NEXDOME OBSERVATORIES

NexDome Control System Software Installation and User Manual

Dome and Shutter Kits for Windows

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Introduction

This guide is a step by step guide to install and/or upgrade the software to operate your NexDome dome rotation and shutter kits.

System Requirements

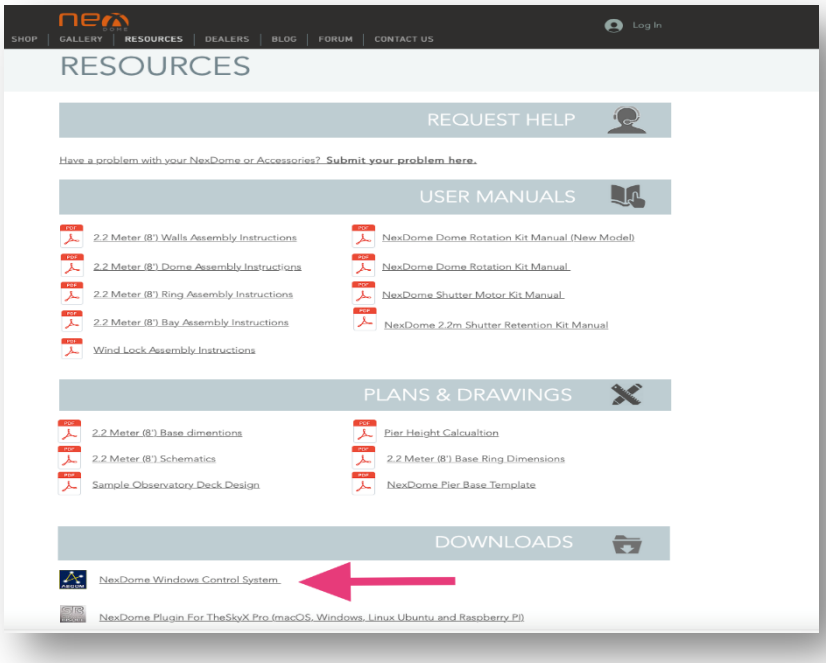
To use this software, your system must meet the following criteria:

1. Windows 10, 8 or 7. Windows “LTS” versions are not supported.
2. .NET Framework 4.7.2 (this will be installed as part of the installation process if needed).
3. ASCOM Platform 6.4 SP1 or later

Software Installation

Download

Download the installer package from https://www.nexdome.com/resources or https://github.com/nexdome/ASCOM/releases



The installer contains:

1. An ASCOM Dome driver that will work with most astronomy software
2. Firmware images that are the recommended versions to use with the ASCOM driver
3. USB Serial port drivers for the NexDome devices

Version 3.x of the ASCOM driver requires version 3.x of the device firmware, it will not work with older versions. It is a good idea to update your firmware with the files included (see later).

For Developers

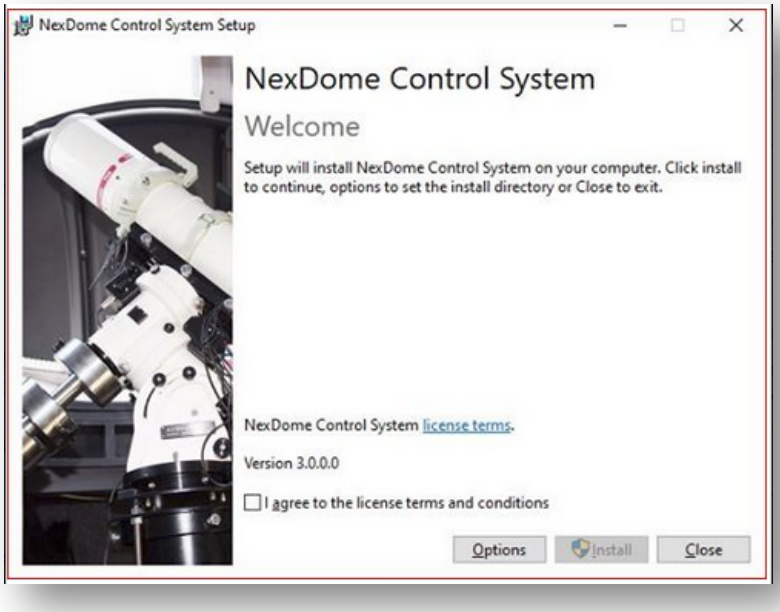
The ASCOM driver and Arduino firmware are open-source and licensed under the MIT License. You can download a copy of the current source, or clone/fork the repository on GitHub. The firmware and ASCOM driver are in separate repositories. In addition, there is also a Wiki that you can contribute to.

We welcome pull requests. If you wish to submit any bugfixes or features, please create a pull request targeting the **develop** branch. Please note that pull requests will be accepted at the discretion of NexDome. Ideally, you should also have an open issue that describes what you are doing and why.

Installation

You should first uninstall any beta versions or versions prior to 3.0.0. For release versions after 3.0.0, the installer can upgrade an existing install.

Run the downloaded executable installer package. The installation wizard will start and show the license terms.



Check the “I agree” box and click Install to begin. The system will ask you to allow the installer to run with elevated permissions, you must allow this.

After a few moments the software will be installed.

ASCOM Device Hub

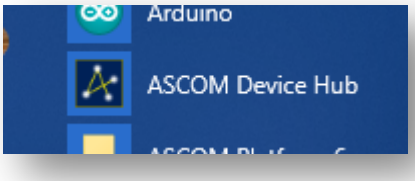
It is highly recommended that you download and install ASCOM Device Hub. This provides synchronization between your dome and telescope and a handy user interface that we will use to complete the setup process.

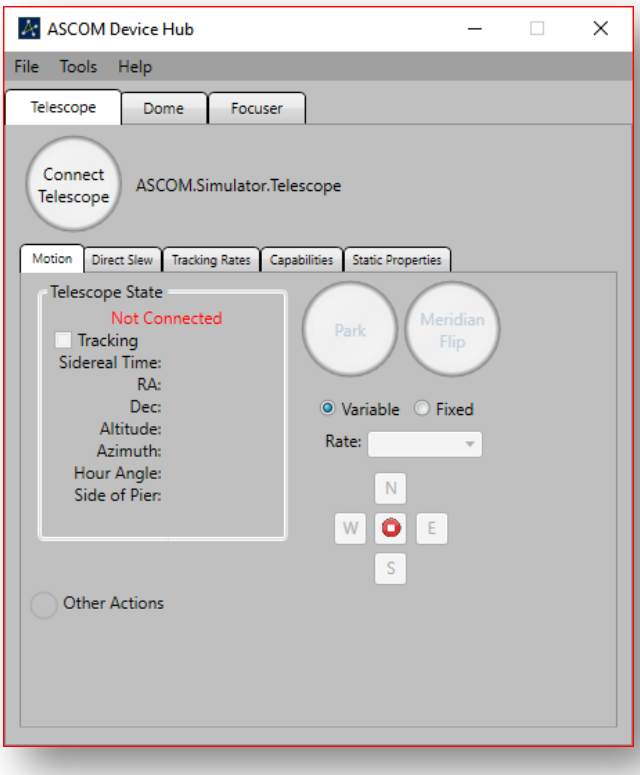
ASCOM Device Hub is a modern replacement for *POTH* (Plain Old Telescope Hub) and *ASCOM Dome Control Panel*. Both POTH and ADCP have known issues with scope-dome synchronization and are no longer being maintained, therefore, you should upgrade to ASCOM Device Hub.

Download ASCOM Device Hub from https://github.com/ASCOMInitiative/ASCOMDeviceHub/releases/latest. Note: ASCOM Device Hub is new and has not been incorporated into the ASCOM Platform yet at the time of writing, but it will be in the future.

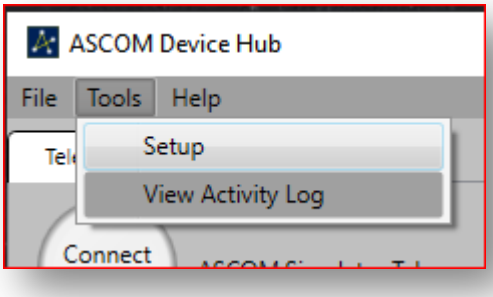
Configure ASCOM Device Hub

1. Start ASCOM Device Hub using the icon on your start menu

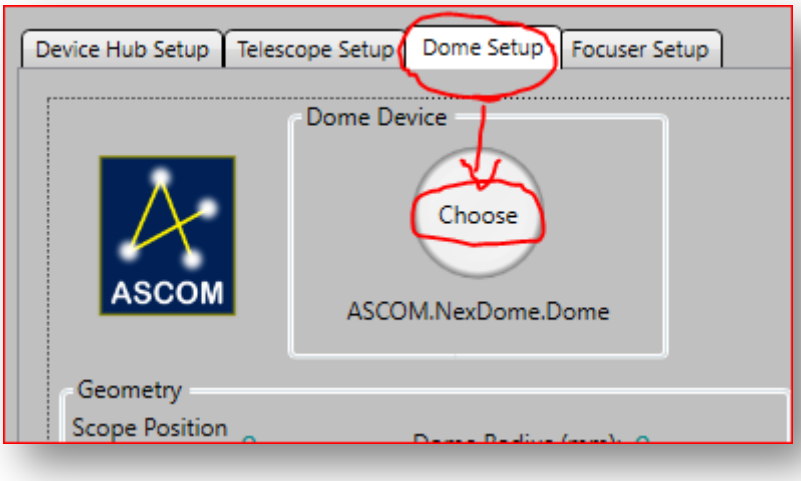




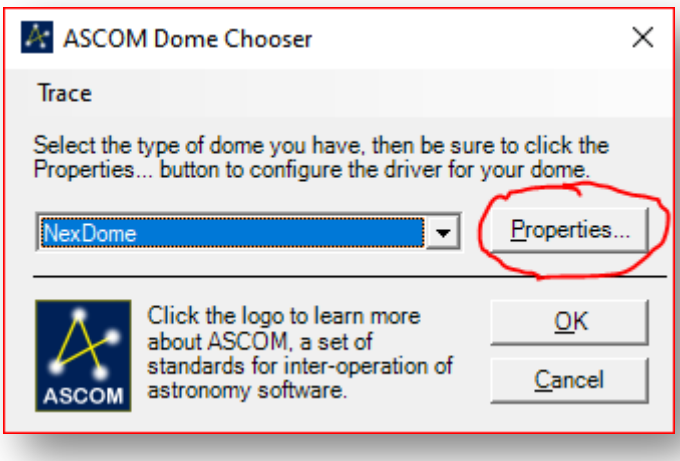
2. From the **Tools** menu, select **Setup**.



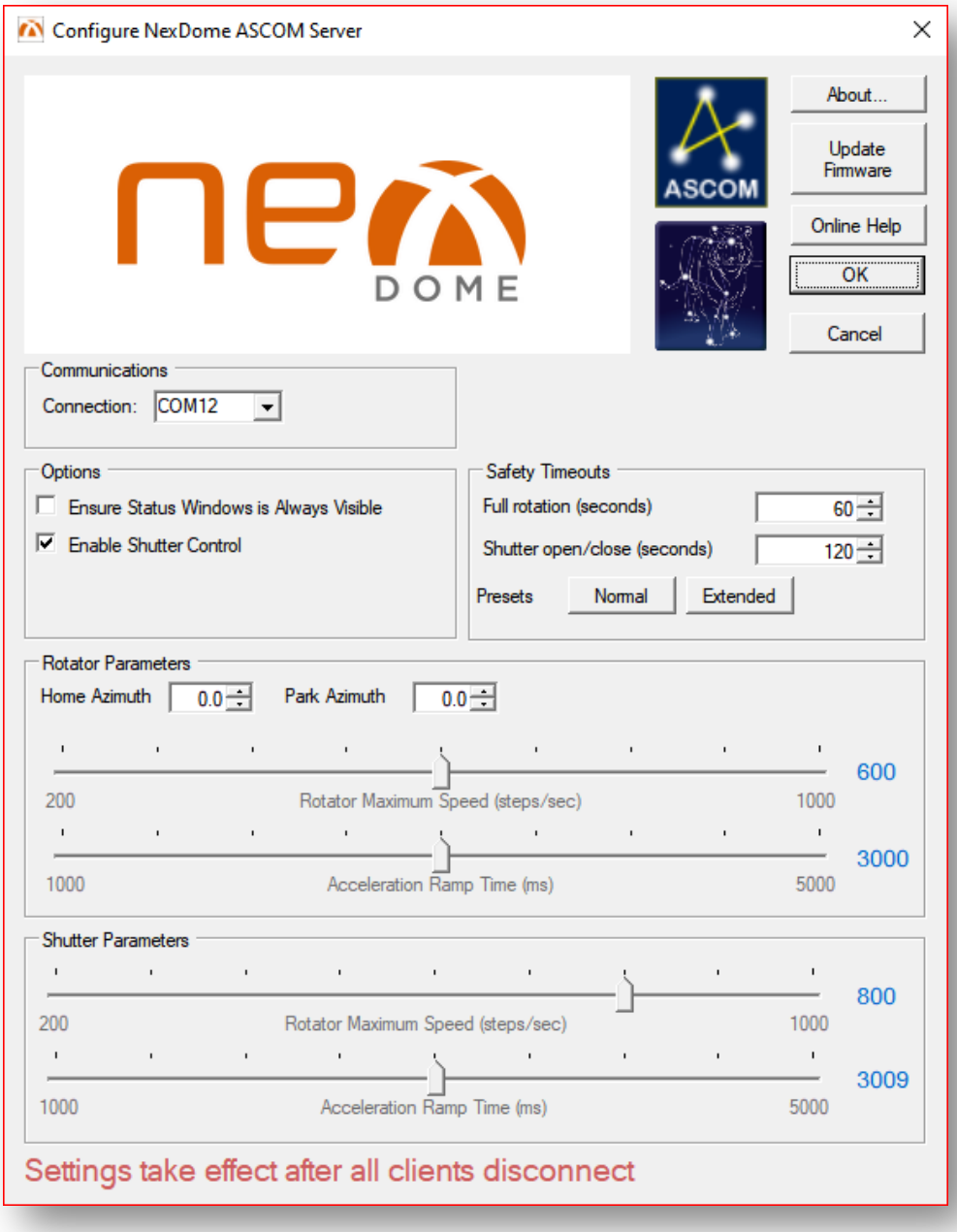
3. Switch to the **Dome Setup** tab and click **Choose**. This will open the ASCOM Device Chooser.



4. In the ASCOM device chooser, select **NexDome** in the drop-down list, and then click the **Properties…** button.

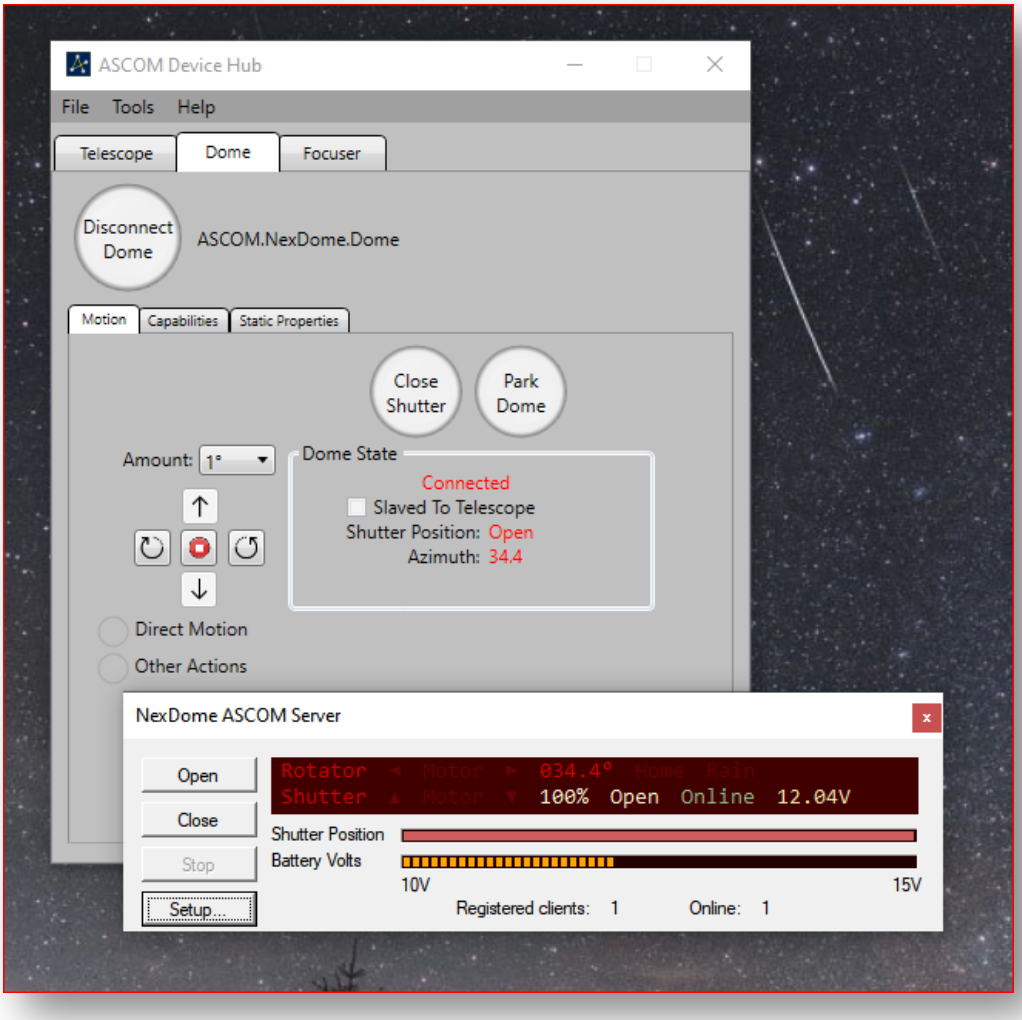


5. This will display the NexDome Control System configuration screen.



6. In the **Communications** section, select the serial port that corresponds to your NexDome rotator. If you don't know the serial port number, check **Windows Device Manager**. If you have the shutter kit, you can select **Enable Shutter Control**. The rest of the settings can remain unchanged for the time being.
7. Now is a great time to flash the firmware, if you need to. This is a must if you have upgraded from a driver version prior to 3.0.0, and highly recommended whenever you install or update the software. This is a one-time operation and you should not need to do this again unless you upgrade the software. Please refer to Appendix A – Updating the Firmware. After you've completed the firmware update, return here and continue with step 8 below.
8. Click **OK** to dismiss the settings screen and save settings.
9. Click **OK** in the ASCOM Device Hub settings screen.

10. Close ASCOM Device Hub to ensure that all settings are saved and become active. Driver settings only take effect upon initial driver load, so any time they are changed it is safest to quit out of all client applications and start from scratch.
11. Re-start ASCOM Device Hub, switch to the Dome tab and click Connect Dome. If all is well, the ASCOM dome driver should load and display a compact status panel. The dome status in ASCOM Device Hub should change to **Connected**. The controls in ASCOM Device Hub will "light up" and you should be able to control your dome using them.



Using the ASCOM Server

About the ASCOM Server

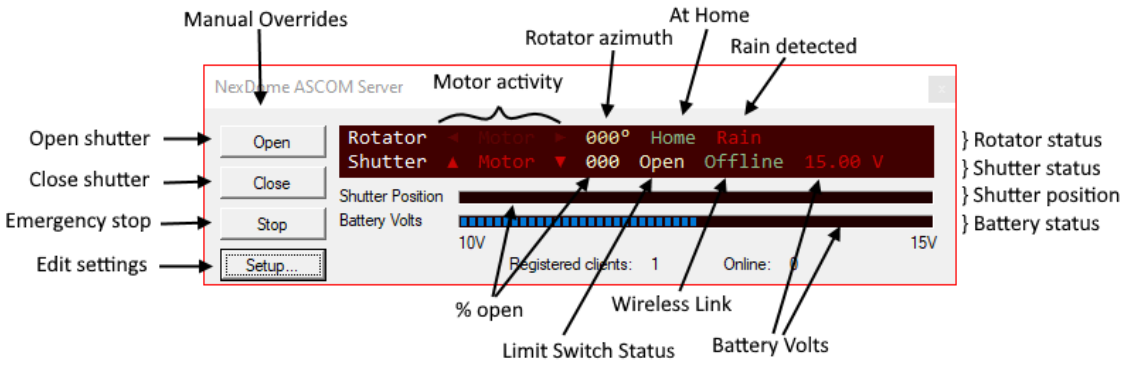
The NexDome ASCOM Server enables your dome to operate with many ASCOM-compatible programs, for example: TheSky, ACP (Astronomer's Control Program), Cartes du Ciel (Sky Maps), Starry Night Pro, Voyager, NINA, MaxIm DL, and many others.

The server is a multi-instance hub, which means it can accept simultaneous connections from multiple client applications.

The server is compatible with both 32-bit and 64-bit applications.

The Status Display Panel

When in use, the ASCOM server displays a window showing the current status of the dome hardware. The display shows the current rotation angle and shutter position along with several other annunciators as shown in the diagram below. It also provides a few basic controls including an emergency stop button, and easy access to the configuration page.



Although this window does provide a few simple controls, it is not intended as the primary control panel for the dome. For that, you should use a compatible planetarium program, or a utility such as the ASCOM Device Hub (see Using With ASCOM Device Hub).

The status panel has the following features:

- Manually open/close your dome shutter
- Monitor your shutter position
- Keep watch on your shutter battery voltage
- Display rotator and shutter positions
- Perform an emergency stop of all dome movement
- Show rain sensor status (if installed)
- Access the Setup window

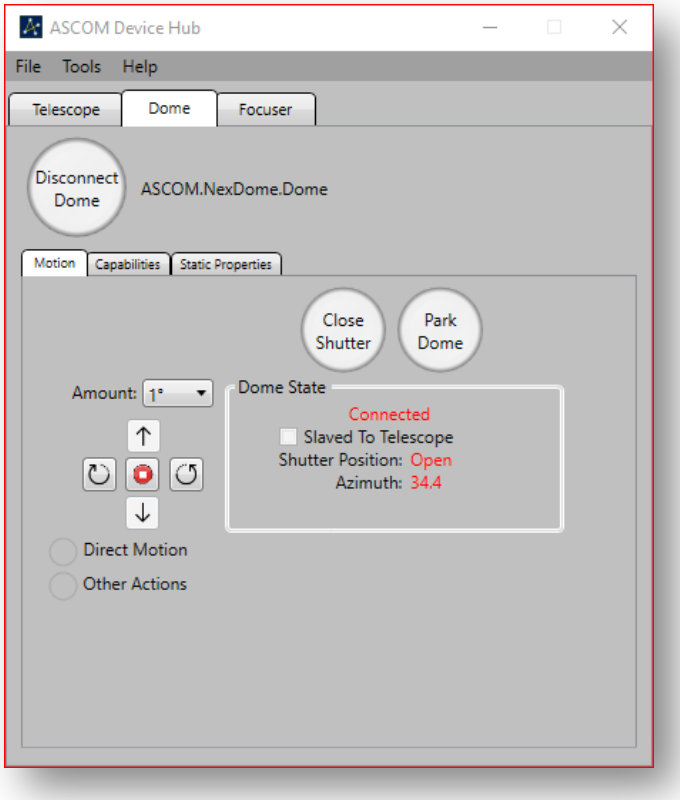
Using With ASCOM Device Hub

Some client applications provide built-in scope-dome synchronization while others do not. If your application of choice has this feature, then we recommend you use it. Refer to the application documentation for setup instructions.

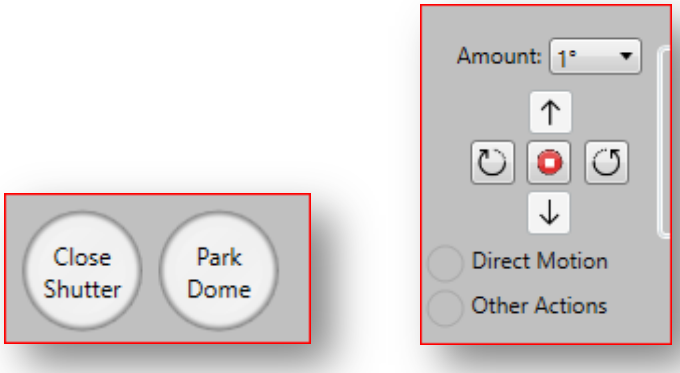
The ASCOM driver itself cannot (per the ASCOM standards) perform scope-dome synchronization, so if your application of choice does not do this, you will need to use a separate utility. There are several to choose from, but we highly recommend ASCOM Device Hub (which is part of the ASCOM family) for this purpose. In this document, we will assume you are using ASCOM Device Hub.

Basic Dome Operation

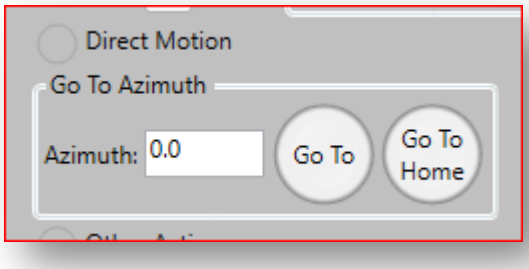
ASCOM Device Hub provides everything you need to fully control your dome.



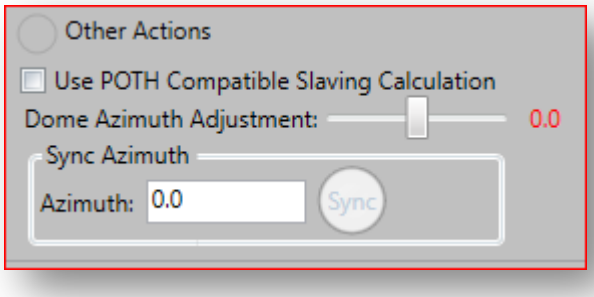
The large buttons let you open and close the shutter or park the dome. The motion controls let you control rotation in steps of 1, 4, 10, 40, 100 or 180 degrees. Currently, the ASCOM server does not support direct shutter positioning so the up/down arrows have no effect. The red button in the center is the emergency stop button and is the same as clicking **Stop** in the ASCOM server status window.



Underneath the main controls are two expandable areas with additional options. **Direct Motion** lets you type in a required azimuth value and go directly to it, or to start a *Find Home* operation, which moves to the home position (note: homing always occurs clockwise).



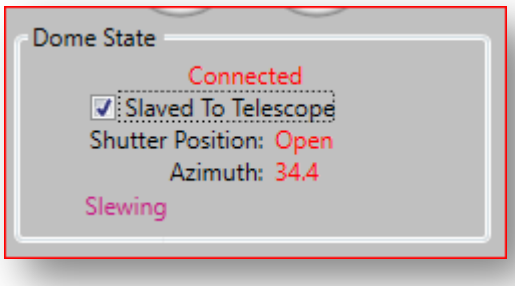
And finally, the **Other Actions** panel provides a way to add an offset to the requested dome azimuth, which can sometimes be useful for fine tuning scope-dome synchronization, or to set a "look-ahead" so that your dome always positions slightly ahead of the telescope. The **Use POTH Compatible Slaving Calculation** option may be useful for older telescope drivers that incorrectly implement the ASCOM *SideOfPier* property. If you notice that your dome position is significantly off in certain areas of the sky, try enabling this option (but for modern telescope drivers, you shouldn't need it).



Synchronizing With a Telescope

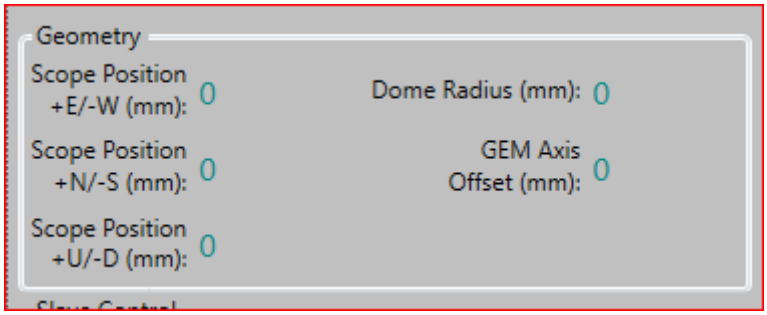
Perhaps the most useful way of using a dome is to have it automatically follow a telescope. ASCOM Device Hub provides this facility as do many ASCOM-compatible planetarium programs and automation systems.

In *ASCOM Device Hub*, simply check the **Slaved To Telescope** option on the Dome panel. Note: this option will only be available if you've configured a telescope driver and it is currently connected.



Configuring Scope-Dome Synchronization

In order to synchronize with a telescope, you must provide information about the telescope geometry and how it is positioned within the dome.



The computations required for scope-dome synchronization are nontrivial and somewhat sensitive to small input errors. Therefore, to get accurate scope-dome synchronization across the whole sky, your geometry settings must be as accurate and precise as possible.

The meaning of each setting will be explained in detail, but first a note about origins.

Scope Position Offset is the amount by which your telescope's centre of rotation is offset from the center of the dome's rotation. It is important to understand where the telescope's center of rotation is located. This is not necessarily over the center of the pier; it is the intersection between the polar (right ascension) axis and the declination axis. In the following examples, the center of rotation is circled in green.

Note: the point of interest is inside a solid object! This makes measuring somewhat tricky, but it is important to be as precise as possible when taking measurements. You may need to use some ingenuity to obtain your measurements. For example, one can measure to the edge of the axis and then add the axis radius.

Similarly, the center of rotation of your dome is an imaginary point in space. This can be found by dropping a plumb line from the centre of the roof and then taking the point along that line that is level with the top of the dome walls. This point, the dome center of rotation, is the origin for all of your geometry measurements.

Geometry Measurements Explained

The **N/S** and **E/W** and **Up/Down** parameters are how much the mount intersection point is off from the centre of rotation of the dome. The best way to measure this is often by taking differences. First identify the four cardinal points (North, East, South, West) around the dome rim. Remember that North is true north, not magnetic north. You may wish to mark these points for future reference. Then measure from the intersection point of the telescope to the north point on the dome rim, to the south point, to the east point and to the west point.

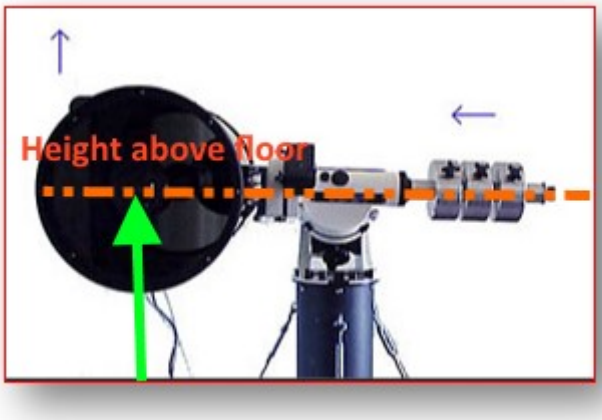
Your offset **N/S** is then your measured distance south minus measured distance north. This will be positive if the intersection is offset to the north and negative if offset to the south.

- **N/S Offset** = Measured Distance South – Measured Distance North

Similarly, your **E/W** offset is measured distance to west minus measured distance to east.

- **E/W Offset** = Measured Distance West – Measured Distance East

The **Up/Down** distance is the height of the mount intersection above the dome rim. Positive means the mount intersection is above the rim, negative means it is below the rim. One way to measure this would be to put both the declination axle and the telescope tube perfectly horizontal (using a spirit level) and then measure the height above the floor of the centre of the telescope tube, or the counterweight shaft.

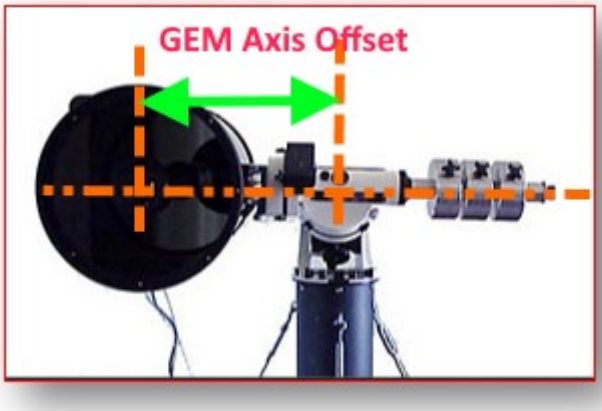


Then subtract the height of the dome rim (1350 mm from the schematic drawings) to give your up/down offset.

- **Up/Down Offset** = Counterweight Shaft Height Above Floor – Height of Dome Rim

Dome radius we can read off the schematic drawings, approximately 1025 mm.

The final measurement is the "**GEM axis offset**", which is the distance from the intersection point to the centre of the telescope tube.



Again, this is a tricky one because it's in the middle of a solid object. This may be best approached by measuring from the intersection point to the top of the saddle plate, then from the saddle plate to the centre of the telescope tube (or, measure the diameter of the tube and divide by 2 to get radius). Then add those two together:

- **GEM axis offset** = Intersection to Saddle Plate + tube radius

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Try to be as accurate as you can in all the measurements, tricky though it is, as the accuracy will affect how well synchronization works. You probably need to be accurate to _at least_ 1 cm and _ideally_ 1mm. It is worth taking a bit of time to get accurate results and hopefully you will only need to do it once.

Also note: synchronization cannot be successful if the dome's home sensor azimuth has not been set correctly. For that, please see https://github.com/nexdome/ASCOM/wiki/Home,-Park-and-Home-Sensor-Magnet-Positioning

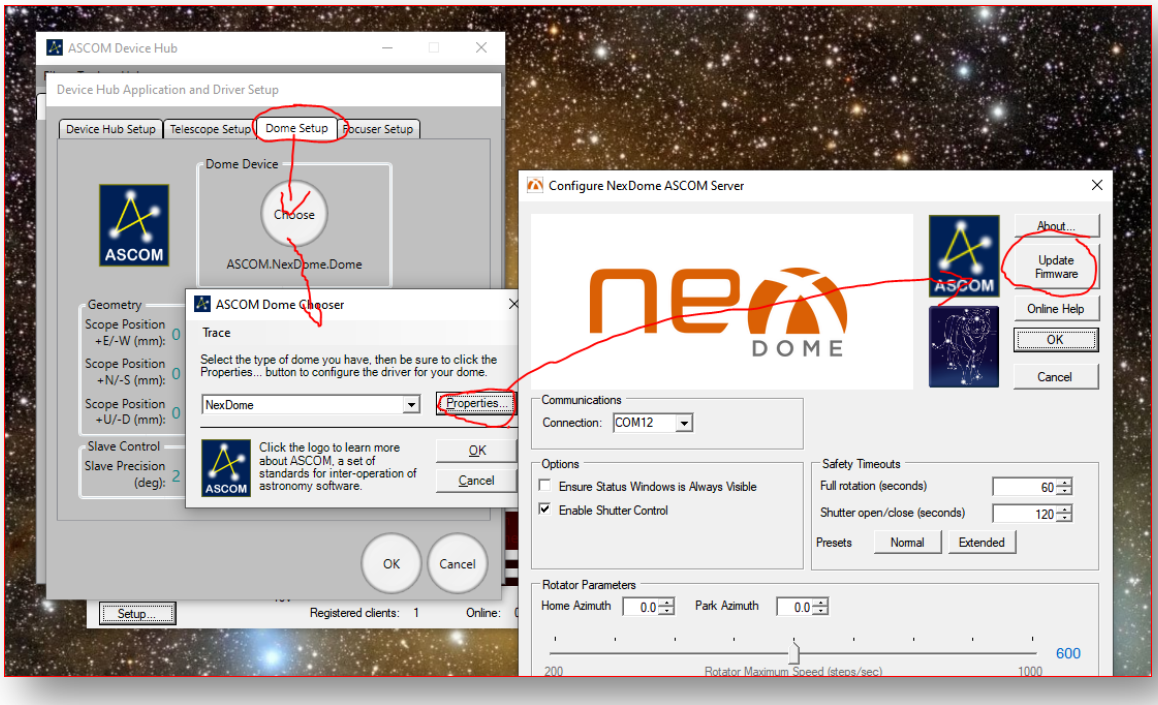
Using With Other ASCOM Client Applications

Many ASCOM client applications and automation systems have scope-dome synchronization built in. In that case, we recommend using the built-in facility and then there is no need for a separate utility such as ASCOM Device Hub. In general, use as few separate pieces of software as possible to do what you need.

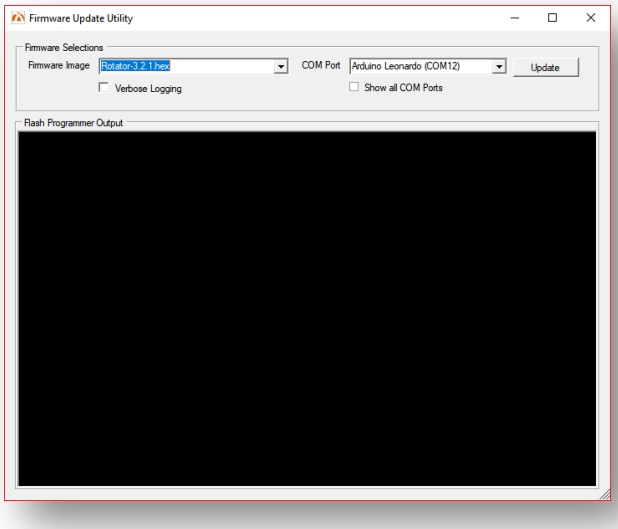
NEXDOME OBSERVATORIES

Appendix A – Updating the Firmware

The ASCOM driver contains a firmware update utility within the Setup Dialog. To update firmware, there must be no clients currently online (these would lock the serial port and cause the update to fail). We suggest that you use the ASCOM Device Hub settings page to load the driver's settings screen without connecting.



After clicking the **Update Firmware** button, you'll see the firmware update utility, which looks like this:



In the top section, there are two drop-down selection boxes which list available firmware images and valid COM ports, respectively. Only COM ports that have NexDome hardware attached will be shown by default. If your COM ports don't show up, please see the online troubleshooting guide.

The lower section of the window shows log output from the Arduino firmware uploader, known as “AVRDude”.

We recommend that you only attach one of your NexDome devices (Rotator or Shutter) at a time, so that it is clear which COM port you need to use for which firmware image. Note that the firmware updater utility only scans for serial ports when the window opens, so if you plug or unplug a device, you’ll need to exit from the window and re-open it to refresh the list of serial ports.

Note that firmware update requires a direct USB connection to the device. Updates cannot "pass through" the rotator to the shutter, you must attach a USB cable to each device in turn and update them separately. It is strongly recommended that you plug the USB cable directly into your computer and not via any hubs or extenders.

The Rotator firmware contains the word `Rotator` and the shutter firmware contains the word `Shutter` - hopefully that is clear enough. Other special-purpose firmware images may be present, but those are for advanced troubleshooting and shouldn't normally be uploaded.

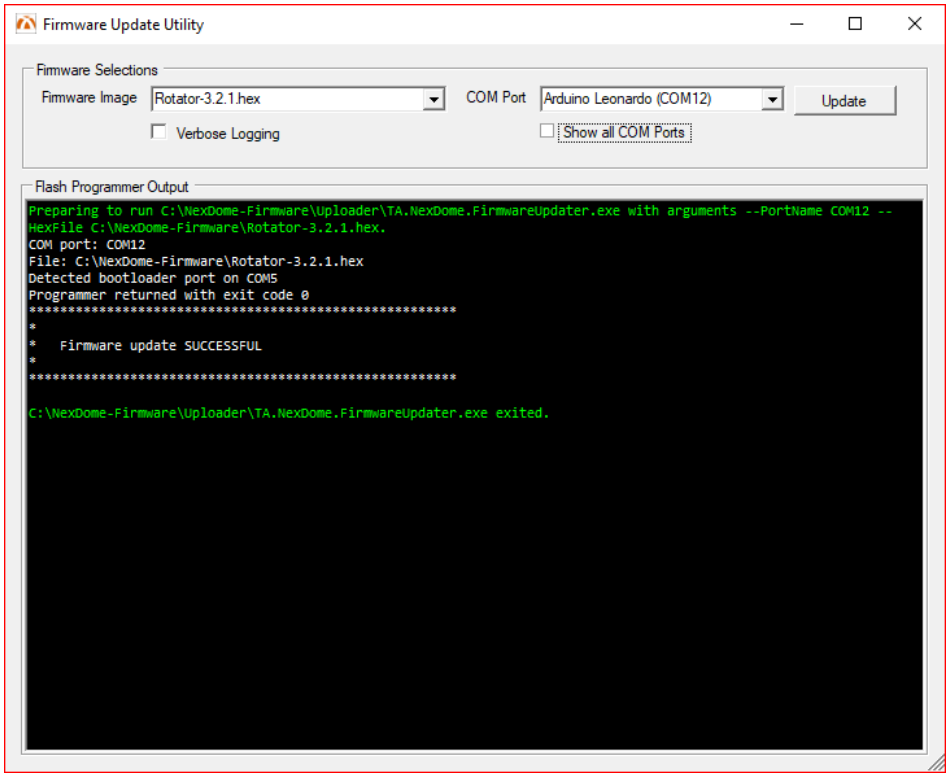
The rotator and shutter should always run the same firmware version.

Select the firmware image you wish to upload and the COM port where the appropriate device is attached, then click the **Update** button. You may hear some sounds as USB devices disconnect and reconnect and you may also see mention of a different COM port in the output window. This is a normal, if confusing, part of the Arduino firmware update sequence.

After a short time, you should see the message *Firmware update SUCCESSFUL* prominently displayed in the log output window.

If you do not see this message, then the update hasn't worked.

This is an example of a successful firmware update.



Once you've updated both the rotator and the shutter, you're done and should not need to upload the firmware again except to install another update. The firmware cannot be accidentally deleted or corrupted.

Note: When performing a major version upgrade (e.g. from version 2.x.x to 3.x.x, or 3.x.x to 4.x.x), your settings will be cleared to factory defaults. They may or may not be cleared during minor version upgrades.

You can query the firmware version by attaching a terminal emulator and issuing the **@FRR** (rotator) or **@FRS** (shutter) commands. Please see the online wiki for details of the firmware protocol and command set.

NEXDOME OBSERVATORIES

Appendix B – Resources and Troubleshooting Guide

There is an online wiki that contains answers to frequently asked questions (FAQ), technical details of the firmware and ASCOM driver implementation, and a troubleshooting guide. We update these pages from time to time as the need arises. The wiki is part of the source code, which is open source and available for you to inspect or download or indeed to contribute to.

You'll find the wiki at https://github.com/nexdome/ASCOM/wiki