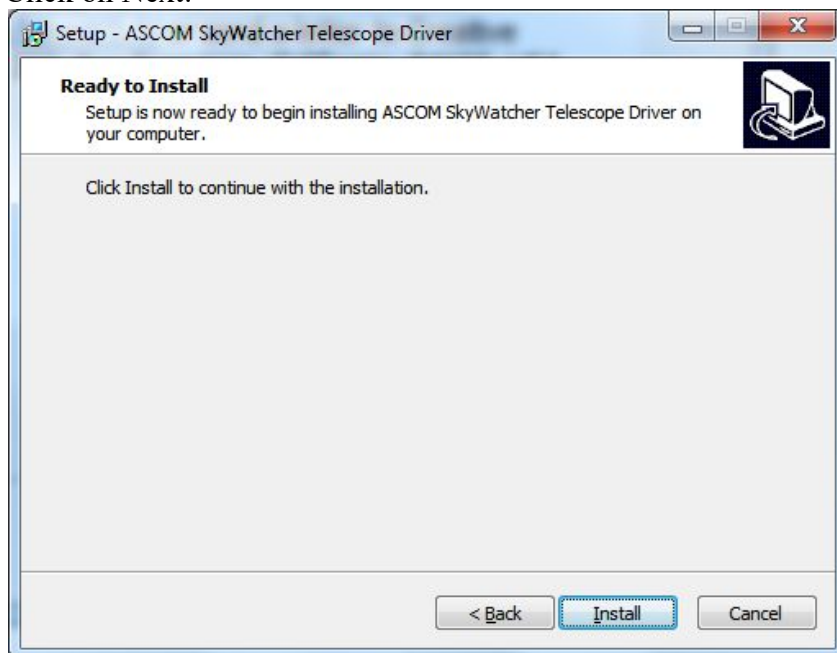
- Click on Install …

- It is a <u>really good idea</u> to read through the ASCOM.SkyWatcher.telescope.pdf file (this is it).
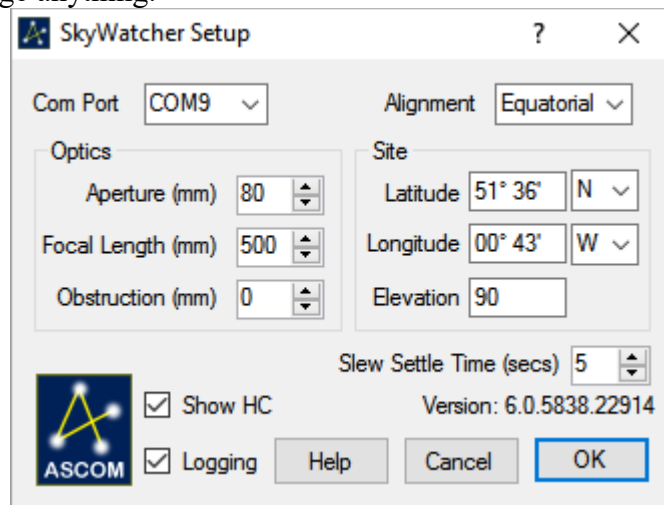- Click on Finish.

Set Up

Connect your mount to your PC using a suitable RS232 cable, with a USB to serial adaptor if required, turn the mount on and align it. For testing a quick align will do.

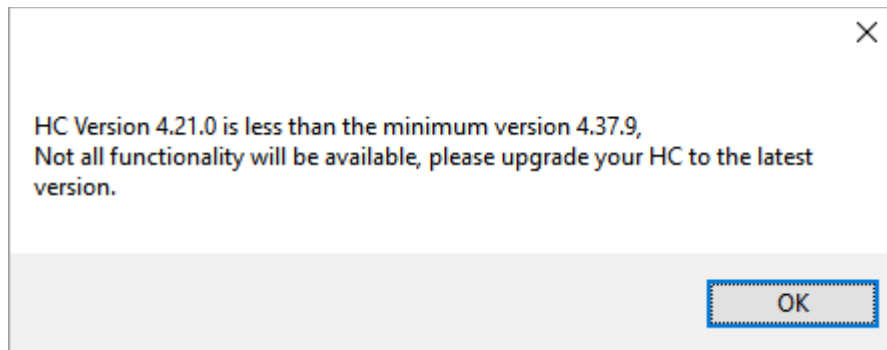Choose the `SkyWatcher Telescope` in the ASCOM chooser:

Click on the `Properties…` button, you must do this the first time and if you need to change anything.

- Set the `Com Port` value. The values shown are the only ones where a serial port exists and a SkyWatcher compatible telescope has been detected. If you don't see any Com ports then check the connections to the mount and that the mount is turned on and aligned.
- Set the `Alignment Mode`. Set `Equatorial` for a GEM or `AltAz` for an Altaz mount. *For mounts with HC software versions of x.37.9 or more this will be read from the mount, overriding the value provided here.*
- Set the `Site Latitude`, `Longitude` and `Elevation`. The values are in degrees, set the hemisphere as well. The elevation is in metres. *For mounts with HC software versions of x.37.9 or more the Latitude and Longitude will be read from the mount and this will update the values shown here.*
- Set the `Optics` properties, the `Aperture`, `Focal Length` and `Obstruction` diameter, all in mm. A refractor doesn't have a central obstruction so in that case set this to zero.
- Check `Show HC` to enable displaying the Hand Control window when the mount is connected.
- Check `Logging` to enable logging driver trace information to a file in the PC. The trace log files are very useful to diagnose problems and it is better to leave this on until you are confident that things are working well.
- Click on `OK` to save these parameters and close the setup window or `Cancel` to close the window without saving.
- Click on `Help` to get Help on installing and operating this driver (this file). Clicking on the '?' in the title bar will also show the help file.

If the hand control version is too low to allow full control a message will be shown saying this and recommending that you update the HC:

HC Version 4.21.0 is less than the minimum version 4.37.9,
Not all functionality will be available, please upgrade your HC to the latest
version.

OK

The basic functionality of reading and setting the right ascension will be available but
very little else.

Click on OK in the ASCOM Chooser window.

Once this is done your application should be able to connect to the SkyWatcher mount
and control it.

Hand Control

If Show HC is checked then a small hand control window will be shown when the
mount is connected.
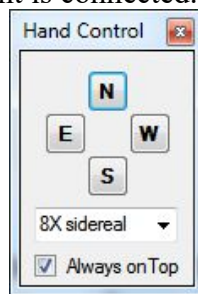
- The N and S buttons move the mount in Declination or Altitude.
- The E and W buttons move the mount in Right Ascension or Azimuth.
- The rate can be changed.
- Check Always on Top to keep this window on top.

The functions available are described in more detail in the *Driver Implementation
Details* section below.

Resolving problems

Most problems have a simple solution, usually something to do with connection
issues. Things to check are:

- *Is the mount connected and turned on?* The driver is designed to help you select
  the correct serial port but to do this the mount must be connected and turned on
  so it can respond to the test messages sent to it. If the mount is not turned on, or
  if there are connection or communication problems your mount will not be
  found.
- *Check that the RS232 cable is good*. They fail surprisingly often. The cable
  must be compatible with the SkyWatcher HC connector.
- USB to RS232 adaptors are well known to be unreliable. Bad ones can fail in a
  variety of ways, they can work with one application but not another, when
  connected directly but not through an extension or a hub and also work with

short RS232 cables but not long ones. Edgeport and FTDI based adaptors seem to be more reliable.

- Try using a simple application that makes few demands on the driver. Cartes du Ceil is good for this, if there are problems then it reports the error messages from the driver accurately.
- Some applications will trap errors from the driver and replace the driver error messages with less informative errors. If you get connections but with obscure or generic errors try a different control application or contact the application support people for more information about exactly what causes the error they report.
- Some applications seem to need to be run as administrator. If you are running one application as administrator then you will need to run all applications that are connected to the driver as administrator. It is greatly preferable not to run any application as administrator.

Support

We are happy to help but will need you to help us to help you. There is very little we can do if all we hear is that something has gone wrong but with no information about what. We aren't looking over your shoulder and can't visit you to see what the problem is.

Here are some of the things we need to know:
- Describe what you do, what happens and what you expect. Try to provide details. Screenshots may help, and a full description of what you do to generate the problem. Descriptions of the problem such as "it doesn't work" or "it's broken" are seldom useful without some information about what these subjective terms mean.
- Provide log files showing what happened. The driver logs are enabled by checking the Trace checkbox in the Setup window:
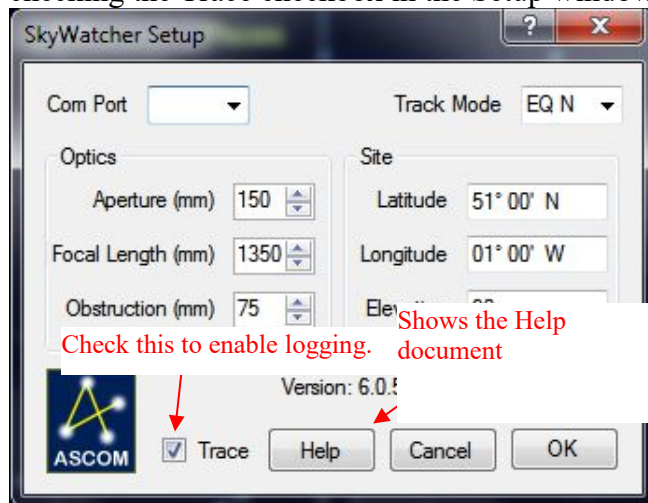
- Run your system to generate the error and post the log files, with a description of what you see happening, to us.
- The log files are in the "My documents\ASCOM\logs <date>" folder called ASCOM.SkyWatcher.nnnn.nnnnnn.txt. They can be large but compress well so it is probably best to zip up the logs, with a document describing the problem.
- Bear in mind that if you send too much information it is much less of a problem than too little.

- Uninstalling and reinstalling drivers, applications or the ASCOM platform are unlikely to help.

It is almost invariably worth starting by reading the documentation that is available; this may allow you to resolve your issue without help. That's going to be quickest and more satisfying for you.

Driver Implementation Details

The ASCOM properties and methods that are implemented will vary depending on the mount type and hand control version used. The major difference is how the mount is aligned. The two main types are AltAz and GEM.
The things that make a difference are:
- The HC type. Version 2 HCs use a totally different and very limited control method. It can only handle Ra and Dec positions and Synchronous slews. *Very little testing has been done using this HC type and results cannot be guaranteed.*
- HC Versions 3 and 4 are functionally the same. The control available depends on the version of firmware that is installed. HCs with firmware versions lower than 3.37.9 or 4.37.9 only have limited control available. It is strongly recommended that the HC is updated to the current version.

The detail of how this affects what control is available is described below. In all cases the corresponding capability properties will reflect what can be done.

Read Right Ascension and Declination

These are read from the mount for all mounts. The positions are in the J2000 epoch and are not corrected for refraction. Their accuracy depends on the accuracy of the mount alignment.

Read Altitude and Azimuth

These are only available for mounts using the Version 3 and Version 4 hand controllers. *They are determined by reading the right ascension and declination from the mount and converting to altitude and azimuth using the mount position and time.*

Slew Commands

All mounts implement slews to right ascension and declination positions. The positions are using the J2000 epoch. Mounts using the version 2 controller only implement asynchronous slews where the slew command waits until the slew has completed.
Altitude and Azimuth slews are only implemented for Version 3 and Version 4 controllers.
Slews to Ra/Dec positions are only allowed when the mount is tracking and slews to Alt/Azm positions when the mount is not tracking. This is required by the ASCOM specification.
Slews to positions below the horizon are not allowed. If an attempt is made an InvalidOperationException is thrown. The horizon position is determined using the time, latitude and longitude so if these are incorrect the horizon detection will be incorrect. This affects all slews.
AltAz slews are implemented by converting the position to the corresponding Ra and Dec and slewing to that position. The position is determined when the slew is started.

This relies on the driver having a good location and time, either from the HC or the driver.

Tracking Commands

Tracking can be turned on and off for HC Versions x.37.9 or more. The tracking rate can be set to Sidereal, Lunar or Solar. For other mounts tracking will always be reported as on and the rate will be reported as Sidereal.

Sync Commands

All mounts implement Sync to Ra and Dec positions but not for Altitude and Azimuth positions. For mounts using HC version x.37.9 firmware or better the sync is implemented using a mount command and for others by determining and applying an offset in the driver. This offset will then be applied to all subsequent Ra and Dec slews and positions.
The HC based Sync currently implements the mount PAE function. This improves accuracy over a small area of the sky. It is only expected to be used to make small corrections, no more than a few degrees, and it will only improve pointing close to the position where the sync was done.

Guiding Commands

Guiding is only available for HC Versions x.37.9 and better. *It is also only implemented for equatorial mounts*.
PulseGuide is implemented by sending a command to start a move at the guide rate, wait for the guide duration, and sending another command to return to the normal tracking rate. *The wait is implemented in the PC and things such as the PC being busy or other commands being sent can increase the guide time.* The guide commands are asynchronous and both Ra and Dec commands can be sent at the same time.
The guide rates can be set to between 10% and 100% of sidereal. The default rate is 50% sidereal.
It is not known if the guide commands can be used to train PEC.

Pier Side Commands

These commands are only implemented for equatorial mounts.
SideOfPier is only implemented for GEM mounts with HC versions x.37.9 or more.

DestinationSideOfPier is not implemented.

It's recommended that the mount is allowed to track significantly past the meridian before a pier flip is attempted. This will help to avoid issues because the expected pointing state may be uncertain close to the meridian. One to two degrees (4 to 8 minutes tracking) should be enough.

Park Commands

These are only available for HC Versions x.37.9 and more.
- Park is implemented by stopping tracking, and sending a command to move to the park position. *The park position is specified as an hour angle and declination and this may be uncertain close to the meridian for GEM mount. If*

> *the side of the mount the OTA is parked on matters then it is recommended that you set a park position that is a few degrees from the meridian.*

- Set Park remembers the current position as hour angle and declination. *The position must be above the horizon. An InvalidOperationException will be thrown if a position that is below the horizon is specified.*
- UnPark removes the park flag and resumes tracking.
- Reconnecting will also unpark the mount but may not resume tracking.

The HC Park command is not implemented at present.
The alignment will be lost if the power to the mount is removed.

Location

The Site Location properties are available for all mounts. For HC versions x.37.9 or more the latitude and longitude are read from and written to the mount. For others the driver has its own location values and these must be set in the setup dialog. *The location must be correct to use altitude and azimuth positions and slews.*

Date and Time

The **UTCDate** property is read from the mount for HC versions x.37.9, it can also be set in the mount for these versions. The time zone and DST settings are read from the PC. For other HCs the values is read from the PC and cannot be set.
The **SiderealTime** property is computed from the UTCDate and the Location. These properties will be read from the HC if possible, otherwise the values in the driver and PC will be used.

Optics

The **FocalLength**, **ApertureDiameter** and **ApertureArea** are handled in the driver. The values are specified in mm.
The area is computed from the aperture diameter and obstruction diameter.

FindHome

This is not implemented.

Other Properties

AlignmentMode is read from the mount for HC versions x.37.9. It will be AltAz if the tracking mode is AltAz or GEM if the tracking mode is equatorial. This assumes that all equatorial mounts are GEMs and that an AltAz mount cannot be used on a wedge in equatorial mode.
AxisRates are available for HC versions x.37.9 or more. The rate can be set to any value between 0 and 4 degrees per second.
DeclinationRate and **RightAscensionRate** are not implemented.
DoesRefraction is not implemented.
The **SlewSettleTime** can be set to values from 0 seconds (default) to 100 seconds.
The **EquatorialSystem** is always J2000.

Orion Telescopes

This driver will also work with mounts provided by Orion Telescopes that use the SynScan telescope control system. At present these are:
- Sirius Pro AZ/EQ-G

- StarSeeker IV
- SkyView Pro
- Sirius EQ-G
- Atlas EQ-G
- Atlas Pro AZ/EQ-G
- HDX 110 EQ-G

Celestron Telescopes

The Celestron telescope control protocol is similar and the driver may detect and be able to connect to a Celestron telescope. This will tend to behave as if the HC version is low and only limited functionality will be available. *There are no plans to extend this driver to work with Celestron mounts, or the Celestron driver to work with SkyWatcher mounts.*

Additional functions:

We are planning to add functionality to this driver. We can't give firm commitments or time scales but the things we are thinking of – and the rough order in which they should happen are:

- DestinationSideOfPier. Setting the SideOfPier may be possible but this could come later.
- There is a need for the PulseGuide corrections to be used for PEC training. We are investigating, and hope to have this in place.
- We would like Park, SetPark and Unpark to use the HC commands instead of being independent. We hope that the Unpark command will be able to unpark a parked mount.
- We would like the FindHome to use the mount home sensors where these are present (on the EQ8). This would allow a mount to be aligned using an existing mount model using the home switch position as a reference.