



STARGO GoTo CONTROL SYSTEM



USER MANUAL

Version 4.1.4, February 2022 by Mauro Ghiri

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Preface

Avalon Instruments manufactures astronomical mounts and control systems that are known for excellence of design, superior engineering and extreme accuracy. The StarGo Control System has been designed for integrated use with the Avalon Linear and M-uno mounts, or in a separate control box for the M-zero mount. The StarGo system can also be equipped with special hardware for use with mounts from other manufacturers.

This manual describes the new Avalon Goto Control System for astronomical mounts; it is part of a set which also includes the manuals of the single mounts produced by Avalon Instruments as well as a training manual for the use of third party software with the StarGO hardware.

The manual is in a process of continual development and improvement. Therefore it is suggested that users regularly consult the Avalon Instruments web site support page to obtain easy access to newer updated versions.

Please report any errors, omissions or inaccuracies in this manual by sending an email to info@avalon-instruments.com. We also welcome suggestions for improvements in this manual and in our products.

VERY IMPORTANT NOTE

Starting from the StarGo 6.2.0 SP6 version, it is possible to install and run all the system without the Administrator Privileges

In this case all the software that interact via ASCOM with the StarGo, must be also run without the Administrator Privileges.

If this requirement is not applied the simultaneous communication among the applications and the StarGO hardware and software are not guaranteed

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1. System Description and Technical Specifications

The StarGO is a GoTo Control System based on stepper motor technology. It has been designed to be intuitive and easy to use. Thanks to this characteristics it can be used in three main modality:

- Simple tracker – Without any kind of device. Just get the power and it is ready to track both in Equatorial and Alt/Az axis mode.
- Wireless GoTo System - To be used with SkySafari and smartphones/tablets. In this mode the 24 star pointing model is already available. This modality is mainly suggested for visual observation.
- Full GoTo system mount controller – To be used with a PC. In this way it will be possible to use the Stargo System, via ASCOM driver, with the main astronomical softwares such Maxim, TheSkyX, Phd2, SGP, Carte du ciel etc. allowing the full control and features: home position, goto, park/unpark, autoguide, focus etc. This modality is mainly suggested for astrophotography. The System has been succesfully tested with Windows 7/8/10 (via ASCOM Driver) and OS X (LX200 classic).

The StarGo Goto Control System was designed mainly for the Avalon Instruments mounts but, thanks to the programmable gear ratio and the motors kit available, it can be easily adapted to other mounts also.

The StarGO hardware has been designed to be strong, reliable and long lasting. The StarGo intelligence has been moved to the internal firmware and the external software, both easily to update. It is important to note that in this way it will be possible to maintain the whole system always updated without the need of any hardware upgrade.

In the following page it is possible to see the StarGO connection and functionality scheme.

Wireless Connections:

Bluetooth and Wi-Fi

Devices:

Macintosh, Win PC, Android & iOS.

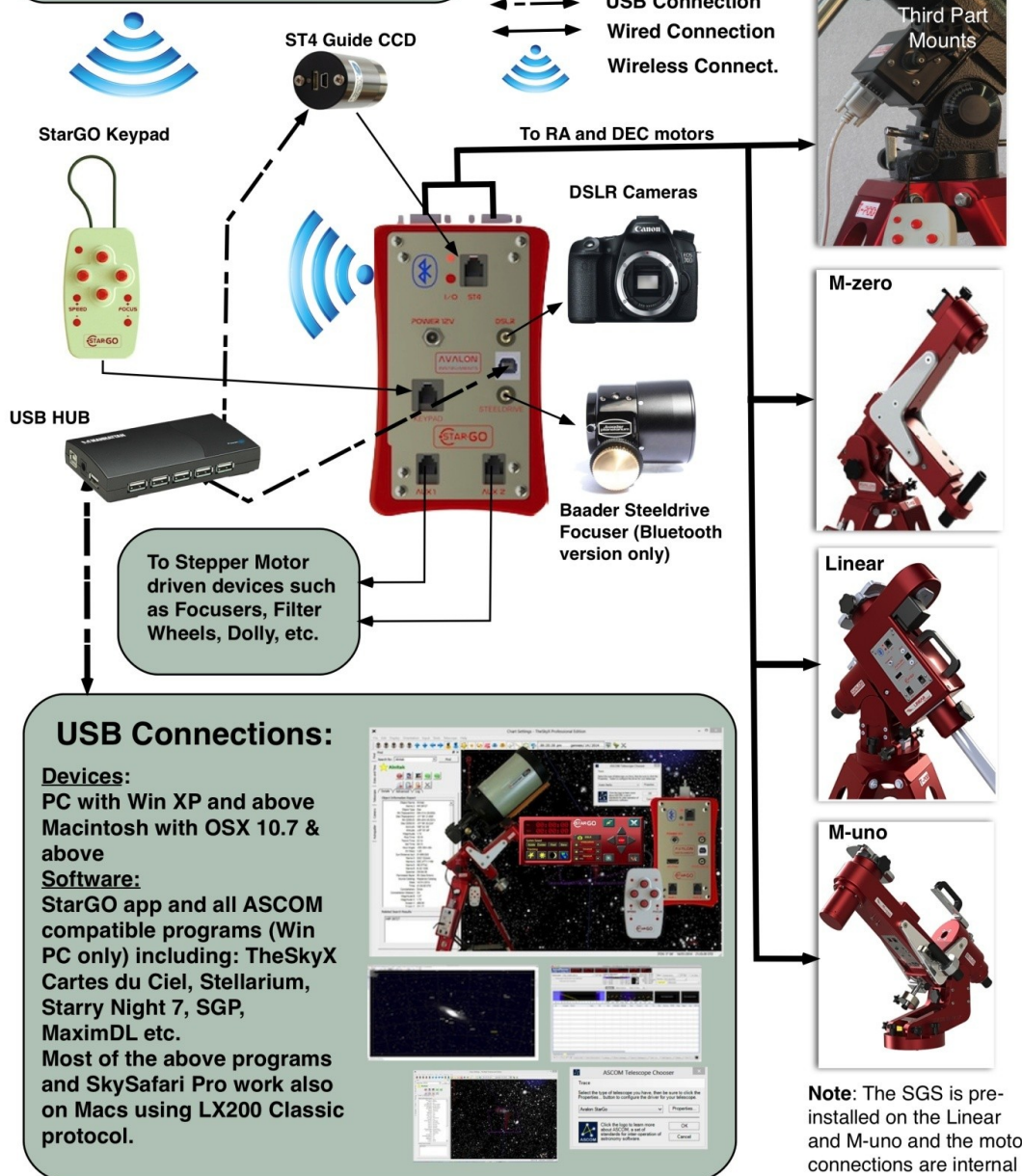
Software:

StarGo (Win PC), StarGO BT (Android),
SkySafari (Mac, Android and iOS),
TheSkyX (Mac, Win PC)



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STARGO CONTROL SYSTEM



Note: The SGS is pre-installed on the Linear and M-uno and the motor connections are internal

The StarGO Goto Control System is composed by the following parts:

1. **The StarGO Control Box**, which can be embedded within the mount as in the



Avalon Linear and M-Uno, or in a separate control box for the M-Zero. In addition, thanks to the programmable Gear Ratio and the special motor kit, the StarGO Control Box is also compatible with many mounts from other manufacturers. It has the ability to provide a smart interface between the mount's drive motors and the external world. Using internal and user-selected computerized astronomy software applications, it performs all the necessary communications with specific components,

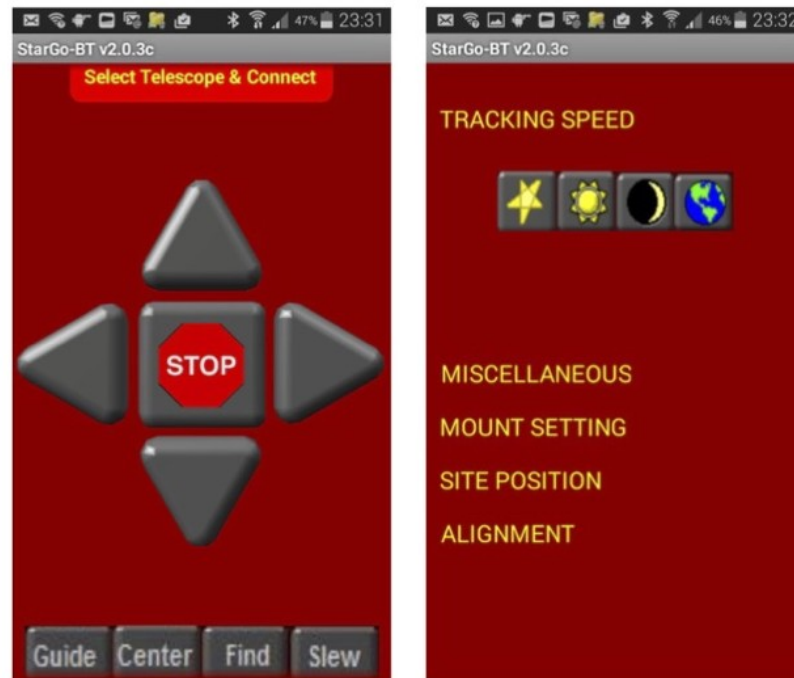


including autoguiders, focusers, CCD rotators, DSLR cameras, and other auxiliary devices via USB connections with Windows and Macintosh computers. Wireless capability, based on Bluetooth (right picture) or Wi-Fi (left picture), is also integrated in the control box unit to interact with intelligent devices such as smartphones, tablets, Android devices as well as Windows and Mac computers. The wireless system (BT or Wi-Fi) must be chosen at time of order.

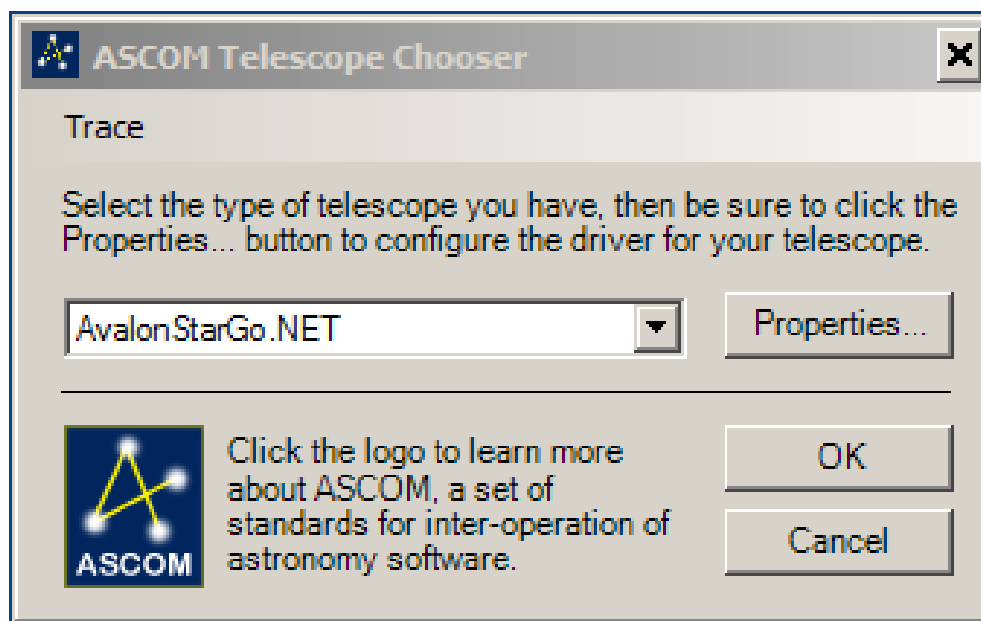
2. **The StarGO Keypad** is able to physically command the mounts and perform almost all the most needed operations without the use of a computer or other control device.
3. **The StarGO software**, developed entirely by Avalon Instruments, uses a computer to perform all the setup and management operations, including the control of various external equipment that can be connected to the control box. It is also able to perform all the same operations performed by the StarGO keypad.



4. **The StarGO-BT application** for Android devices allows them to interface with the StarGO control box via Bluetooth connection. With this application the Android devices become perfect smart-device control pads. This application, as well as StarGO, is under continuous development to add new functionalities.



5. **The Avalon Stargo ASCOM driver** makes possible the interaction between the StarGO Control Box and the most used astronomical softwares.



1.1 Technical Specifications:

General	Computerized control system based on stepper motor technology and dual communication (USB and Bluetooth or Wi-Fi).
Operational Mode	Equatorial or Azimuth (for the appropriate mounts)
Pointing Model	<ul style="list-style-type: none">• Single star• Three star (only in Alt Az axis mode)• Multistar (Up to 24 stars)
System Speeds:	<ul style="list-style-type: none">• “Guide”: From 0,05 to 0,95X in 0,05X increments.• “Center”: From 2 to 10X• “Find”: From 10 to 150X.• “Slew”: N. 4 speeds ranges (Low, Medium, Fast, Ultra) depending on the mount “gear ratio” and, for the maximum speed “Ultra”, on the power supply (requires at least 15 VDC).
Tracking Speeds	<ul style="list-style-type: none">• Sidereal• Solar• Lunar• Terrestrial (No tracking)
RA – DEC Motor Currents	Typical currents are 0.3 A for tracking and 1.5 A (adjustable) for slewing.
Input/Output Ports	<ul style="list-style-type: none">• USB• Bluetooth or WiFi• ST4
Output Ports	<ul style="list-style-type: none">• AUX1: Hybrid Step Motor with a max current of 1 A.• AUX2: Hybrid Step Motor with a max current of 1 A.
Electrical Characteristics	<ul style="list-style-type: none">• Power Supply: 12 – 18 VDC stabilized• Current: from 0.3 to 1.5 A (adjustable) in all operating conditions
Control Operations	<ul style="list-style-type: none">• Goto and Sync to celestial objects• Automatic Meridian Flip• User definable parking and homing functions• Programmable Custom Gear Ratio.
User updatable firmware	Via USB connection
Operating Temperature Range	-20 ≈ +40 °C

1.2 The StarGO Goto Control System hardware interface

It is supplied with the following items:

1. Main Board and aluminium case. (*Figure 1 StarGO Bluetooth Front Panel; Figure 2 StarGO Wi-Fi Front Panel*)
2. StarGO control keypad.
3. Keypad connection cable (RJ45 Standard).
4. USB cable.
5. 12-24 VDC power supply with 110-240 VAC and 12 VDC inputs + cigarette lighter 12V power cable.
6. A USB flash drive containing the StarGO software and other utilities needed for its setup and operation, as well as the complete documentation, including this and other manuals.
7. A foam-lined high-impact carrying case for all of the above (provided only with the StarGo Stand Alone kit.)

The Main Board for the Avalon Instruments Linear and M-uno mounts comes already internally installed in those mounts from the factory. On the M-zero mount and the Stand Alone kit, it is mounted externally in a separate case. The StarGO control box (item 1 above) which comes with the M-zero and the Stand Alone Kit is an attractive Aluminium case which contains the StarGO main control board. It is also designed to be installed externally on mounts of other brands and has external connections to power the motors and other devices. This section describes the StarGO control interface and the related keypad.

Figure 1.2.a illustrates the physical interface of the StarGO Bluetooth control box.

Figure 1.2.b illustrates the physical interface of the StarGO Wi-Fi control box.

Figure 1.1.a. StarGO Bluetooth Front Panel



1. On/Off Power button
2. ST4 autoguide port
3. 12-18 VDC power supply plug
4. Bluetooth capability symbol
5. DSLR Canon exposure management port
6. USB2 I/O Port
7. Baader SteelDrive focuser control port (Bluetooth version only)
8. Handheld keypad RJ45 plug
9. Stepper Motor Auxiliary Output Port (Aux 1)
10. Stepper Motor Auxiliary Output Port (Aux 2)
11. On/Off LED

Figure 1.1.b.StarGO Wi-Fi Front Panel



12. On/Off Power button
13. ST4 autoguide port
14. 12-18 VDC power supply plug
15. WiFi capability symbol
16. DSLR Canon exposure management port
17. USB2 I/O Port
18. Handheld keypad RJ45 plug
19. Stepper Motor Auxiliary Output Port (Aux 1)
20. Stepper Motor Auxiliary Output Port (Aux 2)
21. On/Off LED

Figure 1.1.c Illustrates the manual keypad which is connected to the StarGo Control Box at the plug labeled “Keypad” (#7) with the included RJ45 cable.

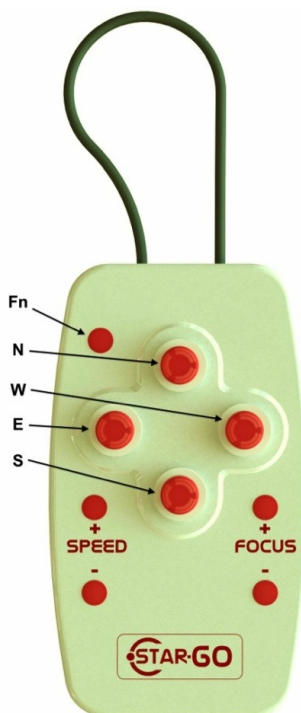


Figure 1.1.c Keypad

W / E Decreases/Increases the Right Ascension

N / S Increases/Decreases the Declination

Fn Function Key

SPEED+/- Increases/Decreases the mount's movement speed

Fn&SPEED+/- Increases/Decreases the Polarscope LED light intensity

FOCUS+/- Controls the in and out movement of the SteelDrive focuser motor in the port with the same name. Also controls the movement of any focuser connected to either of the two Aux ports.

Fn&FOCUS+/- Changes the Aux port to which the changes are sent. (1)

Fn&N / S Select system tracking speed (Sidereal, Solar, Lunar, Terrestrial) (2)

Fn&E / W Select telescope max slewing speed (Low, Medium, Fast, Ultra) (3)

- (1) By holding pressure on the Fn key and then pressing the FOCUS+ key, each time the FOCUS key is pressed, the output port to changes the order: Steeldrive (in the Bluetooth version only), AUX1 and AUX2. By keeping pressure on the Fn key then pressing the FOCUS- key the selection order is inverted: AUX2, AUX1, Steeldrive (in the Bluetooth version only).

- (2) *By holding pressure on the Fn key and then pressing the S key, each time the S key is pressed, the system speed varies in the order: Sidereal, Solar, Lunar, Terrestrial. By keeping pressure on the Fn key then pressing N key the selection order is inverted (Terrestrial, Lunar, Solar, Sidereal). The system does not memorize the tracking speed as modified and the next time the system is powered on, it returns automatically to the default Sidereal speed.*
- (3) *By holding pressure on the Fn key and the pressing the W key, the telescope max slewing speed varies in the order: Low, Medium, Fast, Ultra. By keeping pressure on the Fn key then pressing E key the selection order is inverted (Ultra, Fast, Medium, Low). The system does not memorize the slewing speed as modified and the next time the system is powered-on, it returns automatically to the default Slew speed.*

1.3 StarGO Power On

Preliminary operation to do before start using the StarGO.

1. Using the USB cable provided connect the StarGO to the PC
2. Connect the power supply cable connector to the StarGO.

NOTE: before to connect the StarGO please check that the power supply is set on 15V as shown in the image below. StarGO can also work fine with 12V input with the only limit that in this way is not possible to go beyond the medium slew speed.



Figure 1.3.a: Power supply

3. Before to start the software installation or a session, please check that the power cable is well inserted on StarGO power connector and that the StarGO is connected to the PC via USB cable as shown in the picture below



Figure 1.3b: StarGO power connection

Detailed info about the StarGO power supply using and characteristics please visit [StarGO power supply using](#) web page.

2. StarGo software suite installation

In order to get the maximum performances with the StarGO System it is necessary to install the StarGO Software Suite. The installer file can be found in the Installer-Tutorial-Software folder inside the flash drive that comes with the mount.

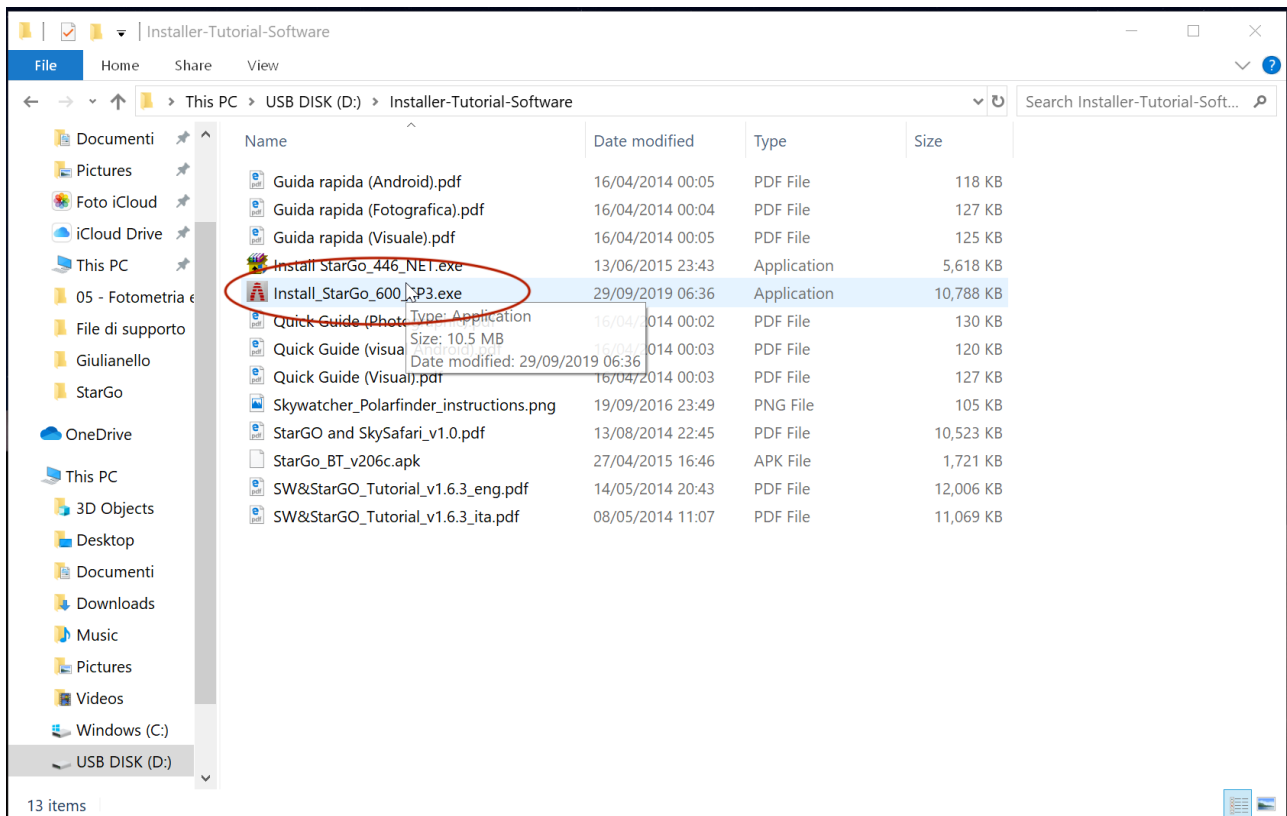


Figure 2.a: StarGo Installer folder location

The step by step Windows version installation procedure (that you can also find in a tutorial video on our [support page](#)) is the following:

1. Run the Installer file

Starting possible to install and run all the system without the Administrator Privileges

NOTE: in this case all the software that interact via ASCOM with the StarGo, must be also run without the Administrator Privileges.

During the software installation process, as described below, the Avalon ASCOM driver, the serial-USB FTDI drivers, the StarGO application, its firmware and related update utility are installed.

More details about the StarGO using with others astronomical software can be found in the “SW&StarGO_Tutorial_v1.x.x_eng.pdf” file that is inside the flash drive.

Note: Before launching StarGO be sure that the ASCOM platform is already installed (<http://download.ascom-standards.org/ASCOMPlatform6>). If this is not done, the program will abort and the Run-Time error message “429” will be generated.

2. Select the preferred language and then press OK:

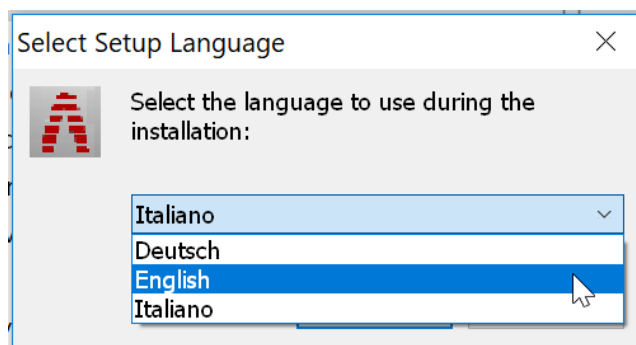


Figure 2.c: Installation language chooser

3. The installation splash screen will appear containing the StarGO GoTo Control System Setup Wizard welcome window. Click Next:



Figure 2.d: StarGO System setup wizard

4. The welcome window inside the splash screen will be replaced by the License Agreement window. Select “I accept the agreement” and then “Next”.

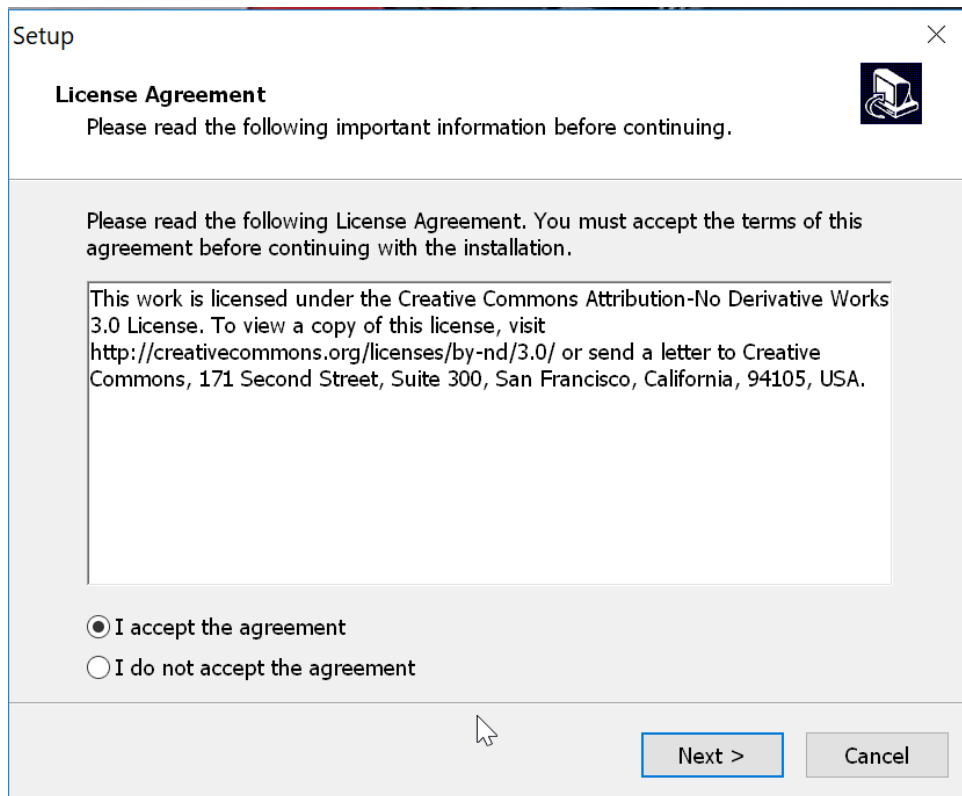


Figure 2.e: StarGo software license agreement

5. The next window will allow the creation of a StarGO desktop icon. It is advised to accept and then press "Next"

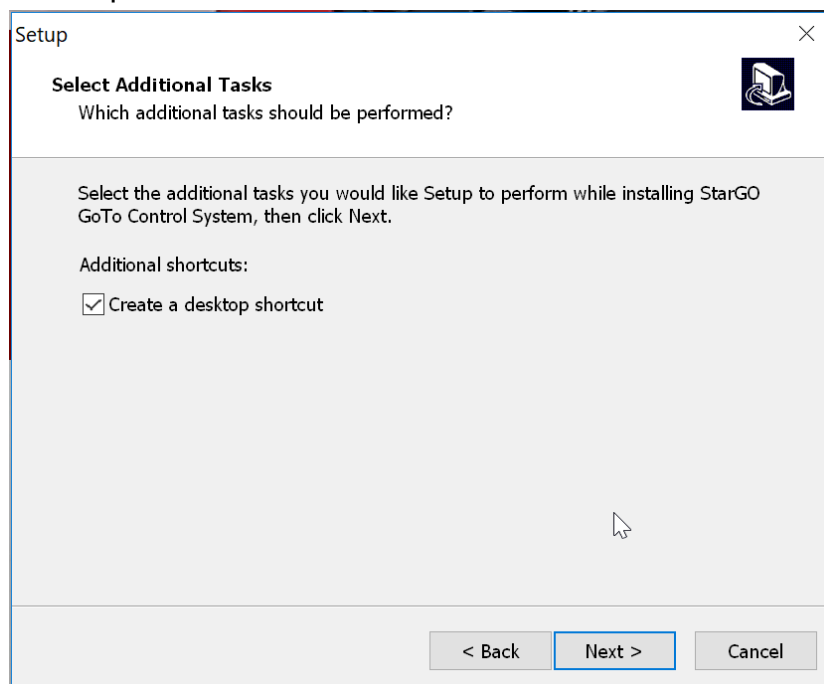


Figure 2.f: Desktop icon creation option

6. The next window inside the splash screen will present the summary of the task selected and proposes to start the installation. Click on the "Install" button.

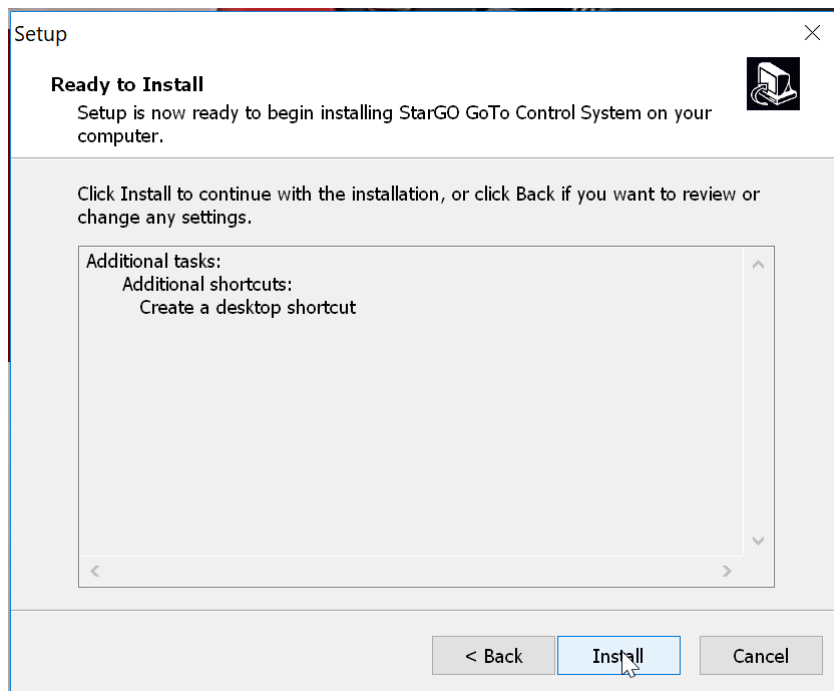


Figure 2.g: Start installation window

7. At the end of the installation process a window will be presented to asking to finish the StarGO installation process. It will ask to perform additional operations if needed, such as install the FTDI USB drivers, install the most updated StarGO ASCOM driver and launch the StarGO software at the end of the installation process. Click on the “Finish” button.

NOTE: The FTDI serial-USB drivers must be installed during the first installation. Because they are much less frequently updated than the StarGO driver, it is not necessary to install them each time.

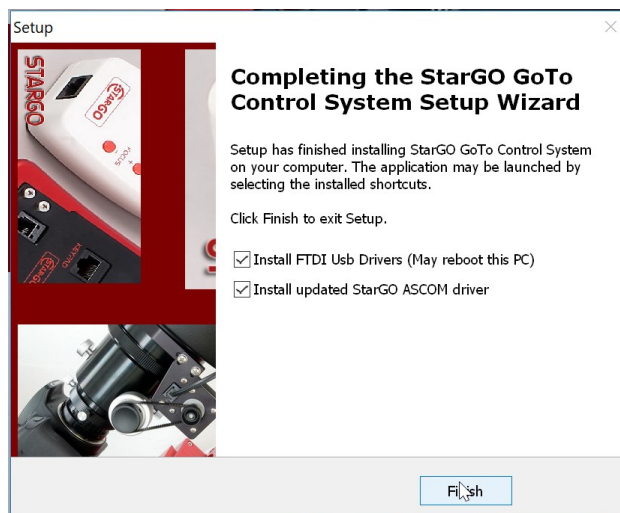


Figure 2..h: Install FTDI driver options window

8. If the FTDI driver installation has been selected, the FTDI CDM window will come up, click on the "Extract" button

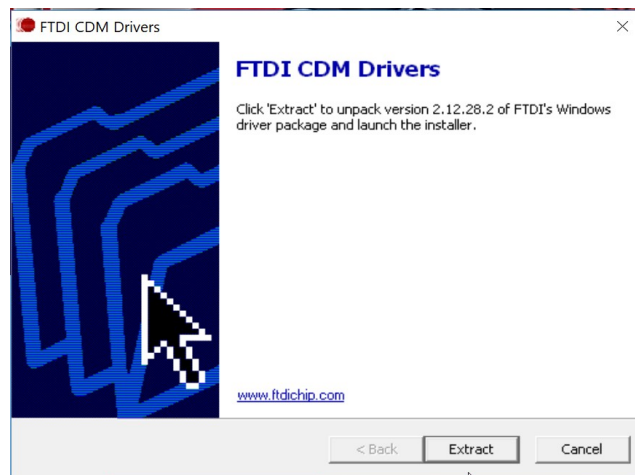


Figure 2.i: FTDI Driver extracting window

9. At the end of the FTDI drivers extraction the "Device Driver Installation Wizard" will appear. Click on the "Next >" button to go on with the installation.

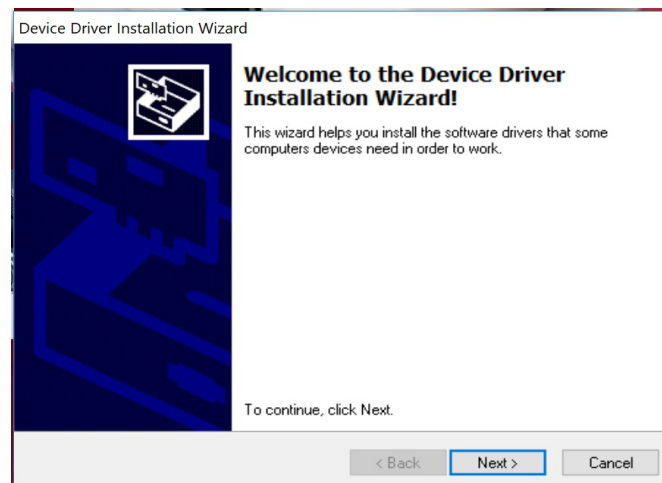


Figure 2. j: FTDI Device Driver Installation Wizard

10. Before to proceed with the installation it will be necessary to accept the agreement. Check the "I accept the agreement" check box and click on the "Next >" button.

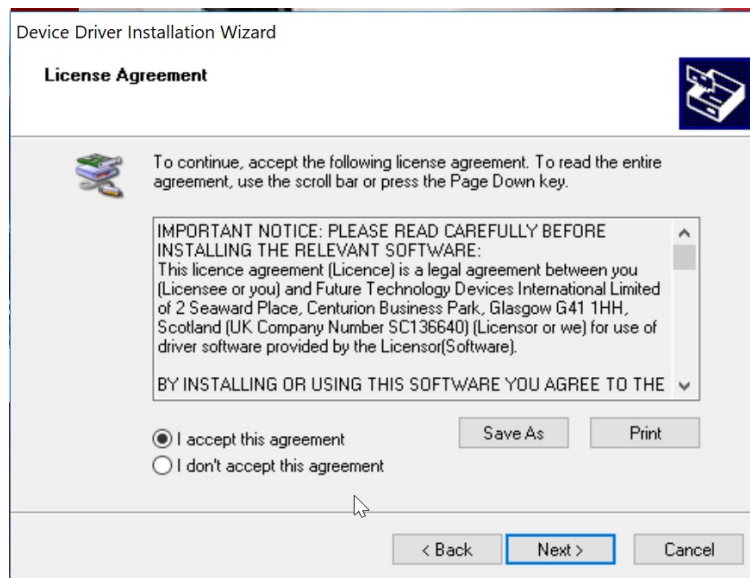


Figure 2.k: driver license agreement

11. Click on “Next”. The windows announcing the correct driver installation will appear. Press “Finish” to exit. The new drivers are ready for the USB connection.

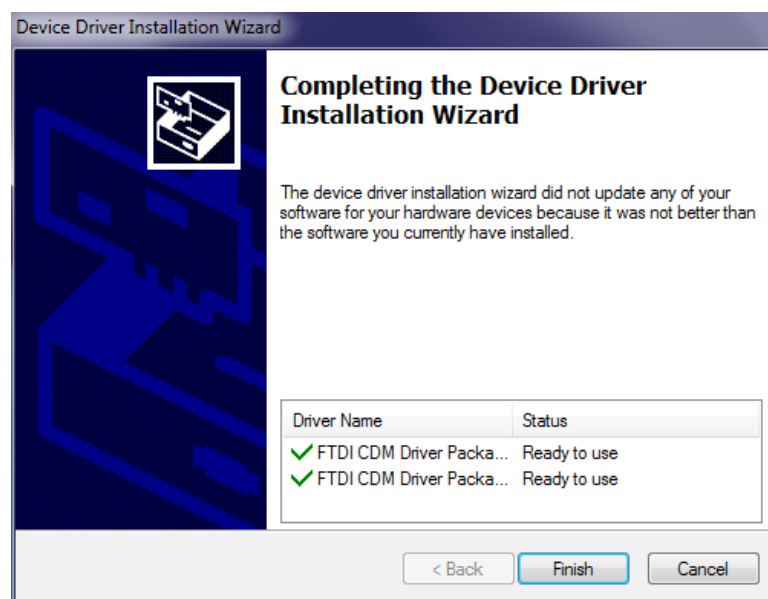


Figure 2.l: FTDI finish installation window

12. After the FTDI driver installation (if selected) the Accept the License Agreement in the following window and click on “Next”. Click on “Install” in the subsequent window:

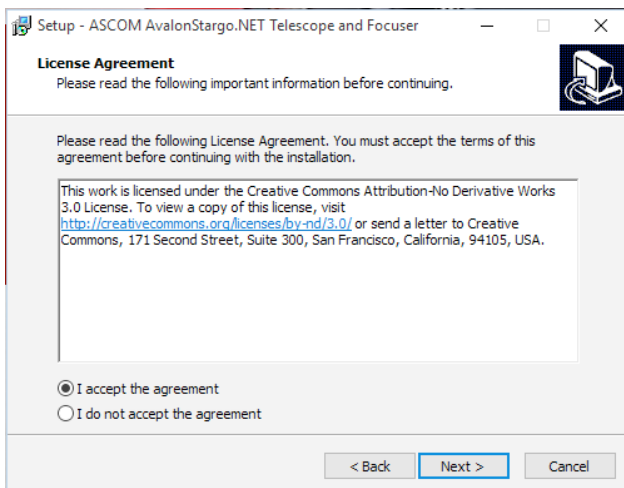


Figure 2.m: Avalon ASCOM driver License Agreement

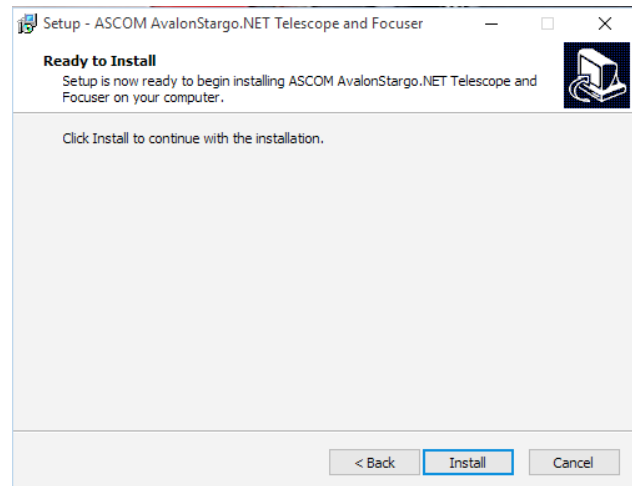


Figure 2.n: Avalon ASCOM driver License Agreement (2)

13. A final window will inform that the installation process has been successfully completed and will propose to view the contained Readme file of the installation.



Figure 2.o: Avalon ASCOM final installation message window

2.1 Mount preliminary settings for a mount quick use with StarGO Software

- 1) Point the telescope toward the North Pole if you are on the Northern Hemisphere or to Southern Pole if you are on the Southern Hemisphere
 - i. **Eq-mode:** perform a fine balancing and an accurate polar alignment (see detailed info on your mount user manual).
 - ii. **Alt-Az mode:** fine balance the telescope on the altitude axis and be sure that the tripod is well levelled and the Azimuth arm is parallel to the ground by using the two centering bubble on the tripod head and on the Azimuth mount arm. Then point the telescope approximatively to the north pole.
- 2) Connect the mount to the PC with USB cable
- 3) Connect the power supply to the StarGo **control box**.

When you plug in the power connector in to the StarGO board it starts and the led begins to blink but the RA and DEC motors are not yet powered on

Once the power has been provided the StarGO is powered but the RA and DEC motors are not yet powered. To use the mount follow the procedure explained below:

A) If the mount is not parked

The red LED above the On/Off button blink slowly. To activate tracking, briefly push either a) the red button (#1) on the StarGO Control Box, or b) one of the directional buttons (W – E – N – S) of the keypad or c) one of the directional buttons of the StarGo GUI main panel on the PC (see [Figure 3.1 a](#)).

To interrupt the tracking movement while still leaving the StarGO powered, hold the red button (#1) down for at least 5 seconds. The red LED will commence blinking slowly once again.

B) If the mount is parked

The red LED blink fast. The mount under this status cannot be moved, it is first necessary to perform an unpark. This operation can be done in two different way:

- Clicking on the "UNPARK" button in the "ALIGN" panel.
- Clicking on the ON/OFF button on the StarGO device (#1 [Figure 1.1 a](#), [Figure 1.1 b](#)) Please note that in this way the park position will be lost and another sync home position must be performed.

- 4) Launch the StarGO software on your PC
- 5) Go to the ALIGN panel and set the correct Observatory Location

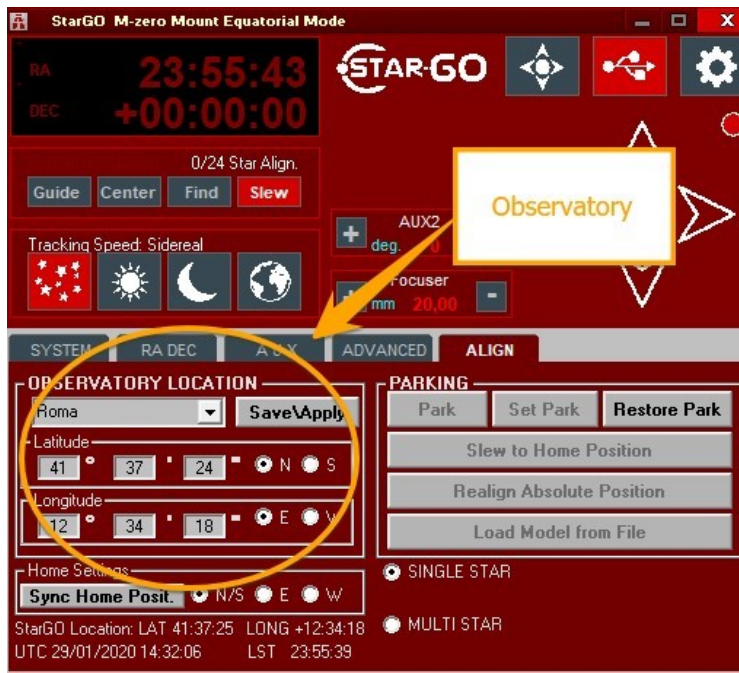


Figure 2.1.a: Set the correct Observatory Location

6) Then choose the preferred pointing method SINGLE STAR or MULTISTAR.



Figure 2.1.b: Choose the preferred pointing system

7) Press the Sync Home Position button to align the mount to the Sky (detailed instruction at section 4.5 for Eq mode, 4.6 for Alt-Az mode). At this point you can start with a fine star alignment (1 star or up to 24 star). For detailed GUI instruction please skip to section 3.

3. StarGO software description

3.1 Graphic User Interface (GUI)



When using StarGO with a computer or other device, activate the StarGO GUI by clicking the  icon created on the desktop during the program installation. The user interface appearance is shown in [Figure 3.1 a.](#)



Figure 3.1.a: StarGO Main Panel before connection

To animate the GUI it is necessary to connect the StarGO to the hardware. To do this click on the USB icon  and the COM port selection window will appear.



The connection will be established by selecting the correct COM port (normally the port suggested in the Select Com Port menu) and pressing OK. The USB icon will be highlighted  and the red LED on the StarGO starts blinking signaling the correct connection. The red LED  on the GUI has the same functions as the button on the StarGO control box. If at the end of the previous session the mount has been correctly parked, the main GUI panel will appear as follows:



Figure 3.1.b Main Panel with the mount parked

If the mount is unparked or after the UNPARK button is pressed, the GUI will look like this:



Figure 3.1.c.: Main Panel with the mount unparked

A quick click on the LED or on one of the directional arrow buttons will activate sidereal tracking and the LED will remain on (same as the physical LED on the StarGO) producing the same result as briefly pressing the physical button #1 on the StarGO Control Box.

A double click on the LED symbol will cause tracking to stop, which is the same effect as holding the red power button on the StarGo Control Box for longer than 5 seconds. The red LED on both StarGO Control Box and the LED software symbol will flash as tracking stops. This action will initiate a warning message and a confirmation to stop the tracking motors.

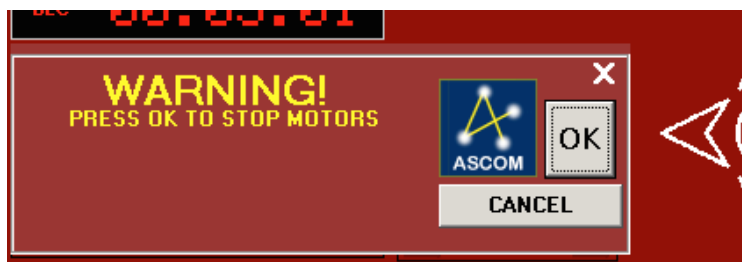



Figure 3.1.d: Stop motors warning message

3.2 Parameter setting

Click on the setup button  on the upper right, and the GUI will bring up the mount parameter setting panel. As seen in [Figure 3.2.1a](#), this panel contains five tabs for setting different parameter types.

3.2.1 System Panel

The SYSTEM tab allows the selection of the StarGO connection COM port number, as seen in [Figure 3.2.1a](#) and the upload of a newer firmware version. Selecting the “Save Screen Position” checkbox will cause the StarGO GUI position on the screen to be saved.

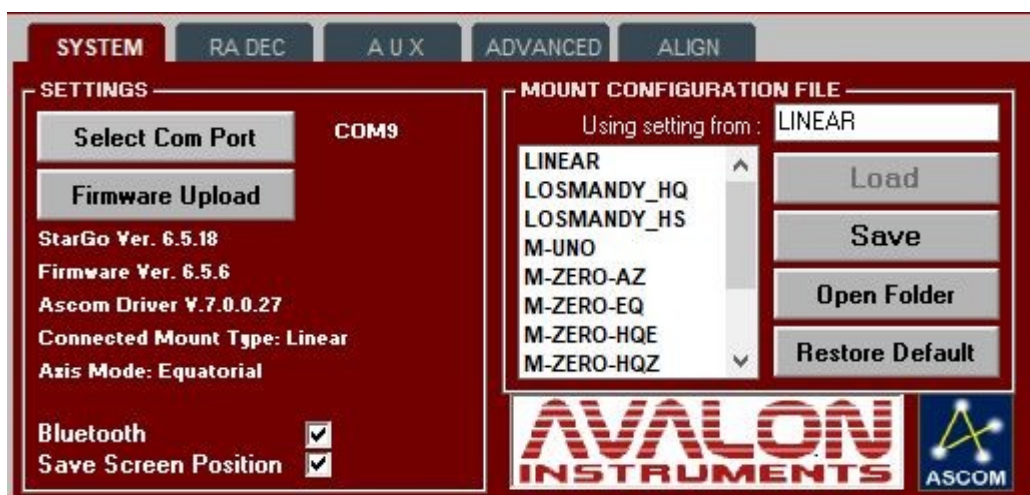


Figure 3.2.1a. "SYSTEM" Panel

This panel also reports the StarGO software, firmware and ASCOM driver versions as well as the type of mount and the axis mode (equatorial or alt-azimuth).

The timeliness of the given versions of firmware and software is evaluated by the software itself and, if they are not current, the user is warned and advised to update.

Saving the "Mount Configuration File" containing the mount configuration parameters (this file has the .mcf extension) is done by typing inside the string below the **Save** button your personal Mount Configuration File. By default the string show "User". To save the new file click on the "Save" button. The names of the parameter files to be loaded are shown at the left of these buttons.

The Configuration Files have the following format:

M-zero-MGH.mcf - Blocco note

File	Modifica	Formato	Visualizza ?		
0	Type	Parameter	Value	Description	
1	TXT	STARGO_VER	StarGo Ver. 5.6.38	App. Release	
2	TXT	Ascom_Driver	Ascom Driver V.6.8.2.59	Ascom Driver Release	
3	TXT	FIRMWARE_TCB		TCB FW Release	
4	TXT	FirmwareRif	5.6.6	Required StarGo FW Ver.	
5	TXT	VERSION_FW	Firmware Ver. 5.6.6	Found StarGo FW Ver.	
6	TXT	COMPORTNUMBER	COM4	Com Port	
7	NUM	GEAR0	385,027	RA Gear Ratio	
8	NUM	GEAR1	385,027	DEC Gear Ratio	

Figure 3.2.1.b. Mount Configuration File

The above figure shows only a few of the mount parameters. There are normally a total of several tens of parameters in this file. Their values depend on the software version, the mount type and the custom settings. When StarGO is installed, several default .mcf files are copied in the StarGO folder, related to the Avalon Instrument mounts and to the StarGO standalone kits available for supported mounts of other brands. Other configuration files may be added by the user, containing different customized setups for the owner's mount(s), using the described Save button. The most suitable configuration file is uploaded to the StarGO using the Load button ([Figure 3.2.1a](#)).

The Bluetooth capability can be switched ON by selecting the checkbox located beneath the SAVE/LOAD buttons.

3.2.2 RA DEC Panel

Pressing the RA-DEC tab opens the panel shown in [Figure 3.2.2 a](#) which enables access to the guide settings of the mount.

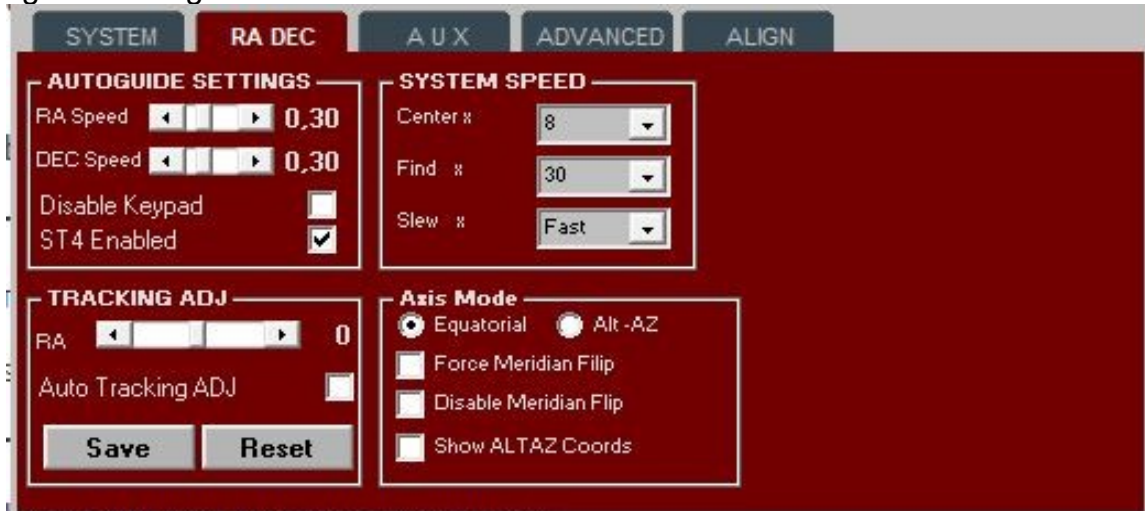


Figure 3.2.2.a. "RA-DEC" Panel

The "AUTOGUIDE SETTINGS" frame allows the regulation of the auto-guiding speed, with increments of 0.05x times the sidereal speed. This regulation can be performed independently for the two axes. It has effect for the signal coming from the ST4 port and for the pulse guiding signals coming from the USB ports.

The "Disable Keypad" option allows to enable/disable the StarGo Keypad.

NOTE: By using the mount with the StarGo Keypad unplugged, the "Disable Keypad" option must be checked.

The check box "ST4 Enable" allows the ST4 port to be to enabled/disabled.

NOTE: Some CCDs leave the port locked when it is not active. This condition keeps the system locked on the guide speed, preventing any other movement. By checking this checkbox the ST4 will be unlocked.

The TRACKING ADJUST frame allows the precise manual adjustment of the sidereal speed. By checking the Auto Tracking ADJ checkbox, the StarGO Software will automatically adjust the tracking speed, reducing the effect of long PE values. The algorithm uses the pulse guiding commands that come from the guiding software. This function does not work while guiding using the ST4 cable.

Starting from the StarGo 6.2.0 version it is also possible to Save the Auto Tracking ADJ value for the reuse in future sessions.

The "SYSTEM SPEED" frame enables changing the values of moving speed when using the directional buttons of the main panel of the StarGO GUI or the Fn&E / W keys in the keypad.

The available slew speeds are: "Low", "Medium", "Fast" and "Ultra". The latter requires at least 15 VDC to be supplied to the system.

The AXIS MODE frame allows the selection of either the Equatorial or Alt-Azimuth mount operating mode.

Selecting the "Show ALTAZ Coords" check-box will cause the main display to show Alt-Az coordinates instead of Equatorial coordinates.

The "Force Meridian Flip" allows a Meridian Flip to be performed before the Meridian is reached.

The "Disable Meridian Flip" feature allows to disable the Meridian Flip on both the side of the Meridian, these are the procedures to perform starting from a Sync Home Position to activate the feature:

- A) Target on Eastern side, mount pointed to East (Standard condition, DEC arm down)
 - 1) Sync Home Position
 - 2) Goto to the target
 - 3) At the end of the goto, check the "Disable Meridian Flip" option (now the mount will not flip anymore and you can start with Plate Solve on both side of the Meridian)
- B) Target on Eastern side, mount Pointed to West (flipped condition, DEC arm up)
 - 1) Sync Home Position
 - 2) Check the "Force Meridian Flip" option
 - 3) Goto to the target (do not perform Plate Solve at the end of this Goto otherwise the mount flip again)
 - 4) At the end of the goto, check the "Disable Meridian Flip" option (now the mount will not flip anymore and you can start with Plate Solve on both side of the Meridian)
- C) Target on Western side , mount pointed to West (standard condition, DEC arm down)
 - 1) Sync Home Position
 - 2) Goto to the target
 - 3) At the end of the goto, check the "Disable Meridian Flip" option (now the mount will not flip anymore and you can start with Plate Solve on both side of the Meridian)
- D) Target on Western side, mount Pointed to East (flipped condition, DEC arm up)
 - 1) Sync Home Position
 - 2) Check the "Force Meridian Flip" option
 - 3) Goto to the target (do not perform Plate Solve at the end of this Goto otherwise the mount flip again)

- 4) At the end of the goto, check the "Disable Meridian Flip" option (now the mount will not flip anymore and you can start with Plate Solve on both side of the Meridian)

The procedures can also be used after the Sync Home Position, simply starting from point 2

3.2.3 AUX Panel



Figure 3.2.3.a. "AUX" Panel

Clicking on the "AUX" tab brings up a panel (Figure 3.2.3.a) that controls the setting of the two auxiliary AUX 1 and 2 ports controllable by the StarGO. These ports can drive stepper motors for specialized functions such as generic focusers, filter wheels, CCD rotators, etc.

The two frames below, AUX1 and AUX2, contain the parameters pertaining to the auxiliary devices as follows

- **Step/mm – Step/degree:** Device speed measurement selection (linear/angular) and related values.
- **Decimal:** Number of decimal to be shown in the main panel (see [figures 3.2.3b](#) and [3.2.3c](#)) and in the separate windows (see section 3.4).
- **Show checkbox:** Show or Hide the controls in the main panel (see figures [figures 3.2.3b](#) and [3.2.3c](#)).
- **Reverse checkbox:** Reverse the motor movement direction.

The SHOW BUTTON frame check box is for show/no-show the DSLR in the main panel.



Figure 3.2.3b: SHOW BUTTONS checked...



Figure 3.2.3c: ... and unchecked

Figures 3.2.3b, show the main panel appearance when the DSLR and Steeldrive buttons are checked, Figure 3.2.3c, shows the main panel when are unchecked.

The Check for AUX Advanced Function push button allows, when pressed, to access the controls of AUX1 and AUX 2 device motor parameters for fine tuning:



NOTE: The motors driven by the AUX 1 and AUX 2 ports are disconnected from the power once they reach the required position. It means that in this state they do not absorb any current but are not able to keep mechanical loads requiring an active effort.

NOTE: In all three frames of this panel it is possible to define the number of decimal digits that will be shown in the main panel or in the separate windows (see section 3.4). Furthermore, it is possible to change the Aux port denomination by double clicking over the frame tab.

POLAR ALIGNMENT TOOL

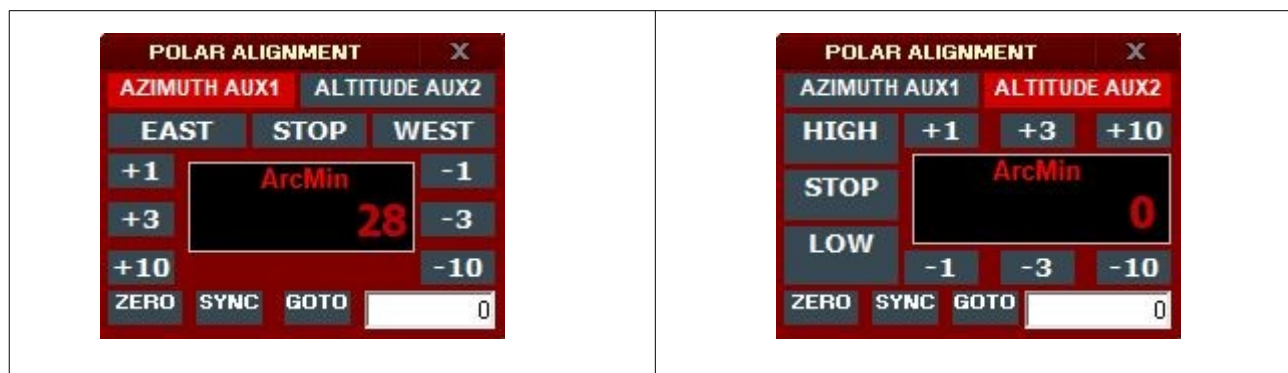
Starting from the StarGo 6.2.0. SP4 version, it is available the new Polar Alignment tool for the control of the optional Alt/Az motors of the M-uno and the M-zero OBS.

This tool can be activated by clicking on the “AUX as Motorized Polar Alignment” radio button.



The use of this tool it is really intuitive, the control of each motors can be activated by clicking on the corresponding button:

AZIMUTH AUX 1 – For the AZ motor and **ALTITUDE AUX2** for the Altitude motor.



When the Azimuth AUX1 motor control will be activated, it will be possible to adjust the azimuth.

The first operation to be performed it will be to select in which direction the mount should move. This can be done pressing on the EAST button or on the WEST button.

When the ALTITUDE AUX2, panel will be activated, it will be possible to adjust the LATITUDE.

The first operation to be performed it will be to select in which direction the mount should move. This can be done pressing on the HIGH – LOW buttons that allow to select in which direction the motor will be moved.

Then, in order to physically move the motors, the user can select how many ArcMin the mount has to move on the selected directions, has described below.

ArcMin buttons Each panel shows the following buttons:

- +1 = Move the motors of +1 ArcMin unit in the selected direction
- +3 = Move the motors of +3 ArcMin unit in the selected direction
- +10 = Move the motors of +10 ArcMin unit in the selected direction
- -1 = Move the motors of -1 ArcMin unit in the selected direction
- -3 = Move the motors of -3 ArcMin unit in the selected direction
- -10 = Move the motors of -10 ArcMin unit in the selected direction
- ZERO = Reset the display ArcMin Display to the Zero Value
- SYNC = Perform a Sync on the current position, displaying the current value typed in the value field on the ArcMin display
- GOTO = Perform a GoTo in the selected direction, of the amount of value typed in the typing field below, in ArcMin unit.

3.2.4 ADVANCED Panel

Clicking on the “ADVANCED” tab brings up a panel in which base parameters are selected during the installation phase and rarely used thereafter. ([Figure 3.2.4a](#)).



Figure 3.2.4a: “ADVANCED”

NOTE: When using the Stand Alone kit on third party mounts, please use the specific mount configuration file that comes with the installer.

In the ADVANCED panel, the “REVERSE MOTOR DIRECTION” frame checks allow the inversion of the motor rotation direction if it happens that one or both the mount axes are moving in the wrong direction.

The “POLAR FINDER LED” slide control sets the intensity of the polar scope LED during the polar alignment operations (for both types of polar scope available on Avalon mounts).

NOTE: The LED is set to 0 (off) when the system is powered on. It is possible to vary the LED intensity also by simultaneously pressing the Fn and SPEED+ or SPEED- keys on the keypad.

The last two frames of the ADVANCED tab are related to the choice of the mount on which the StarGo system will be used and to the setting of both the RA and DEC motor torque (in percentage of the maximum value). In the “MOUNT GEAR RATIO RA/DEC” frame, the type of mount is selected based on its Gear Ratio.

Starting from firmware version 4.0.0, the motor torque management system has become dynamic. For the regulation of the RA-DEC Torque value, please refer to the following table:

Mount (Voltage)	Linear / M-uno (12 V)	Linear / M-uno (15 V)	M-zero (12 V)	M-zero (15 V)
Max Slew Speed	Fast	Ultra	Fast	Ultra
Torque	70%	70%	50%	50%

3.2.5 ALIGN Panel

The last panel is related to the setting of the observation site geographical parameters and to the mount parking operations in specific positions such as Park, Home, etc.



Figure 3.2.5.a: "ALIGN" Panel

The left frame of the ALIGN panel ("OBSERVATORY LOCATION") allows up to eight observation sites to be set and saved by inserting their geographical coordinates (Latitude and Longitude).

NOTE: To operate the mount in Alt-Azimuth mode (for the mounts that allow this operating mode) it is normally sufficient to use a smartphone or tablet equipped with suitable software such as SkySafari (see the following sections 4 and 5), along with to the control keypad. The StarGo retains the chosen operational mode in its memory.

The Home Settings panel allows management of the starting session key position.

- **Sync Home Position** button, allows synchronization of the telescope to the Home Position that has been previously chosen by selecting one of the three options on the right of the button. N/S is the normal CWD position with the counterweight bar down and the telescope pointing North (for Northern Hemisphere) or South (for the Souther Hemisphere). This is the best choose for the open air sessions or for dome observatories. E or W are the positions in which the telescope is horizontal point East or West depending on the situations. This is the preferred choose for observatories with a flat sliding roof.

The "PARKING" frame allows management of the key positions that the mount will use at the end of the operating session or resetting of the starting point if needed during the session. The functions of the five buttons in [figure 3.2.5a](#) are:

- **Park** button moves the mount to the parking in the positions previously defined. Using the Park function enables the mount to be switched off and restarted, even after many days, without losing the sky alignment.
- **Set Park** button defines and store in the StarGO memory, the position in which the telescope shall be parked.
- **Restore Park** button will park the mount in current position restoring the previous Set Park mount position
- **Slew to Home Position** buttons brings the mount to the Home position previously defined with the Sync Home Position function corresponding to the starting position to which the **Sync Home Position** has been previously set.
- **Realign Home Position** allows to realign the internal absolute position after the Synch by Plate Solve or planetarium Sync
- **Load Model from File** enables the StarGO to accept the sky model built using the X-Solver tool (see the X-Solver Appendix)

NOTE: When the mount is parked the red LED on the StarGo board blink fast. The mount under this status cannot be moved and no other operations are possible. It is therefore necessary to perform an unpark to get back the mount control capability.

Finally, at the bottom of the frame of [Figure 3.2.5a](#). There are two check boxes:

- The first, “SINGLE STAR” box, enables the StarGO software to perform a single star alignment.
- The second “MULTI STAR” box enables the StarGO software to perform a star alignment up to 24 stars.

When the PARK button is pressed the mount will move to the preselected Park position. The StarGO GUI will show the “Parking...” label until the mount stops. Then the directional buttons will be replaced by another label indicating that the mount is now in “PARKED” status ([Figure 3.1b](#)). A usual “UNPARK” push button will become available to perform this operation.

3.3 Warning Descriptions

The StarGO is provided with a warning system to alert the user when setting functions that require more attention or that can jeopardize correct mount operation.

The first of such alarms is presented when there is a significant disagreement between the version of the firmware installed in the StarGO Control Box and the software being used. This can occur quite frequently because both these elements are continuously improved by Avalon Instruments. That is why we repeatedly suggest checking to see if new firmware and software updates are available. New versions are regularly distributed through [Support](#) page of the Avalon web site.

During connection, when StarGO determines that firmware and software versions are incompatible because they are at different stages of updating, the following warning will appear over the main GUI panel:



Figure 3.3.a: Warning obsolete firmware version

Clicking on the "CANCEL" button will allow operation to resume normally. However, malfunctions could possibly occur if any important software changes or updates have taken place since the previous version of the software was used. It is therefore important to follow the warning suggestion to update to the latest firmware version (See chapter 7).

A similar warning is generated if the software version is found to be obsolete, compared to the StarGO firmware version. Similarly, if this is the case, the suggestions given above should be followed.

Another warning important for safe mount operation appears when the user attempts to increase the motor RA/DEC Torque over the 100% threshold in the ADVANCED panel:



Figure 3.3.b: Motor torque warning message

Increasing the motor torque beyond recommended limits could potentially cause damage and dangerous over-heating of the motors and associated hardware. For that reason it is advisable to remain below the specified threshold. Pressing the "OK" button will cause the StarGO to be restarted, with the loss of all operations in progress ([Figure 3.3.b](#)).

The last alarm is generated in the SYSTEM panel. A setup file is open, indicating there is a change in the mount type, gear ratio or other main parameters. This alarm warns the operator that restarting the StarGO is required to complete the action.



Figure 3.3.c: StaGo restarting message

3.4 Using the special features of the Main Graphical Area



Figure 3.4.e: Mount system speed (System aligned)

This section describes in greater detail all items and features in the Main Control Panel of the GUI, which are not described or are only briefly mentioned in the previous sections.



Figure 3.4a: Main Graphical Area



Figure 3.4.c - Directional buttons

The information given are applicable to both equatorial and alt-azimuth modes.

The large window on the upper left (Figure 3.4b) shows the current values of Right Ascension RA and Declination DEC coordinates of the telescope.

The directional buttons (Figure 3.4c) on the middle right control the movements of the telescope in RA and DEC. The large central



Figure 3.4b. RA and DEC coordinates

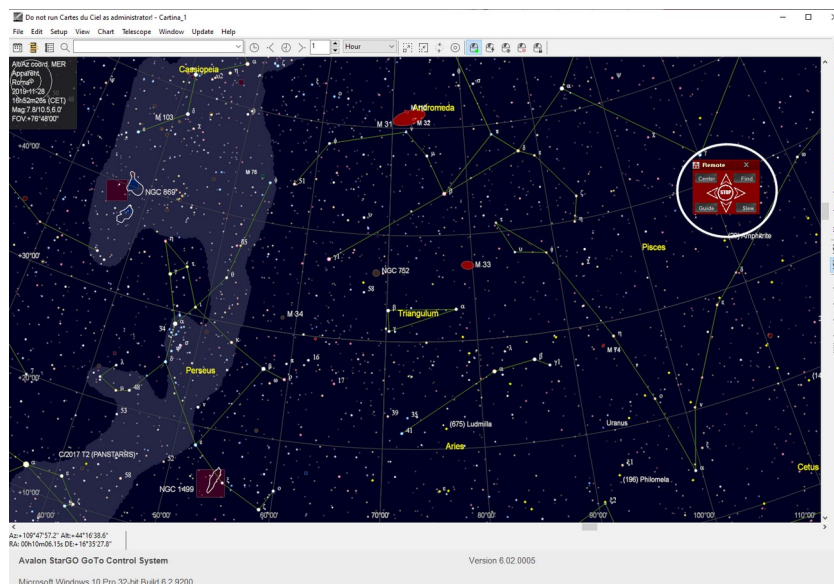
circular button immediately stops all movements in progress when the mount is in operation.

The speeds at which the directional buttons operate the mount (System Speed) are chosen using the buttons in the frame below the RA-DEC display.

The values of the system speeds are set in the RA DEC panel (see section 3.2.2). The label above the buttons indicates the telescope pointing side ("Pier Side: East" or West") and the quality of the star alignment in terms of used stars out of 24 maximum.



3.4.d – Main Graphical Area Top Button



3.4.e - Virtual Keypad active on Carte du Ciel

On the top right there are three buttons, by clicking the first on the left the "Virtual Keypad" will appear, a small panel always on top screen very useful to control the mount with third party Software as "Carte du ciel", "Stellarium" etc.



3.4.f – Virtual Keypad panel

The Virtual Keypad panel allows to easily control and move the mount with the StarGo software functions also when you are using third party softwares. By clicking on the directionals button the mounts will move at the selected speed. By clicking on the Stop button the mount will stop his movement. The Virtual Keypad panel also allows to change the mount speed movement.

NOTE: in case the Virtual Keypad lose the always on top function just click again on the Virtual Keypad button on the StarGo Software top panel and it will soon recover the always on top function.

The bottom left window contains the buttons to select the telescope "Tracking" speeds. The choice is given by the red color of the associated icon. In figure 3.4.e the sidereal speed has been selected.



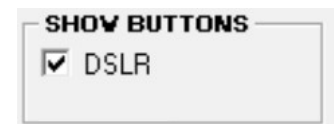
Figure 3.4.g: System tracking speed frame

“Tracking Speed” is the speed (Sidereal, Solar, Lunar and Terrestrial) used by the mount to follow the several types of celestial objects as they appear to move across the sky.

Clicking on the first button in the “Tracking” row selects sidereal speed. This speed remains obviously fixed because most celestial objects move across the sky at a constant speed due to the constant speed of the earth’s rotation. The Sun and Moon move at faster speeds and therefore require faster tracking speeds. Those speeds are selected by use of the Solar and Lunar buttons in the “Tracking” row. If the terrestrial speed is selected, the mount stops and remains motionless relative to the sky, but the display shows the RA changes due to the sidereal motion of the sky.

DSRL Camera Management

NOTE: To enable this button in the Main GUI, which is not visible in Fig 3.4a, it is necessary to select the DSRL SHOW check boxes inside the SHOW BUTTON sub frame in the Aux Panel (see section 3.2.3, [figure 3.2.3b](#)).



The StarGO application is able to efficiently manage photographic imaging with a DSLR camera, using a suitable cable. To use this feature it will be necessary to connect the camera to the port (#5 in Figure [1.1a](#) and [1.1b](#)) on the StarGO Control Box using the proper cable for that camera. Activate the DSRL function by pressing the button with the same name in the Main GUI.



Figure 3.4.g: DSLR button

Currently, this port supports only Canon and some Sony DSLRs. Use the Aux ports for cameras of other brands.

Clicking on the DSLR button causes a new window to appear ([Figure 3.4h](#)), allowing StarGO to set up all photographic parameters for astrophotography and time-lapse.

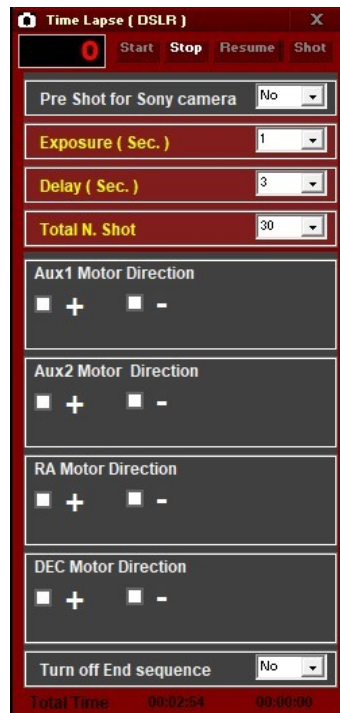


Figure 3.4h: DSLR Control

The following parameters are set in the three drop-down menus:

- **Pre Shot for Sony Camera:** As the name implies, this parameter is applicable only with Sony DSLR cameras. These need a pre-shot command to raise the internal reflex mirror before the actual shot.
- **Exposure (sec):** The length in seconds of each single exposure.
- **Delay (sec):** The length in seconds of the time gap between successive exposures.
- **Total N. Shot:** The total number of exposures to perform.

The controls have been designed with the ability to use “Time Lapse” imaging.

The total time in seconds is reported in the window in the upper left corner.

The “Start” button initiates the sequence of the exposures. The “Stop” button interrupts the sequence before the total number of shots is carried out.

The “Resume” button re-starts a sequence that has been previously interrupted.

The “Shot” button allows the execution of single shots of variable exposure time. Upon first clicking on the “Test” button, the exposures start. The second time the “Shot” button is clicked the process is interrupted.

Below the camera parameters are the commands to operate the auxiliary motors connected to the Aux1 and Aux2 ports and to operate the RA and DEC motors to move the mount axes.

Using these functions with the mount in Alt-Azimuth mode, it will be possible to easily perform photographic panoramas or dynamic time lapse images.

Finally, at the bottom of the DSLR control windows is a box for choosing the action to be performed at the end of the photographic sequence.

Steeldrive and Aux ports

The matrix of buttons under the DSLR buttons allows controlling the devices connected to the three AUX ports of the StarGO (ports N. 7, 9, 10 of Figure 2.1).

NOTE: To enable this buttons in the Main GUI it is necessary to select the STEELDRIVE, Aux2 and Aux1 check boxes inside the related sub frames in the Aux Panel (see section 3.2.3, [Figure 3.2.3.a](#)). Currently, the focuser port only supports the Baader Steeldrive focuser. For motorized focusers of other brands, use one of the AUX ports.



Figure 3.4.i: Focusers Panel

The user performs the setup of the AUX ports parameters as described in Section 4.2.3 “AUX Tab”. Clicking over the name of the device in the related sub frames, a new input window will appear as follows.

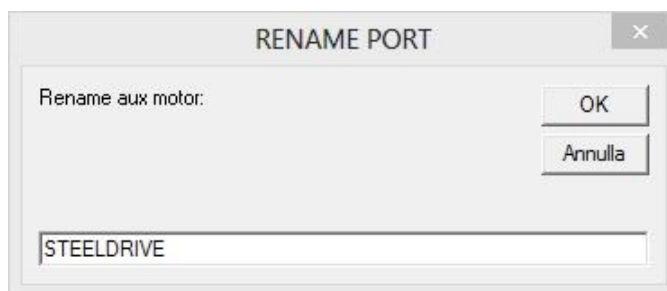


Figure 3.4.I: Rename aux motor panel

In this window it is possible to insert new names for the device connected to each of the Aux ports. This name will appear in the above matrix. Also the gauge units defined in the AUX Tab will be reported in the matrix for each device. In the following example the “Steeldrive” port controls a Steeldrive focuser mounted in a C11 telescope, guide scope focuser is connected to the Aux1 port and the Aux2 port controls a filter wheel.

Double clicking on the name of a device in the matrix above will bring up one of three new auxiliary windows to allow the insertion of the required parameters for motor control of the selected device. The three windows, seen below, are very similar in appearance.



Figure 3.4.m: Steeldrive Panel



Figure 3.4.n: Aux1 Panel



Figure 3.4.o: Aux2 Panel

The positional values may be linear as, for example, focuser extraction or rotational as in degrees of a filter wheel.

The five buttons in each window allow easy management of these parameters:

- The GOTO button performs the repositioning of a device to the value introduced in the display;
- The ZERO button is for zeroing out the display value;
- Clicking on the SAVE button will save the introduced parameters, otherwise these will be lost when the StarGO system is exited;
- The SYNCH button will enable synchronization of the device position with the value reported in the selected row of the table;
- The STOP will halt all the device motor movements in case of need.

The display will show the current values of the parameters, including the measurement units.

The two +/- buttons enable manual movement of the related device in either of the two directions in a continuous manner.

The six small buttons with the numbers -1, -0.1, -0.01, +0.01, +0.1, +1 will move the associated device in a fixed value defined by the number in the button selected.

Double clicking on the small GoTo buttons in the table will move the device to the chosen position. The values of the Posiz. column are manually introduced, corresponding to a well defined position.

3.5 Use of the StarGO for controlling telescope in Equatorial Mode

NOTE: The instructions reported in this section are applicable only to the Equatorial operating mode. The corresponding Alt-Azimuth mode operations are reported in section 3.6.

To perform any go-to telescope pointing operation, it is necessary to start with a polar alignment. For visual observation polar alignment can be somewhat casual, even approximated. For photographic sessions polar alignment must be very precise to guarantee optimal tracking and to prevent star trails. The procedure for obtaining a good polar alignment is described in the manual of every mount type.

3.5.1 Alignment (SYNC) and GoTo Operations

The **sky synchronization** is the operation of aligning the mount to the sky and it is the first to be performed (after polar alignment) to execute correct pointing to celestial objects for visual observation or photography. The method of star alignment may be chosen in the ALIGN panel of the StarGO setup windows:



Figure 3.5.1a: ALIGN Panel

This panel provides two methods for aligning the telescope to the sky. The first method is the simpler and is described in the following paragraphs. The second, called “Multi Star Model” is much more sophisticated. It is based on the Plate Solve Syncing function for as many as 24 stars and is described in detail in the Appendix. The choice of the method to be used is made in the ALIGN setup panel through the “Use Multi-Star Model” check box. If unchecked the single star Alignment is chosen, if checked the Multi-Star Model is selected. The choice is shown in the StarGO main panel, under the coordinate display.

NOTE: If the Multi Star box is selected, the status is retained after the mount is switched off. When the system is started again, this button remains checked and the Multi-Star alignment is enabled. In this case, even if a model has not been loaded to the StarGO (see Appendix, section A2.3), every Sync operation performed after the restart contributes to build the model. For example, if during an observing section, a certain number “n” of Syncs is performed, a n/24 model is progressively built. If a new model or an existing one has been loaded in memory, each additional Sync will increase the number of stars of the model up to the total of 24. In order for this incremental feature to have the correct effect, the operations **MUST** be started with the mount in the Synch Home Position as explained below.

NOTE: To perform a Sync operation it is necessary to use a planetary program for executing a goto command to a well known star and, once perfectly centered, for syncing the mount position to that star. Any planetarium program compatible with

the ASCOM drivers can be used for this operation. Examples of this planetarium application are the Cart du Ciel (CdC) and Skysafari (that can interact with the StarGO even using WiFi connection). The examples that follows are performed using CdC. A more detailed explanation on how to use CdC with Avalon Mount under ASCOM environment is given in section 3.7

For the correct execution of the Single Star Alignment, the operations must start with the mount pointing to the North (toward Polaris) and counterweight bar pointing down toward the ground. This position is usually abbreviated as CWD. For the M-zero and the M-uno mounts it is the DEC arm that must point toward the ground. Their User Manuals explain this in detail. Equipping the telescope with a well-aligned finderscope that has a crosshair reticle eyepiece, will be useful in this procedure, especially if the primary telescope has a long focal length.

In this position it is assumed that the telescope is pointed toward the North Celestial Pole. However, due to several potential errors (approximation in finding the exact CWD position, polar alignment errors, conical errors between the mount and the telescope, etc.), this assumption may not necessarily be true. To navigate in the sky with true precision, after obtaining a good polar alignment, it is necessary correct these errors by performing few syncing operations, described below:

1. **SYNC HOME POSITION:** This operation will inform the system that the telescope is in the CWD position (with the various uncertainties mentioned above). The operation starts with the mount just switched on, after the correct site coordinates and date parameters in the software are verified. Press the "**Sync Home Position**" button in the StarGO Align Control Panel (see also [Figure 3.5.1a](#)). The StarGO coordinates display will show 90° 00' 00" in DEC. The RA value will correspond to the East meridian transiting position at the actual time, as the following figure shows.



Figure 3.5.1b: RA/DEC coordinates display

2. **STAR SYNCHRONIZATION:** The second operation is the telescope synchronization with a star, preferably close to the target object. This action causes the scope to refine the precision of the pointing and corrects most of the errors mentioned earlier. To execute the sync, perform a GoTo to a known star in the CDC planetarium (already connected to the StarGO via ASCOM). To refine the centering, use the telescope eyepiece to bring the star exactly to the center in field of view. Once the star is perfectly centered, press the **SYNC** icon in the CDC menu. The telescope is now aligned with the sky. This operation can be considered as a "**single star alignment**".

A method that makes easy and accurate pointing to objects and precise execution of all the necessary syncing operations is called "Plate Solving." This technique requires the use of a CCD or other camera and is therefore suitable only during astrophotography sessions.

Plate Solving permits the celestial coordinates of the center of the FOV to be determined with extreme precision. This is useful to obtain exact syncing with a celestial object, which

is essential for astro-imaging. Several software applications allow plate solving operations to be performed in a very quick and efficient manner without the need of an external internet connection required by other software programs. These applications also provide automatic synchronization and centering of any celestial object with a pre-defined precision (up to a fraction of an arcmin) without the need to develop a sophisticated and complicated pointing model. Such a pointing model may use tens of stars and may be required to be corrected and updated often for external and uncontrollable reasons.

3.6 Use of the StarGO with a PC for controlling telescope in Alt-Az Mode

The M-zero mount can be used in Alt-Az mode if needed, especially for visual use. To transform the M-zero mount for use in the Alt-Az mode follow the instructions given in the M-zero manual, section 1.4, page 10. To use the StarGO Control System with an Alt-Az M-zero follow the instructions in Section 3.2.2 of this document.

The Alt-Az polar alignment operations described below are best performed with the StarGO system powered off

The first operation to be performed for using the M-zero in Alt-Az mode is an initial approximate manual alignment to the North Pole.

NOTE: In Alt-Az mode, the orientation of the mount is not important because it has a 360 degrees symmetry in the horizontal plane. Assuming a well performed tripod levelling (by using the bubble on the tripod head top) the only strict requirement is that the Azimuth axis must be perfectly level. This is easily accomplished by using the Altitude adjustment features of the mount to center the bubble level on the RA mount arm.

Because the Alt-Az mode is used almost exclusively for visual observations, a very precise polar alignment is not required. Centring the Polar Star in a short focal length eyepiece is usually sufficient to obtain a good visual tracking. If a more precise polar alignment is desired, one of the methods described in the M-zero manual may be used, taking into consideration that the position of the North Pole cannot be determined with the same ease as when using the M-zero polar-scope.

Since the starting position of the telescope also corresponds to the system Home Position, it is necessary to Sync the Home Position after first the powering the StarGO on. To do this, use the appropriate button in the Align Tab of the Main GUI, following the instructions of section 4.2.5. The display in the main GUI will show the Alt-Az coordinates of the North Celestial Pole (if the “Show” check-box has been selected in the RA DEC setting tab).

When this is done, the Control System knows that the telescope is pointing North. To provide a sufficiently accurate sky model to perform precise go-tos, it is necessary to sync the telescope to at least other two Stars. Select two Align Stars from the Celestial DataBase sufficiently far from each other in the sky. Perform a go-to to the first of these stars. It is possible that the telescope will not center the star at the first attempt. With the help of the finder scope, use the directional commands in the main GUI or the directional buttons in the control keypad to center the star in the cross-hair eyepiece. When the star is well

centered perform a Sync using the button in the Celestial Database panel. Now perform a go-to to the second star. This time the pointing should be much more precise. Perform the precise centering again as before and sync to this second star. At this point the model should be enough precise to perform a successful visual session.

3.7 Mount control using ASCOM driver

As previously mentioned, the StarGO system is compatible with the ASCOM astronomical standard via the Avalon ASCOM driver that Avalon Instruments has developed and distributed for use with its proprietary StarGO system.

This capability makes it possible to manage the mount using third party software (i.e. planetarium programs), cooperating with StarGO software in the ASCOM environment.

The purpose of this section isn't the detailed discussion of the Avalon mounts use in ASCOM environment. Instead, we will provide here a brief explanation of how StarGO works with ASCOM. For a more in-depth review of this topic, please read the document supplied with Avalon mounts describing the use of third party software (StarGO – Third Party Software Use, which is part of the documentation supplied with Avalon Mounts and StarGo Stand-Alone kits).

NOTE: To use Avalon mounts under the ASCOM environment, it is of course necessary that this platform has been previously installed in the computer.

For purposes of illustration, the following is a brief description of ASCOM being used with the Cart du Ciel (CdC) planetarium program:

(Sky Chart, <http://sourceforge.net/projects/skychart/files/latest/download>).

With other programs the starting procedure is similar but may be slightly different. This is described in greater detail in the “StarGO – Third Party Software Use” document.

The sequence of operations to perform for controlling the telescope with CdC in the ASCOM platform environment is the following:

- Launch CdC under the administrator privileges (which is strictly required for all other software programs used with StarGO).
- Select the “Telescope settings...” item under the “Telescope” menu of the main CdC interface, as indicated by the red oval in the following [Figure 3.7a](#).

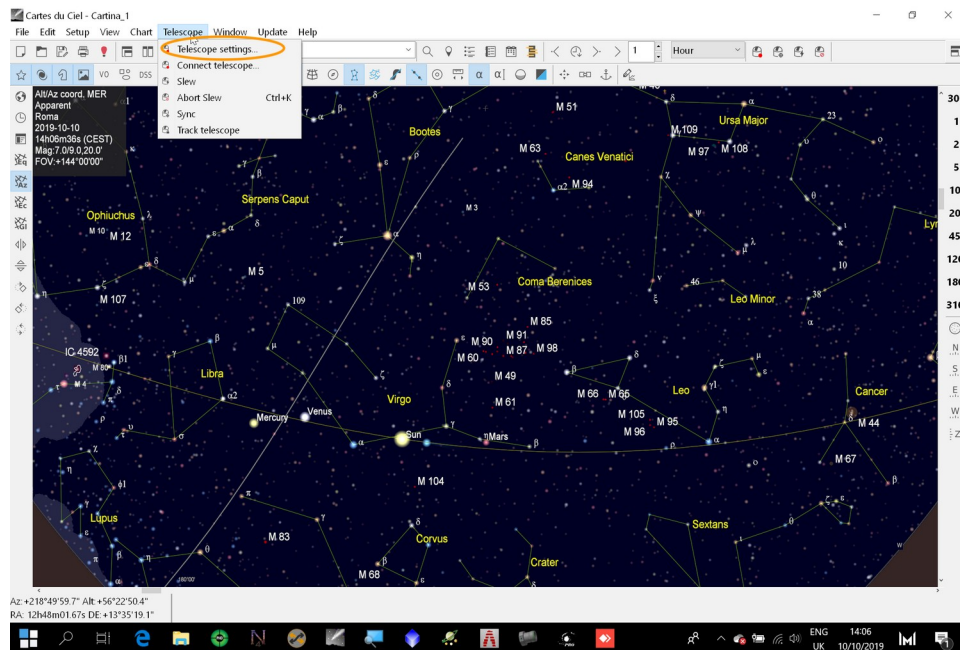


Figure 3.7a: CdC main GUI_1

- The “General” panel will open. Select the ASCOM button, as illustrated in the following [Figure 3.7b](#), and click OK.

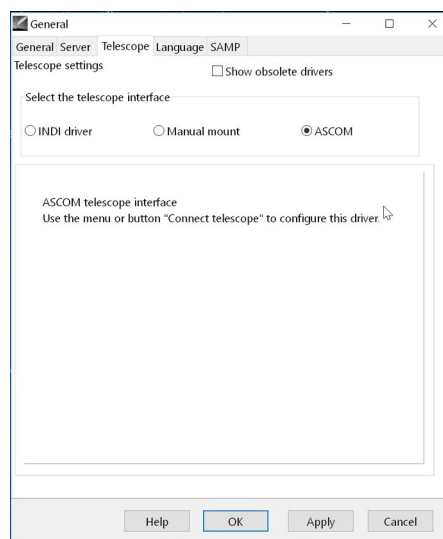


Figure 3.7.b. CdC Telescope Interface selection window

- Open the Control Panel clicking on the icon highlighted with the green oval in [Figure 3.7c](#). The ASCOM telescope interface will open.

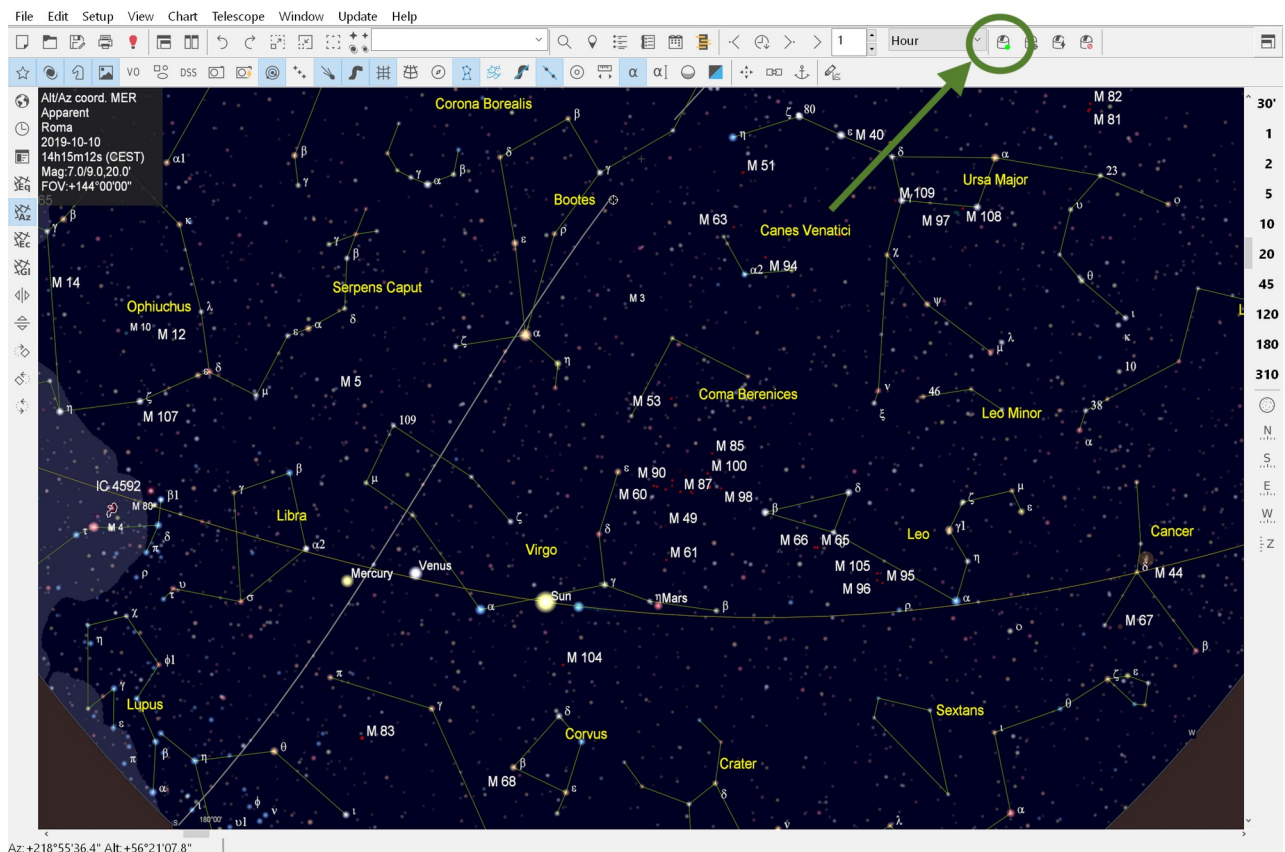


Figure 3.7.c: CdC Main GUI_2

- On the ASCOM panel below (Figure 28) chose the ASCOM driver by clicking on “Select” button.

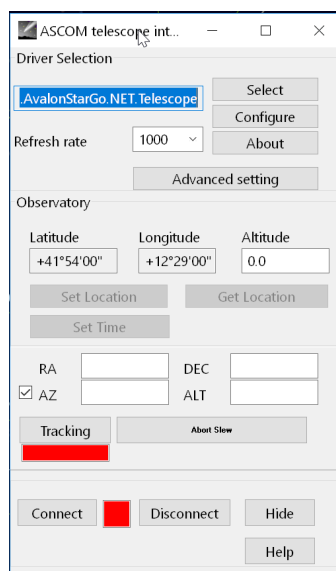


Figure 3.7.d: ASCOM telescope interface

- The classic “ASCOM Telescope Chooser” panel will open. Select the AvalonStarGo.NET driver in the dropdown menu and then click “OK”.

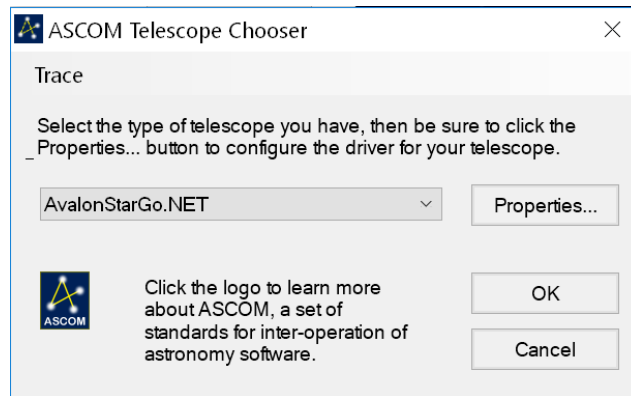


Figure 3.7e: ASCOM Telescope Chooser

Once the Avalon ASCOM driver has been accepted, press the “Connect” button on the ASCOM telescope interface panel of [Figure 3.7e](#).

At this point the telescope will be under ASCOM control and it may be driven by CdC as well as other ASCOM compatible programs like Astrotortilla, PHD Guiding or Sequence Generator Pro (SGP), for example.

The movements of the mount executed through CdC will be transmitted and shown in StarGO and those done in StarGO will have a feedback, also shown, on the planetarium display.

All the instructions described are also valid for the use of the mount in Alt-Az mode. In this case it is useful to select the check-box on the left of the AZ-ALT display windows in the ASCOM Telescope interface, to have the Alt-Az coordinates shown in the panel.

3.8 Using the StarGO with a wireless connection

One of the more innovative features of the Avalon Mount and the StarGO Control System is the capability to manage the connection with the user devices in a “wireless” manner, using the Bluetooth or Wifi standards depending on the choice made at the order time. Taking advantage of this function requires a device (computer, smartphone, tablet) which has wireless capability and software suitable to interact with the mount using this technology.

The following combinations of devices and software have been tested to date:

1. PC Windows (XP, 7 and 8, 10) / TheSkyX Pro
2. MACOSX (10.15.1) / TheSkyX Pro
3. MACOSX (10.15.1) / Sky Safari Pro
4. Samsung Galaxy Tab S5e (Android) / Sky Safari Pro
5. Samsung Galaxy Note 8 and 9 (Android) / Sky Safari Pro
6. Samsung Galaxy 5S (Android) / Sky Safari Pro
7. Apple iPhone iOS 13.1.3 / Sky Safari Pro
8. iPadOS 13.2.2 / Sky Safari Pro

Using portable devices in the above combinations 4 through 8 allows mounts equipped

with StarGO to be operated even without the use of a PC (or a Mac). However, mount preliminary settings must be **set** at least one time with the PC (see 5.2 section).

Avalon Instruments will add more Device/Software combinations once further compatibility tests, now being conducted, have been successfully completed.

The use of TheSkyX Pro and Sky Safari Pro also makes the Avalon Instruments mounts operable n the Mac Operating System (MACOSX).

The procedures for using the StarGO control system connections with a Windows PC via Bluetooth and WiFi are described in section 3.8.1 through 3.8.2.

The use of the StarGO hardware with SkySafari or TheSkyX on MacOSX and with SkySafari on portable devices will be described in section 5.

3.8.1 Bluetooth pairing the StarGO with a Windows PC

The use of a Bluetooth link for the data transmission requires the "pairing" with a Bluetooth capable device. For example, on a PC with the newest Windows 10 operating system, which is fully compatible with StarGO, follow these steps:

Under the Windows "Start" button select "Settings". The following panel will open:

NOTE: All the procedures described below have been execute with the devices and OS available at the moment of the writing. More updated OS may present slightly different screenshots still obtaining a substantial identical result.

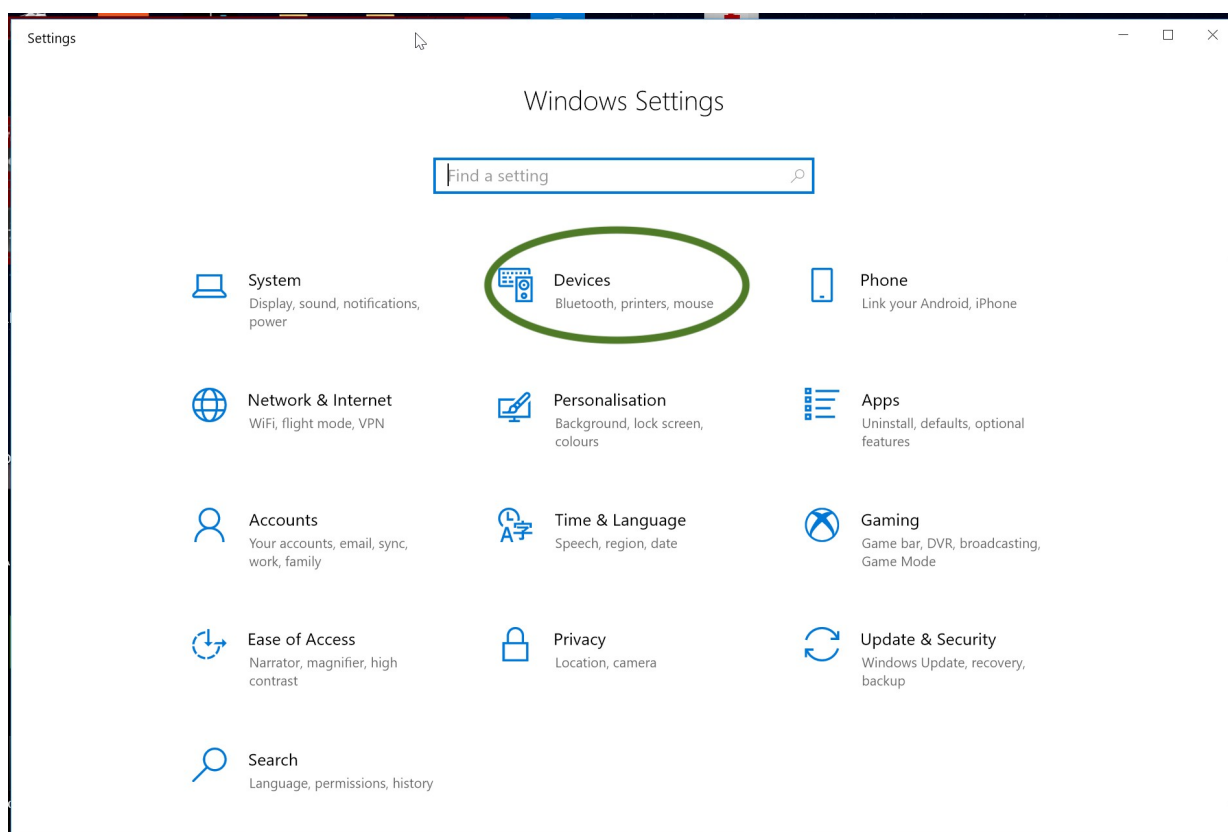


Figure 3.8.1a: StarGo Bluetooth pairing

Select Devices (green oval) to open the related panel as follows:

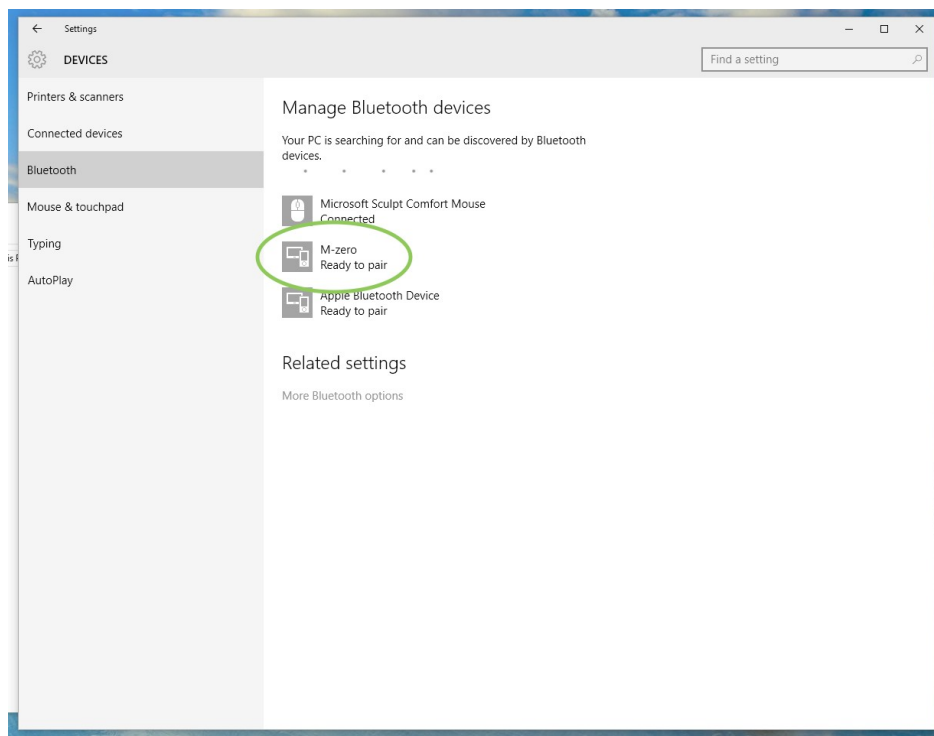


Figure 3.8.1b: Choose StarGo device

In this panel select the Bluetooth item and then the StarGO device. In our example it is named M-zero. However other Avalon Instruments product names are possible and are easily identifiable. A subpanel will open:

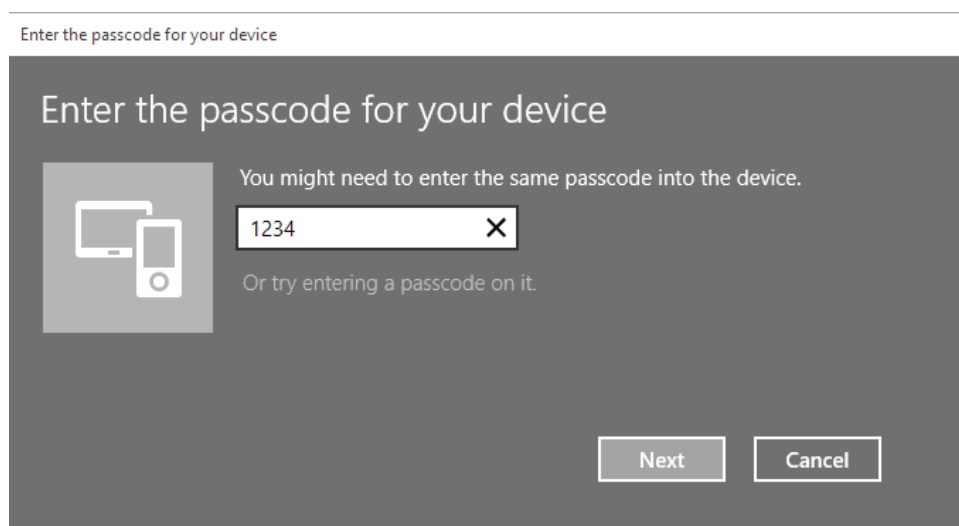


Figure 3.8.1c: Insert pincode

In this panel insert the passcode for the StarGO. Normally it is 1234. If different, the correct one will be provided together with StarGO documentation.

The PC is now connected to the StarGO. After the Bluetooth connection is secured, all other control operations are absolutely identical to those performed with a USB connection.

3.8.2 Bluetooth pairing the StarGO with a Macintosh

The procedure to pair a Mac with the StarGO via Bluetooth is very similar to that described **above**. On the Mac follow these steps:

Open System Preference window and select Bluetooth. The following panel will open:

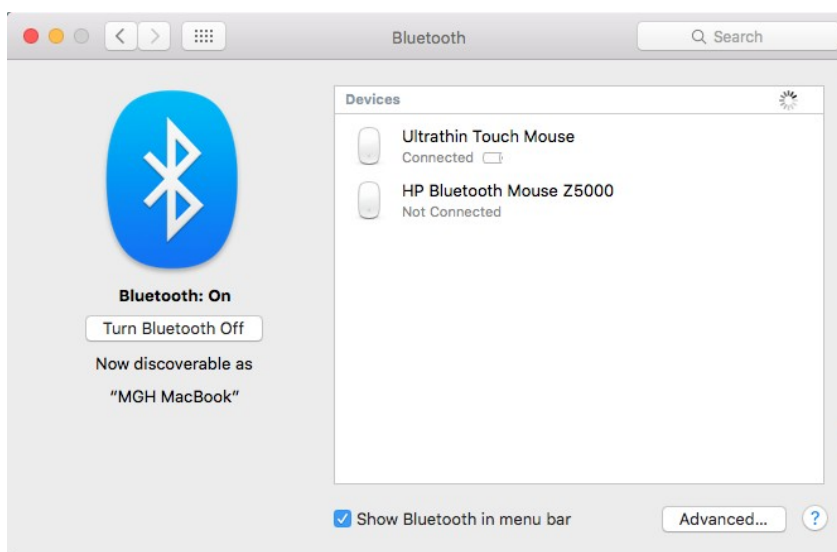


Figure 3.8.2a: StarGo Bluetooth pairing with Mac

The devices already connected will be shown in the window and the rotating wheel in the upper right side will indicate that the Mac is searching other available devices. When the StarGO is powered up, the Mac will find it within several seconds and the following panel will appear:

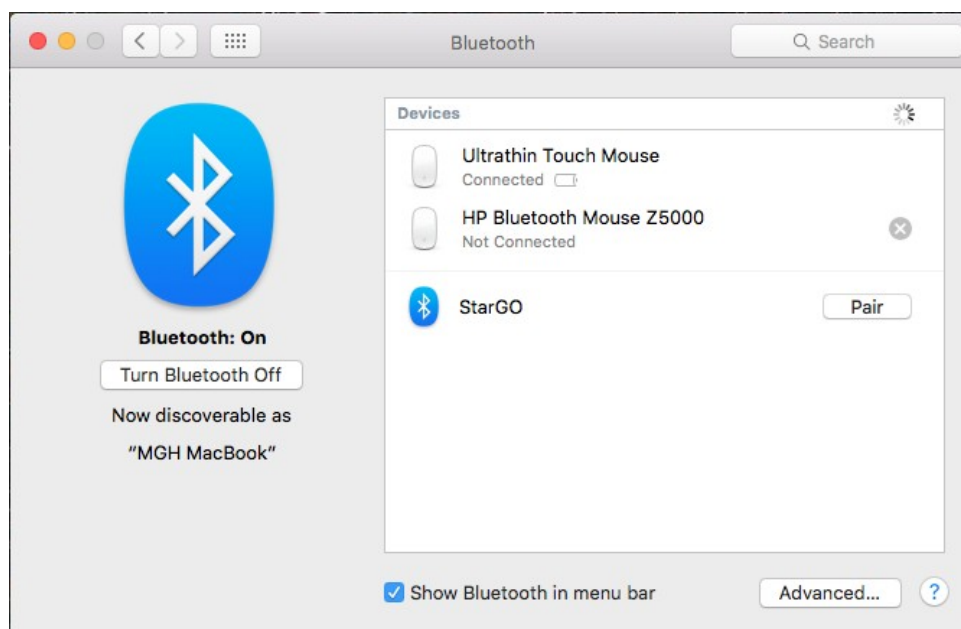


Illustrazione 3.8.2b: StarGo Bluetooth pairing with Mac

When SttarGo is identified, click "Pair" in this panel to link the computer with the StarGO Bluetooth device. A subpanel will open:

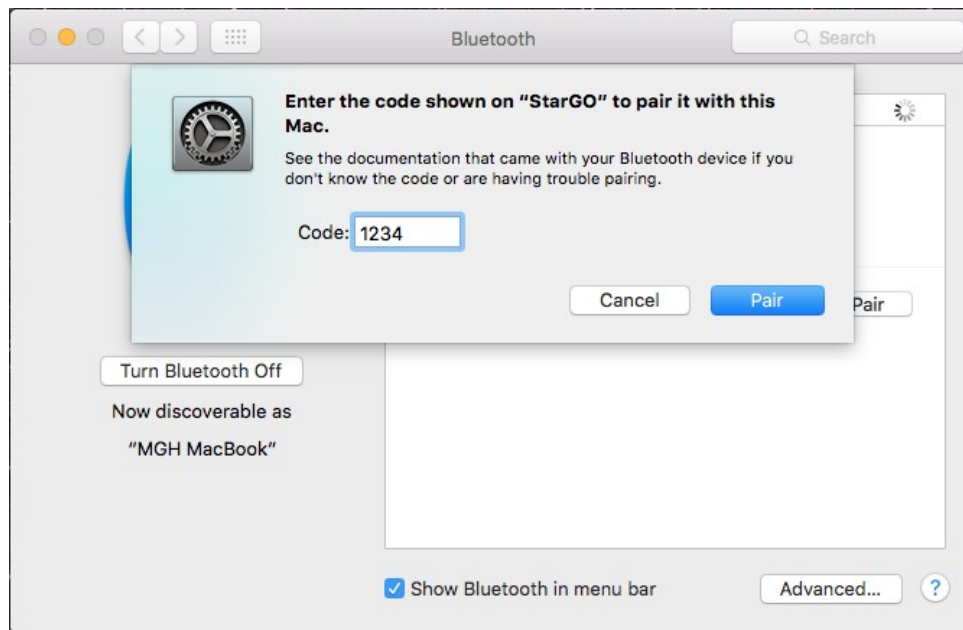


Figure 3.8.2c Insert pincode

Enter the StarGO code, which is normally 1234. If it is different, the correct code will be provided with StarGO documentation. After few seconds the pairing will be established as shown in this screenshot:

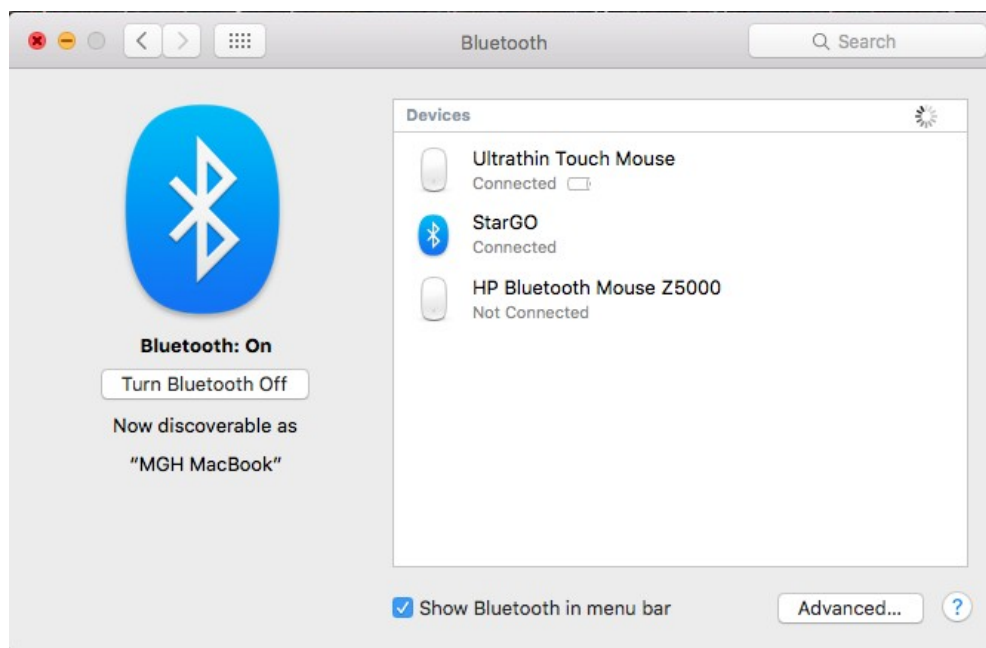


Figure 3.8.2.d: StarGo connected

The Mac is now connected to the StarGO.

3.8.3 Connect the StarGO to a Windows PC via WiFi

The use of a WiFi link for the data transmission between the PC and StarGO requires the PC to be connected to the WiFi network that is created by the WiFi version of the StarGO hardware. On a PC with the newest Windows 10 operating system, which is fully compatible with StarGO, follow these steps:

- Power on the StarGO
- Click the WiFi icon among the windows toolbar icons

Among the available WiFi network names choose “StarGO-WiFi.” If it is the first time the connection is attempted, the password must be entered. Type “avalon1234” or whatever password Avalon Instruments has provided with the software. Wait few seconds until the connection is established. The StarGO SW is now wirelessly connected to the PC and the mount is ready to be operated.

3.8.4 Connect the StarGO to a Macintosh via WiFi

The use of a WiFi link for the data transmission between the Mac and the StarGO requires that Mac is connected to the WiFi network that is created by the WiFi version of the StarGO hardware. On the Mac, follow these steps:

- Power on the StarGO
- Click the WiFi icon among the top toolbar icons.

In the dropdown windows that appears choose StarGO-WIFI:

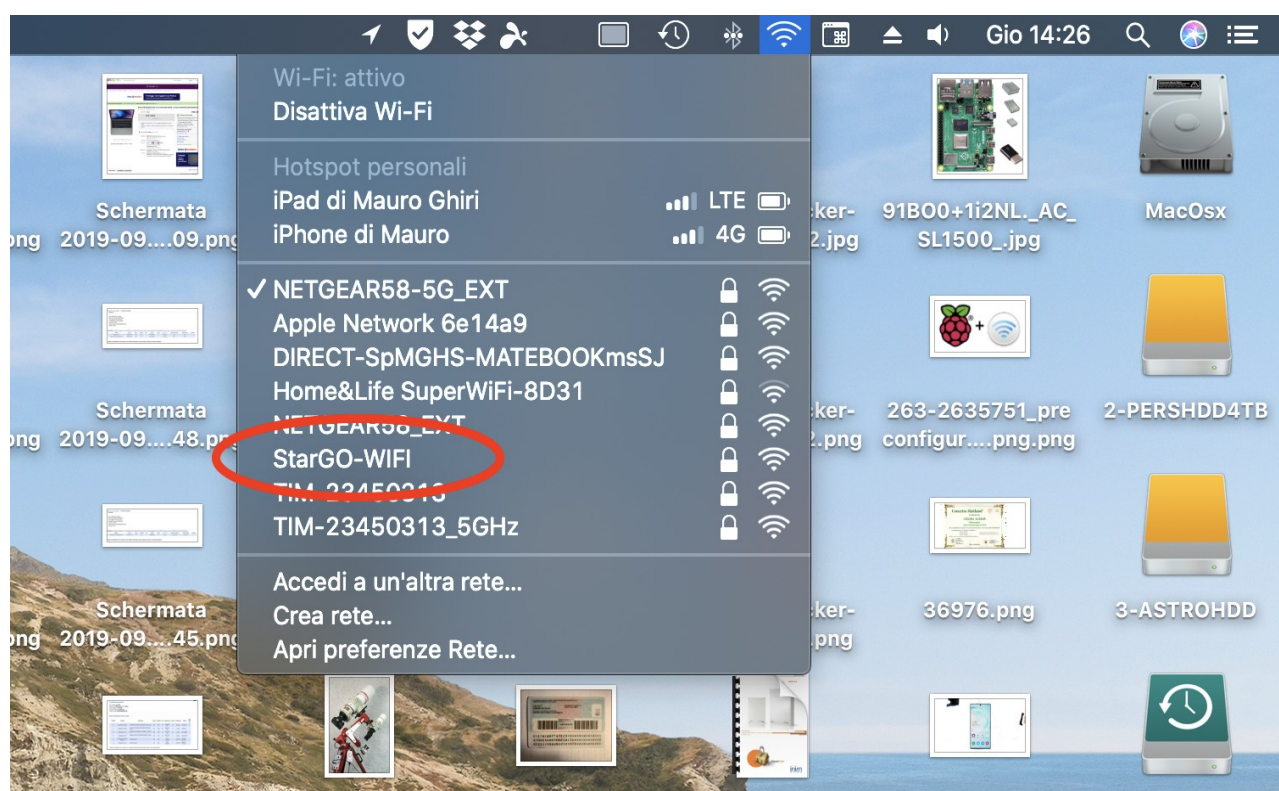


Figure 3.8.4.a: StarGo WIFI net

If it is the first time the connection is attempted, the password must be entered. Type “avalon1234” or whatever password Avalon Instruments has provided with the software. Wait few seconds until the connection is established. The StarGO SW is now wirelessly connected to the Mac and the mount is ready to be operated through compatible software such as The SkyX and SkySafari.

4. StarGO and SkySafari

The StarGO Control System may be easily operated by the SkySafari application running on Macintosh computers and Android and iOS based tablets and smartphones.

As described earlier, Apple mobile devices (iPad and iPhone) can be connected only via WiFi, whereas Android devices can be connected with both Bluetooth and WiFi.

This application cannot be used with a Windows PC because SkySafari is not yet available for this operating system.

The Mac connections to the StarGO via Bluetooth and WiFi have been described in the previous sections 3.8.2 and 3.8.4 respectively.

The Android connection via Bluetooth is described in the following sections 4.1.1 and 4.1.2 respectively. The connection of iOS devices is described in section 4.1.3.

Once the connection has been established, the operational mode is similar for all the devices described previously in this manual.

4.1 Mobile device connection via Bluetooth and Wi-Fi.

4.1.1 Bluetooth pairing the StarGO with an Android tablet or smartphone

This operation can be easily done following these simple steps (the figures may be slightly different in various Android devices):

1. Select Setting in the device main screen and, when window opens, select Bluetooth in “Wireless and network” section.

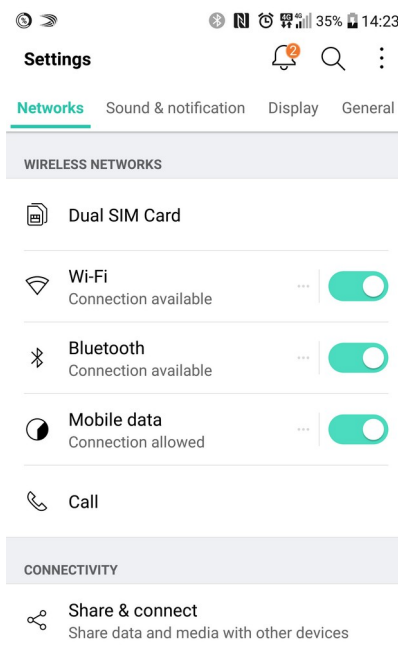


Figure 4.1.1a: Android networks selection

2. Then press "StarGo_xxx" (where xxx represents the StarGo serial number)

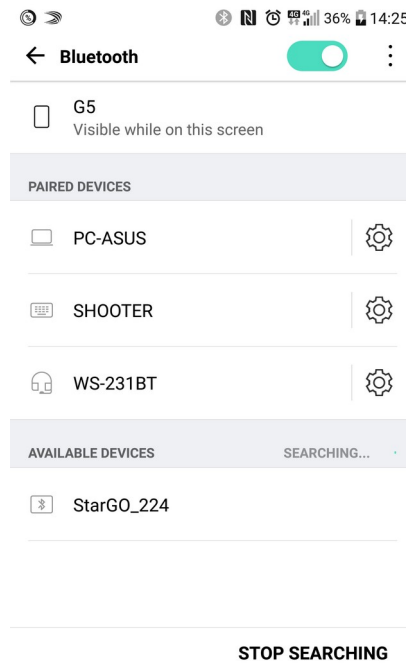


Figure 4.1.1.b: StarGO net selection

3. After a few seconds a small window will require the pairing PIN:

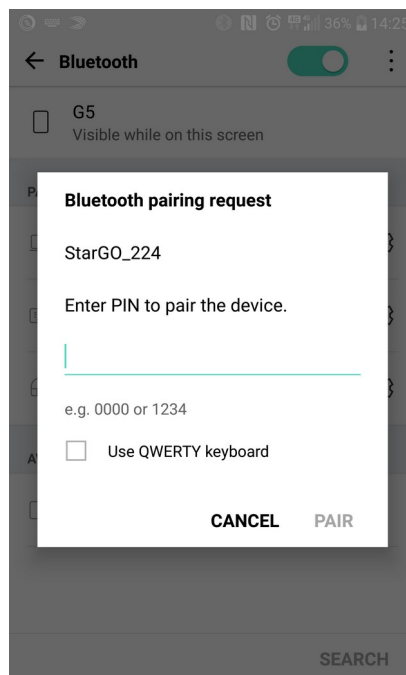


Figure 4.1.1.c: Bluetooth pairing window

4. Enter the PIN provided by Avalon (usually 1234) and press OK. After few seconds the device will be paired (see next screenshot) with the StarGO. The mount will then be ready to be controlled by the device.

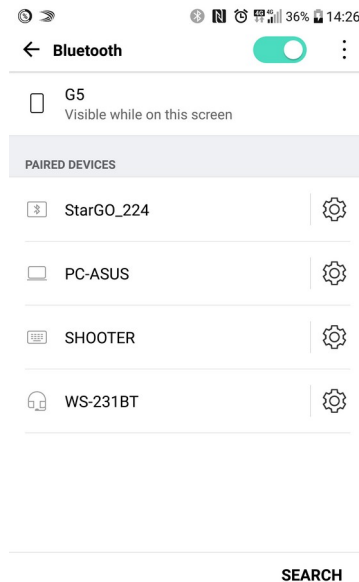


Figure 4.1.1d: StarGO connected screenshot

4.1.2 Wi-Fi connection of StarGO with an Android tablet or smartphone

This operation can be easily done following these simple steps (the figures can be slightly different in various Android devices):

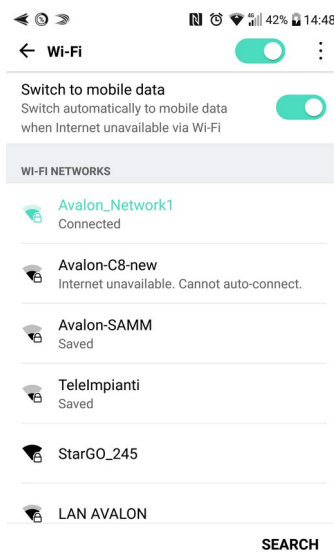


Figure 4.1.1e: Android Wi-Fi selection network

1. Select Setting in the device main screen and, when window opens, select Wi-Fi in “Wireless and network” section, then choose “StarGO_xxx” (where xxx represents the StarGo serial number) in the “Wi-Fi NETWORK” section.

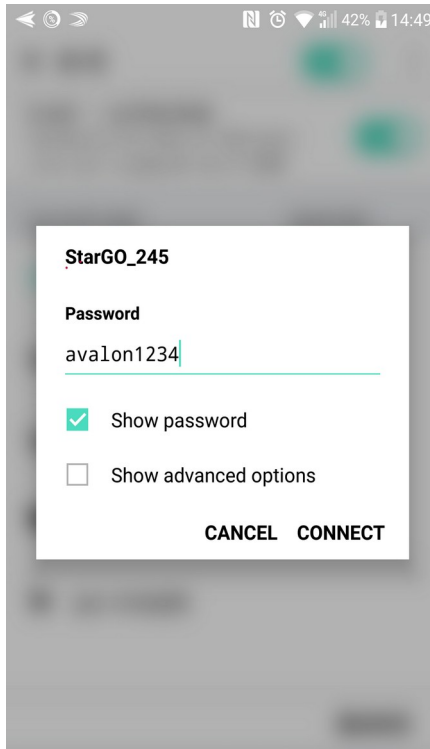


Figure 4.1.1f: StarGO network password entering windows

2. At the first connection, a password is required. Type “avalon1234” or whatever password Avalon Instruments has provided with the software.
3. After few seconds the connection is established as shown in the picutre below.

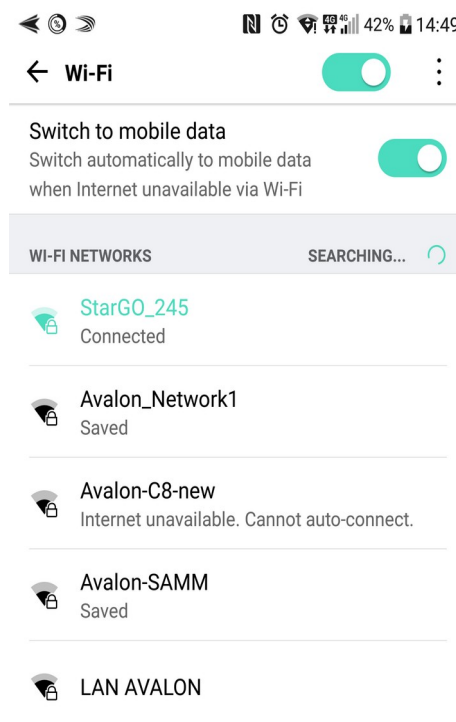


Figure 4.1.1g: Android succesfully StarGO connected screenshot

4.2 Sky Safari setup

Before using SkySafari with Avalon mounts it is necessary to set some important parameters in the program setup page. SkySafari is provided with numerous parameters to be set, mostly dedicated to the program display characteristics. This section of the manual will deal only with those parameters which are necessary for the Avalon mount control. Read the SkySafari manual to set all other parameters

(<http://www.southernstars.com/support/manual/index.htm>).

NOTE: Before controlling the mount with a device (tablet/smartphone/iPhone/iPad), the mount must be set up via a pc at least one time to establish the preliminary settings. The preliminary settings are: choice of the correct mount configuration file, setting of the observatory location, choice of the pointing system (One star, Three star, Multistar). These choice are made only one time and need to be repeated only if the mount has been moved to a new location or if changes have been made to the operating mode or any of the other parameters. The instructions below show how to establish the necessary preliminary settings.

4.3 Preliminary settings via PC for a visual session without PC

1. Connect the mount to the PC with USB cable
2. Connect the power supply to the StarGo control box.
3. Choose the correct mount configuration file



Figure 4.3.a: Load the Mount Configuration File

4. Check the correct axis mode is settings



Figure 4.3.b: Set the correct mount Axis Mod

5. Set the correct Observatory Location

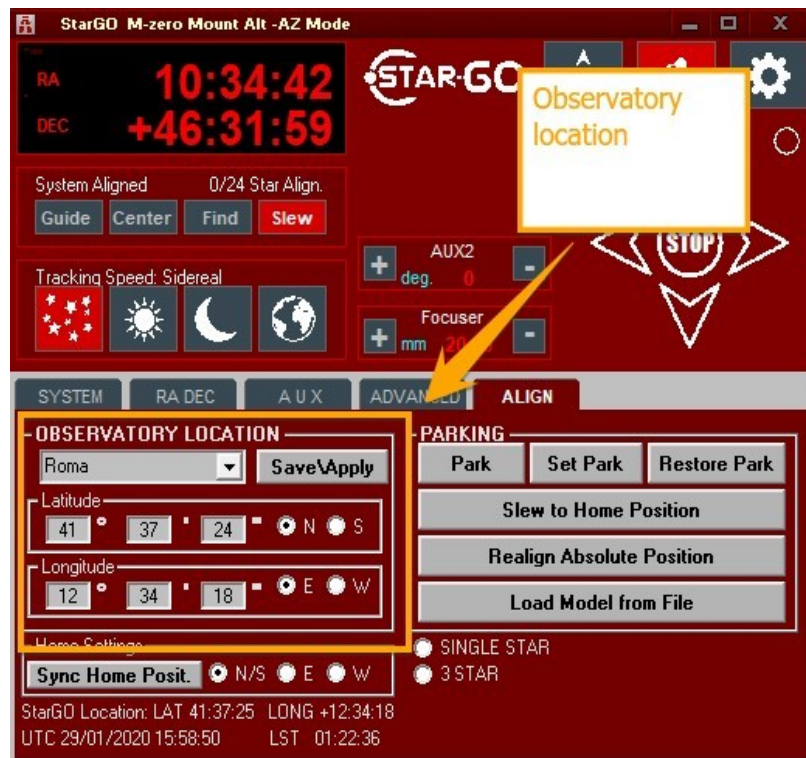


Figure 4.3.c: Set the correct Observatory Location

- On the Align panel choose the preferred pointing system (SINGLE STAR, 3 STAR, MULTISTAR)



Figure 4.3.d: Choose the preferred pointing system

- Close the StarGO software, remove the power supply connector from the StarGO control unit. Lastly, disconnect the USB cable from the StarGO control unit.

Now the mount is ready to work with a device using SkySafari without the need of a pc.

- Launch the SkySafari (version 4 or above) on the device. The program will open with the following screen:



Figure 4.3e: SkySafari opening screenshot

2. Press the Settings icon on the bottom bar. A screen will appear with a long list of all the parameters to be set. First, open the “*Time and Date Setting*” arriving at the screen shown below. If the device date and time shown on the screen are correct, check the “*Use current Time*” box. Otherwise set the current date and time as required. When done click over the X in the upper right corner to save and exit the current page.



Figure 4.3f: SkySafari time and date settings

3. Open the “*Location Settings*” page. Insert the site name and the geographic coordinates, insert also the approximate elevation and the Standard Time Zone. **It is very important that the date, time and location settings are exactly the same as those saved in the StarGO settings to avoid any conflict.** When finished, press “*Save User-defined Location*” for future use.

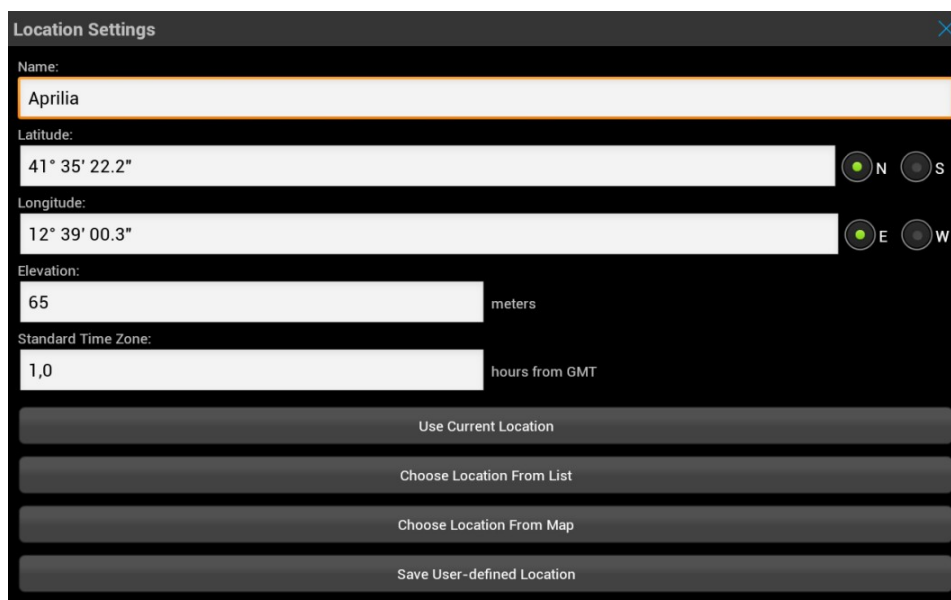


Figure 4.3g: SkySafari location settings

4. The last but very important set of parameters is the “*Scope Setup Settings*”. The instructions in this page show how to insert the telescope and mount type (Meade LX-200 Classic and Equatorial GOTO or Alt-Az as needed, respectively).

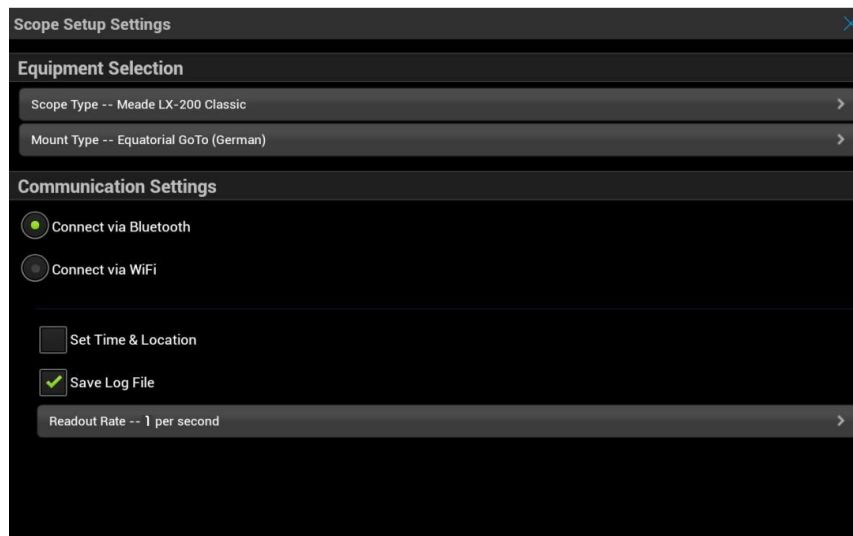


Figure 4.3h: SkySafari communication settings panel

In case of a Macintosh and iOS device connection via Wi-Fi, an IP Address of 10.0.0.1 and a Port Number 4030 should be entered as shown in the following screenshot:

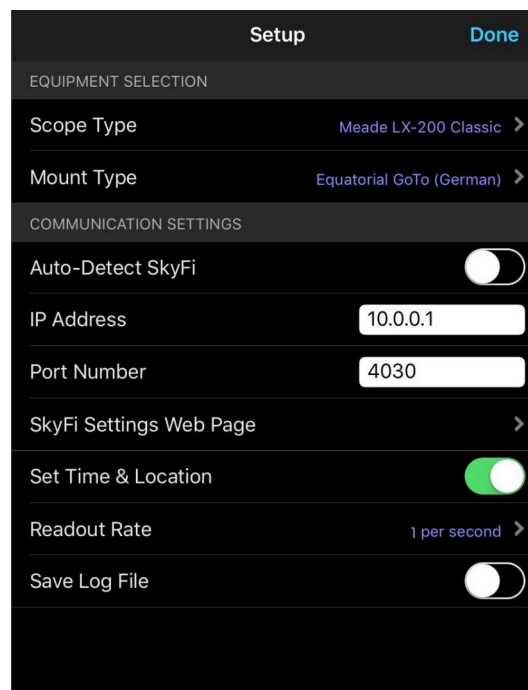


Figure 4.3i: SkySafari communication settings panel

NOTE: “Set Time and Location” option inside the Scope Setup settings.

When the Site & Location checkbox is activated, Skysafari send, during the connection with the StarGo, the data about the time and the location in order to update the internal StarGo location. This option requires exactly 60 seconds, so it is important to do this procedure only in case the mount has been moved to a new location. But soon after the connection has been done, is suggested to uncheck it and leave it always unchecked because the StarGO keep in memory the Location also after the shutdown.

NOTE "Readout Rate" option setting: this option set how many time per second SkySafari will send information to the StarGo. Due to possible overcharge of connection between StarGo and SkySafari, it is suggested to set this option at the as lower as possible value on depending on the SkySafari app version.

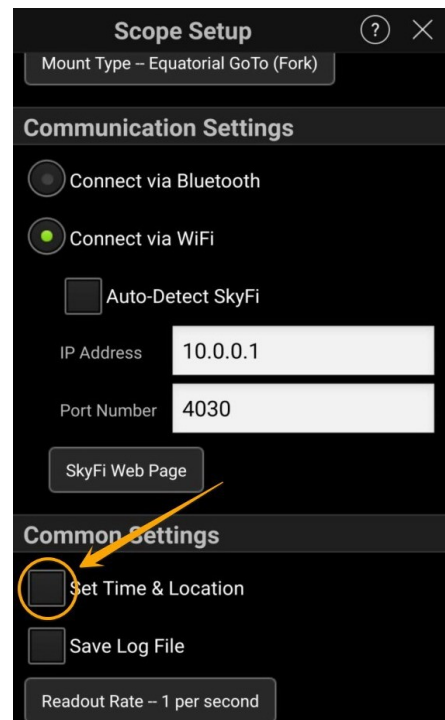


Figure 4.3.h: Set Time & Location option

4.4 SkySafari Connection and alignment

1. Once all the operations described in the previous sections have been completed, it is possible to start moving the telescope using SkySafari.
 - a. **Eq mode:** The first action to perform for the mount in Equatorial Mode is to manually put the telescope in the "Home" position, i.e. with the counterweights pointing down (CWD) and the telescope pointing toward the North Celestial Pole (see next figure to the left).
 - b. **Alt-Az mode:** operation the telescope only needs to be pointing toward the North Celestial Pole, but the mount should be accurately levelled (see figure on the right below). Connect the power supply to the StarGO control unit then connect the mount to the device by pressing the "Connect" button at the bottom of the planetarium application screen as shown in [Figure 4.4c](#).

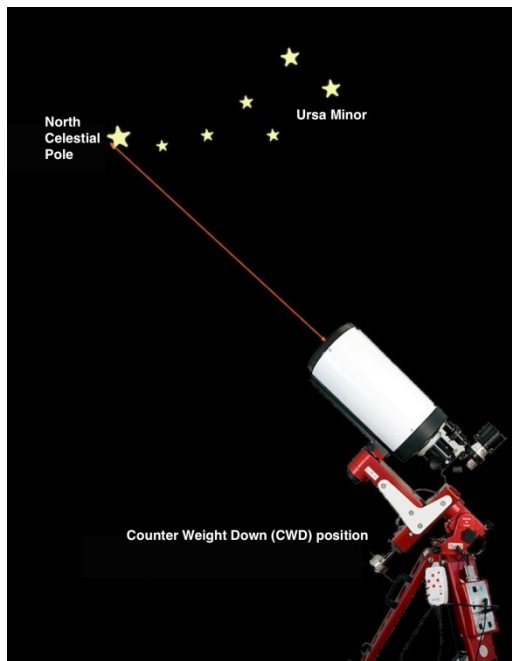


Figure 4.4a. Eq mode Polar Alignment

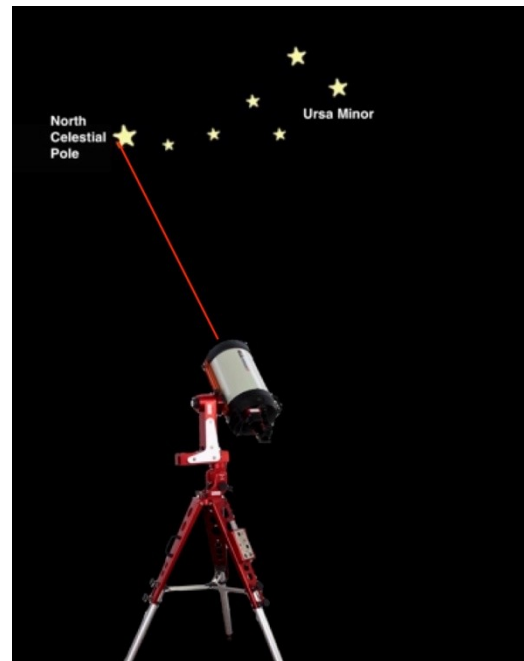


Figure 4.4b. Alt-Az mode Polar Alignment

2. After few seconds the “Connect” button will change to read “Disconnect”. A chime will sound and the telescope FOV pointer position (CCD or eyepiece) on the SkySafari screen will appear exactly at coordinates RA=0, DEC=0 if the mount is in Equatorial mode or with the coordinates of the North Pole if the mount is in Alt-Az mode. The commands to the right of “Disconnect”, i.e. “GoTo”, “Align” and “Lock” will become active [Figure 4.4c](#).
3. To correctly start the navigation operation in Equatorial Mode, it is necessary to transmit the coordinates related to the “Home” position to the mount because when the mount is powered on, StarGo is unaware of these coordinates. After the connection is made with SkySafari, an initial sync must be performed using the “Align” function of Sky Safari. Position the cursor on a star on the meridian and close to the southern horizon. Without moving the mount from its Home position, perform a sync to that star. This is equivalent to performing the “Sync Home Position” using the StarGO software as described in section 3.2.5 and will transmit the point where the mount is really pointing at that moment (i.e. the Celestial Pole) to the StarGO.

NOTE: When the “Multi Star” is checked in the StarGO (see section 3.2.5, [Figure. 2.2a](#)) and therefore the multi-star modeling is enabled, the first and each successive sync, up to 24, contributes to build the model. To maintain the StarGO in Multi-Star Model enabled status it is necessary to check it during the last computerized section, switching off the mount in this status.

The following sequence of three SkySafari screenshots, taken with the mount in equatorial mode, is useful to understand the event sequence and its results: They were taken a) just after the connection has occurred ([Figure 4.4c](#)), b) at the moment of syncing to a near South Meridian star ([Figure 4.4d](#)) and c) after the “Align” function is carried out (North Celestial Pole area, [Figure 4.4e](#)).

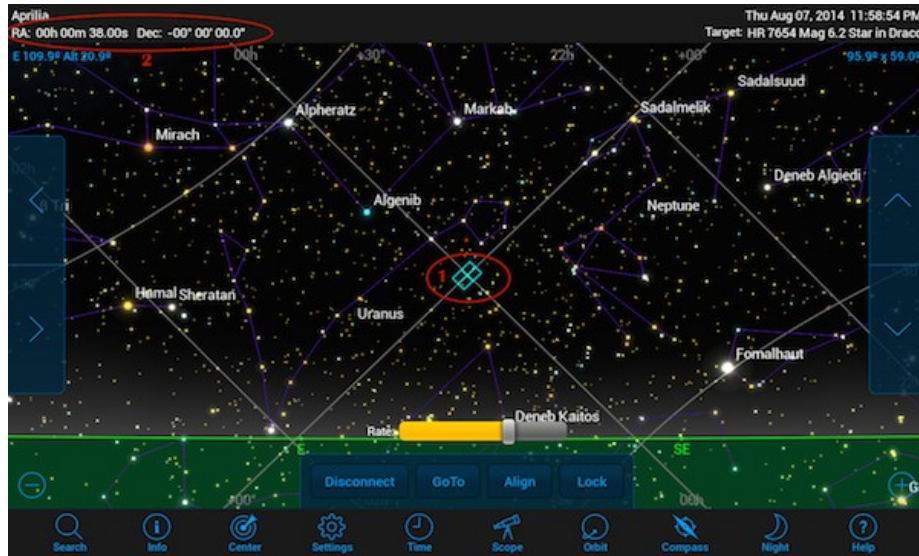


Figure 4.4c. SkySafari connected

The above illustration depicts, as described above, the SkySafari screen just after the connection. The telescope points exactly on the celestial coordinates origins, i.e. RA=0 e DEC=0, (seen ovals 1 and 2). The RA indication in oval 2 differs slightly from the point 00, 00 due to the time elapsed between the moment of the connection and that of the screenshot (38 seconds in our example) because the telescope is not yet tracking.

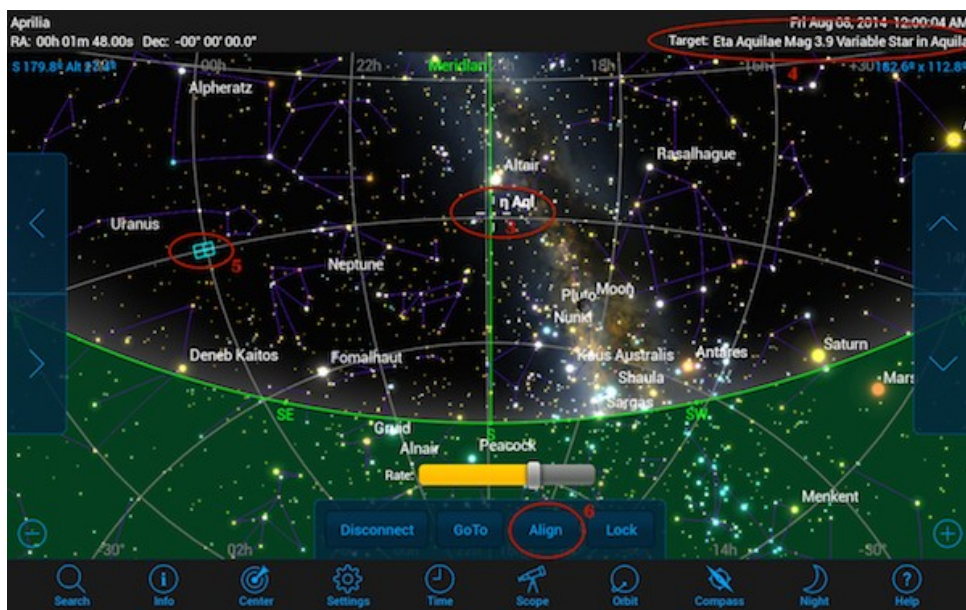


Figure 4.4d. Sync on southern horizon

The second phase in this sequence is the choice of any star very near to the Meridian and to the Southern horizon. In this case the star is η Aql (see ovals 3 and 4 of figure 4.4d). Note that the telescope is still in the initial position (oval 5). Again it is possible to see a small difference in RA from the point 0,0 due to the

time lapse. At this point is possible to tap the “Align” command on the “Telescope Bar”.

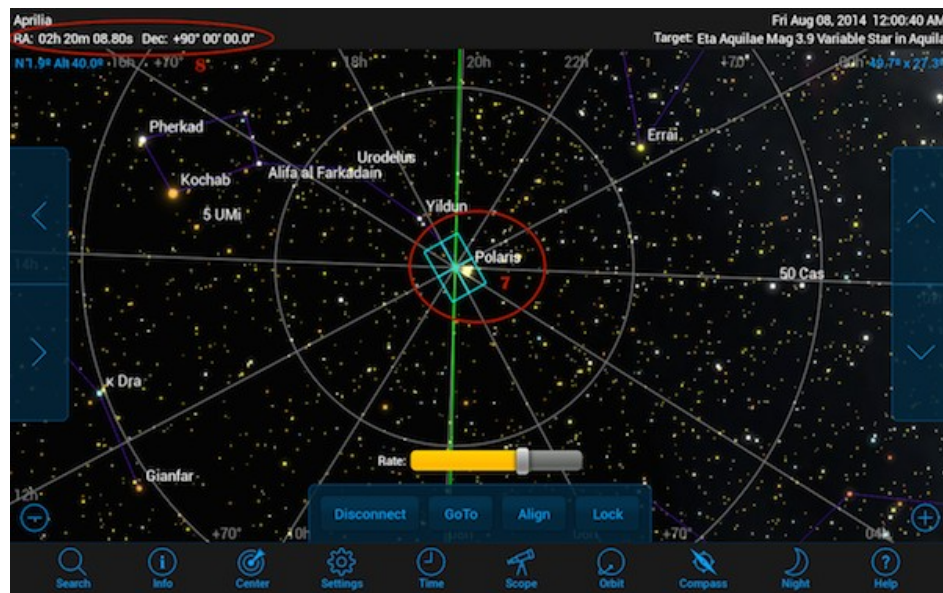


Figure 4.4e: System aligned

This will cause the movement of the telescope pointer to the North Celestial Pole (see oval 7) at the correct RA and DEC “Home” position (see oval 8) where the mount is indeed pointing. This information is sent to the StarGO. This is also the initial position of the telescope in case of Alt-Az mode. From this moment the movement of the telescope is synchronous with that of SkySafari.

4. Now the telescope can be operated using the available commands and the direction control on the side of SkySafari screen below. On the left the RA direction controls and on the right the DEC controls. The telescope movement rate can be adjusted using the yellow “Rate” slide bar above the telescope controls.

5 - Mount Control with StarGO-BT for Android

Avalon Instruments has developed an application, called StarGO-BT, capable of controlling Avalon mounts by means of Android based smartphones and tablets with Bluetooth connection capability.

The purpose of this application is to provide a commonly available alternative to the keypad for controlling the mount with the advantages of a wireless connection and a more user friendly interface. Moreover the application enables setting of a number of mount parameters that are not settable with the keypad or are settable in a more simplified manner than with the keypad. These settings are unidirectional, same as with the keypad.

This application is part of the software package provided with the StarGO control system. At the present time, this application cannot be downloaded from the usual Google Play Store, but it must be directly installed in the device by the user. The following sections describe the instructions for the app installation and use.

The starting point for the installation is the establishment of communication between the Android device and StarGO hardware. This operation has been already described in section 4.1.

5.1 Application Installation

The app is contained in a single file named StarGo-BT.x.y.z.apk, where x.y.z represent the software version. This program, like all other Avalon Instruments, software, drivers and related manuals, are continuously improved and increased in functionality. Thus, the version numbers will vary quite often.

To install the application it is necessary to upload the file mentioned above in the device. This can be done in several ways, depending on the type and brand of the device. For example, the Samsung device can use the [Kies application](#) to copy the file in whatever position of the main memory or external memory (if available).

Once the files is installed in the device, it is possible to access it using the file browser application (for example “Archive” of the Samsung devices) and to launch it.

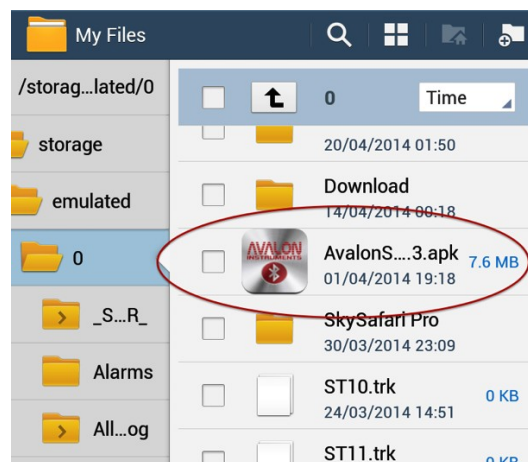


Figure 5.1.a: Select app installation file

When the file is selected, the app installation process will start. It is very probable that, at the start of this process, the installer will inform you that it is not possible to continue because the installation of applications not coming from the Play Store is not allowed. To continue it will be necessary to open the Setup Window of the device and (at least temporarily) enable the installation of applications from unknown sources under the option “Unknown Sources” within the “Security” menu.

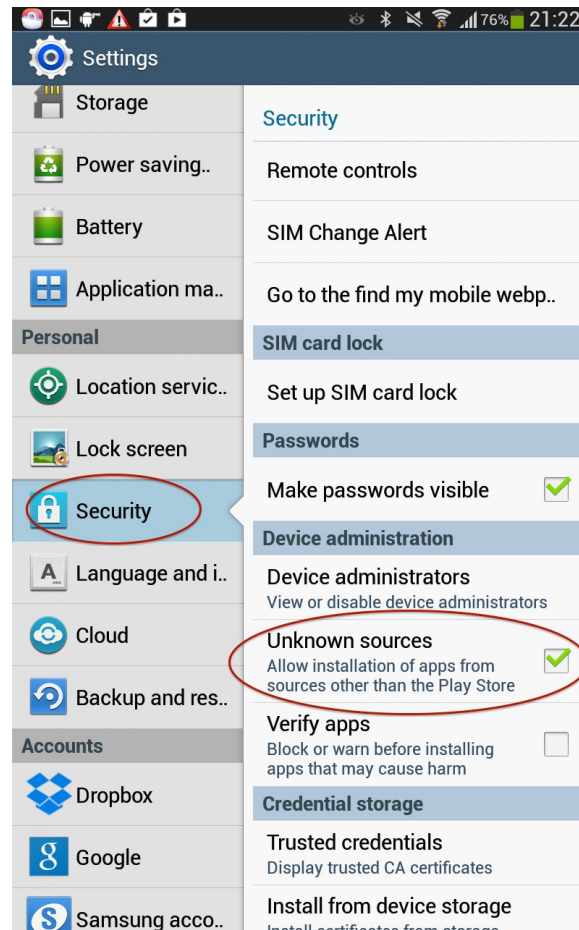



Figure 5.1.b: Enable unknown resources function

5.2 Application Use

As with all Android apps, StarGO-BT is launched by touching the icon  created during the installation process. The initial screen will show the list of all external devices, capable of Bluetooth connectivity, associated with the Android device. To establish a logical connection between the app and the StarGO hardware, select the correct option from the list, which will be StarGO. This action will highlight the “Connect” button through which the connection is established.

Once the connection is established, the app will show the main screen through which all the control operations on the StarGO can be performed. The screen slides vertically to allow the access to the various setup functions

The application screen looks familiar because it is dominated by the same directional keys and the central STOP key that have equivalent functions of the StarGO software keys.

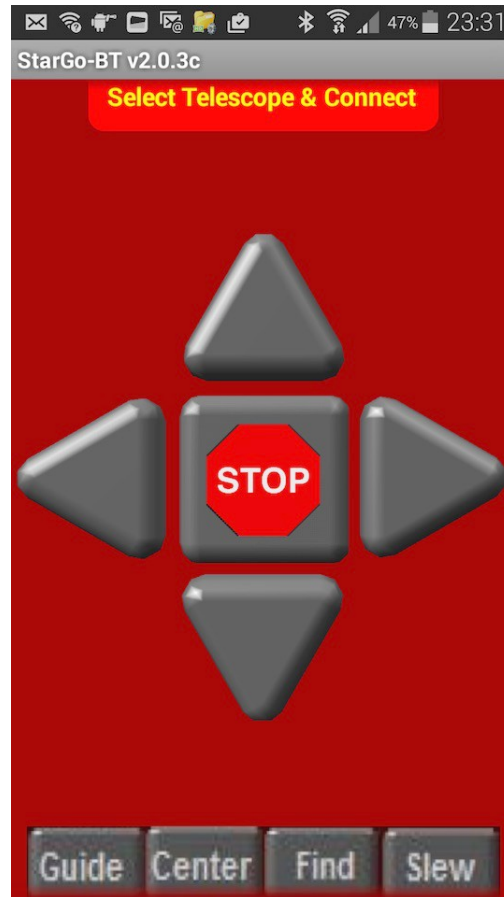


Figure 5.2.a: StarGO BT interface

The speed of mount movement will be set with the four speed setting keys corresponding to those of the StarGO PC software (Guide, Center, Find and Slew).

5.3 Application setup

Next, the screen will be replaced with a group of command setting labels for controlling the mount in Bluetooth:

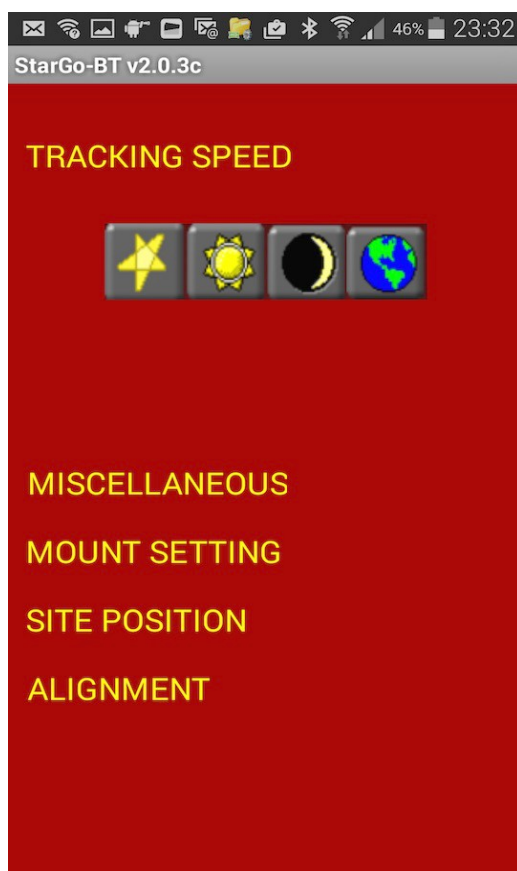


Figure 5.3.a: StarGO BT Tracking speed

The first of the available commands is the “TRACKING SPEED” label ([Figure 5.3.a](#)). Touching the label opens a string of buttons used to select the desired tracking speed: Sidereal, Solar, Moon and Earth. The latter is used for taking terrestrial time lapse pictures.

The MISCELLANEOUS (Figures 5.3b, 5.3c, 5.3d) label controls the auxiliary functions (i.e. focuser or others) which will appear. There will be a pair of opposing arrows to move connected devices in opposite directions. The central button will control Aux 1 and Aux 2 devices or the Polarscope LED intensity.

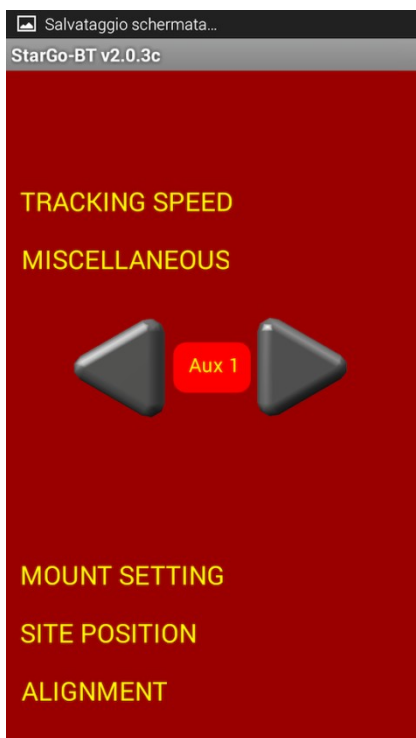


Figure 5.3.b: StarGO BT Aux1

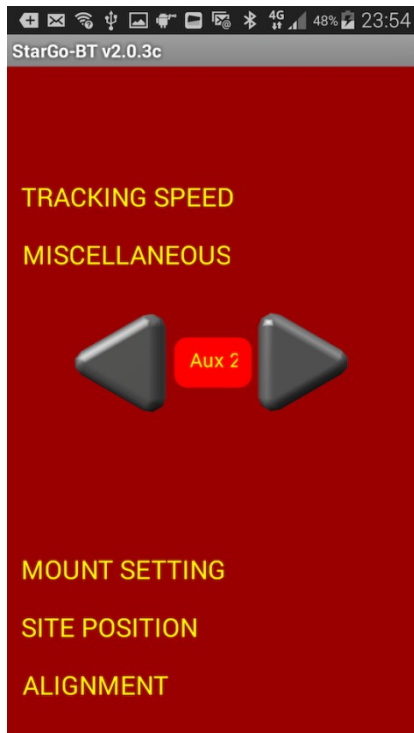


Figure 5.3.c: StarGO BT Aux 2

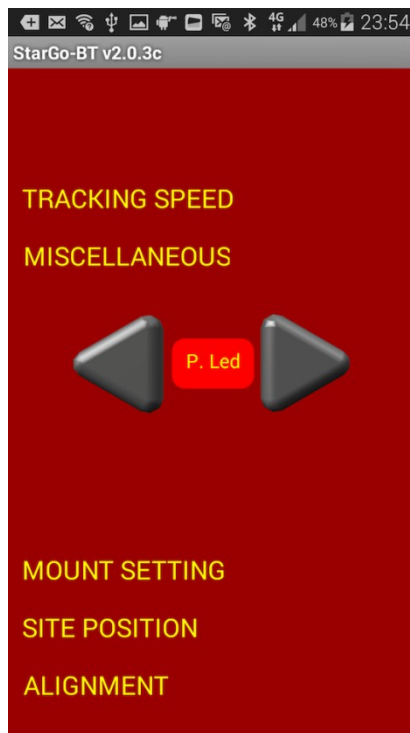


Figure 5.3.d: StarGO BT app

By touching the “MOUNT SETTING” (Fig. 5.3e) label brings up a set of commands to reverse the motion direction of the RA and/or the DEC motors, to chose among the M-zero,

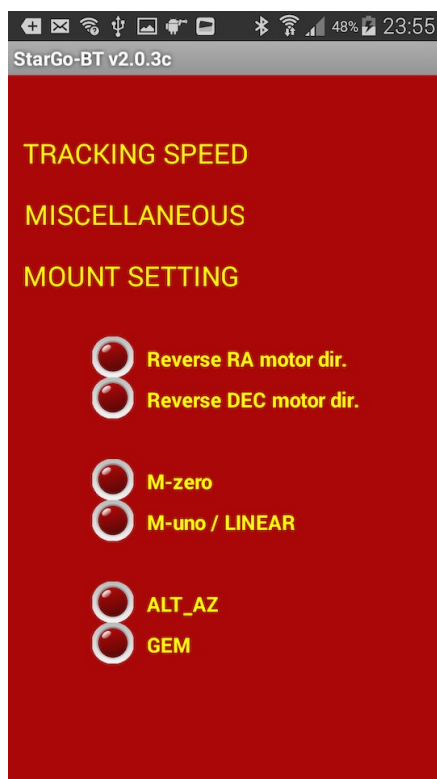


Figure 5.3e: StarGO BT mount setting

M-uno and Linear mounts, and to select the operational mode between Alt-Azimuth and Equatorial (GEM).

The middle label, "SITE POSITION," (Fig. 5.3f) will bring up a set of commands to introduce the observation site coordinates and to show their values. The commands are self explanatory. Other commands allow the site position information to be obtained from the tablet or smartphone internal GPS, if any and to send the acquired coordinates to the StarGO if active.



Figure 5.3f: StarGO BT site position

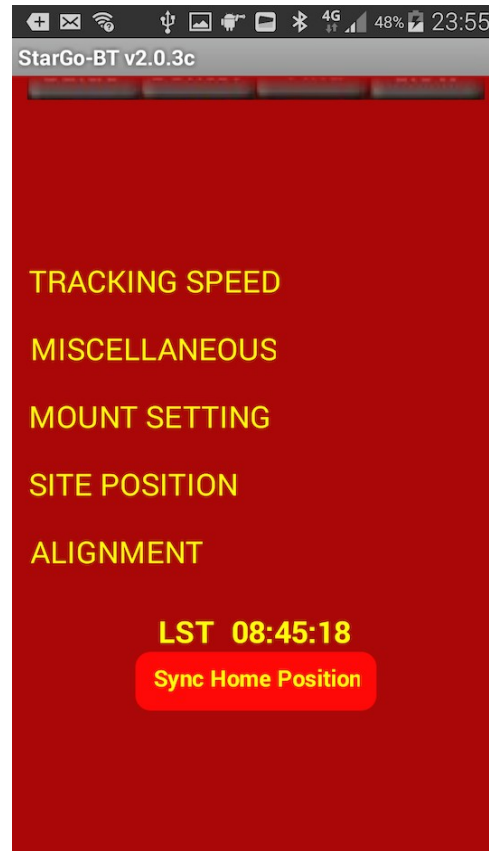


Figure 5.3g: StarGO BT alignment

Note: When using the Sky Safari application, it is necessary that both applications (StarGO-BT and Sky Safari) have identical geographic coordinates or unpredictable mount behaviours could ensue. If the Android device's internal GPS is used to obtain Latitude and Longitude, the correct configuration is automatically attained. If custom values for coordinates are used in either StarGO-BT and Sky Safari, exactly the same values must be manually inserted in both applications.

The last label, "ALIGNMENT," (Fig. 5.3g) enables the actual Local Standard Time (LST) value to be read and the syncing to Home Position to be reached. The "Sync Home Position" button allows the mount to synchronize with the home position, as done with the PC StarGO software (see section 3.1.1).

APPENDIX

X-SOLVER TOOL

Plate Solve and Sky Modelling

A1.0 Introduction

After StarGO Version 5.1.42, the Software Suite includes the X-Solver, which is an application based on the Plate Solve solution. With X-Solver it is possible to build a Sky Model allowing up to 24 stars to be saved and used later during other night sessions.

The X-Solver application comes with two very useful tools: the Sky Model and Polar alignment. The **Sky Model** allows a user to build a sky model of up to 24 stars. The tool provides an intuitive GUI that shows a 2D representation of the sky. With this application the user can design a customized model by selecting the positions of points in the sky by double-clicking the mouse. Alternatively, a user can select the predesigned model available on the right side of the Sky model panel (i.e. the 8+8 model).

The modeling function is particularly useful in fixed observatory installations, however for the speed of its execution, it may be used also for mobile setup for visual observation or astrophotography.

The **Polar Align** tool enables a quick and easy Polar Alignment by using the Plate Solve function.

Required Equipment

X-Solver require:

- PC with Windows 7 or higher
- CCD imaging Camera

NOTE: The StarGo must be turned on and connected, an accurate Polar Alignment it must be performed and the mount must be positioned and synced in Home Position, before the X-Solver application is started.

The X-Solver does not work with Windows XP, due to the internal Framework functions that are no longer supported by Microsoft for the Windows XP version. Concerning others Microsoft Windows O.S. (such as: Vista, Windows 7, Windows 8.0, Windows 8.1 and Windows 10) X-Solver need at least [Microsoft .NET Framework 4.5.](#)

A2.0 X-Solver Operation

A2.1 X-Solver connection

The Figure A2.1a shows the first window that appear after double clicking on the X-Solver icon located on the desktop.



Figure A2.1a: GUI before connecting to X-Solver

Once the X-solver window is opened, the top header will inform the user about the program version and which Plate Solver solution method will be used.

The first four menu items are related to image acquisition process, the fifth calls for the Polar Alignment function and the last activates the Sky Model tool. Below the picture there are two progress bars that will show the solving process (time to solve, average time to solve and total solving time).

Clicking on the lens icon will zoom the images in the center of the X-Solver window. The yellow crosshair icon will switch on and off the crosshair on the image.

Press the CONNECT button and the ASCOM connection window will popup:

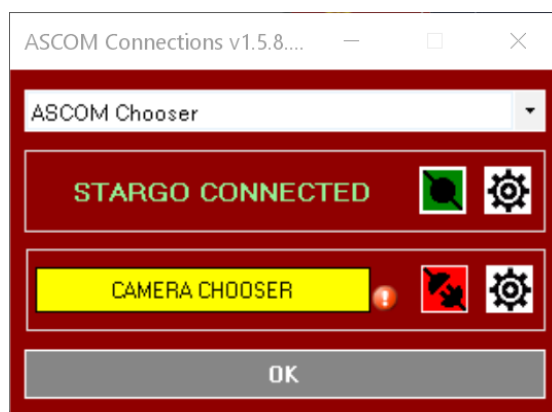


Figure A.2.1b: Equipment connection panel

Note that the StarGO is automatically connected if it, as recommended, has been corrected switched on and connected before the X-Solver launch.

The first operation to be performed is to choose the CCD by clicking over the “CAMERA CHOOSER” button.

The X-Solver can be connected with any CCD Camera that works under ASCOM. It is strongly suggested to connect X-Solver with the imaging camera (and not with the autoguide CCD) because its primary function is to build a sky model for imaging.

In case your CCD/Camera has no ASCOM Driver it is also possible to take images outside ASCOM and then use them for plate solving selecting “LOAD Image file acquisition” in the ASCOM Chooser dropdown menu.

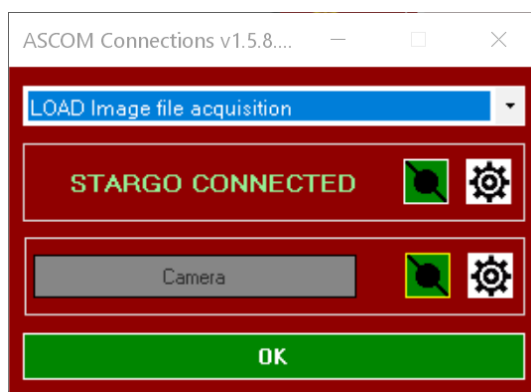


Figure A.2.1c: LOAD Image file acquisition

If we want to use the X-Solver to plate solving an existing image, it is necessary to select the “Load Image File acquisition” from the dropdown menu on the top, enabling the manual image loading. For a normal online use, the clicking on the CAMERA CHOOSER button, leaving the check box unselected, will invoke the ASCOM camera chooser. This is a standard chooser that through the dropdown menu allows the selection of our camera among those listed. In the example windows below we choose the ASI camera.

By clicking on the camera chooser button the standard ASCOM Camera chooser panel will appear. Select the camera, set the correct parameters (by clicking on the properties button) and press ok for the camera connection.

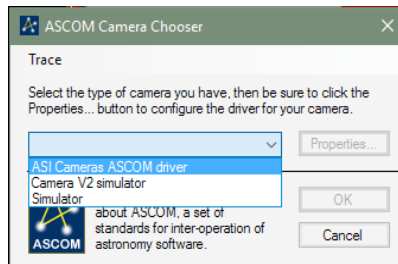
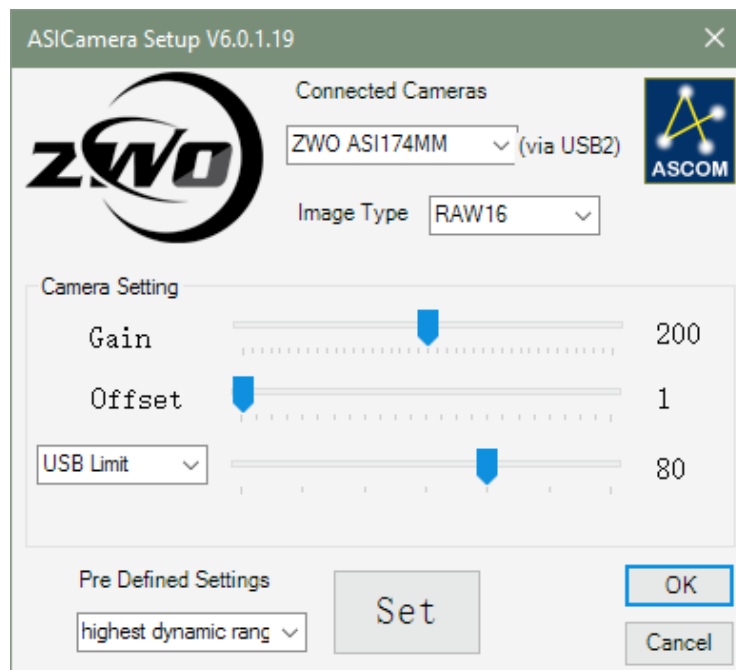


Figure A.2.1d: ASCOM Camera Chooser

After the connection a new frame will appear on the right side of the main X-Solver windows with two tabs: Plate Solve and Settings.

If this is the first time that camera is selected a warning will inform the user that before to go on it is necessary to set some camera parameter by pressing the Properties button. If this is the case a setting panel, similar to the following, will appear.



It is clear that it is only an example linked to the chosen camera. Other cameras will use different setup panel.

Once introduced the needed parameters (very often the default ones are ok) press Ok and Ok again in the Chooser panel.

It is evident in Fig. A2 that the StarGO is pre-selected and no other choices are possible.

The gear buttons will allow in every moment to invoke the setup panel if different setting are need to optimize the shooting and solving operations.

At this point it is possible to connect the devices, camera and mount, simply by pressing the plug buttons. After the connection is established the button will change the color from red to green. At this point it is possible to close the chooser window.

A2.2 – Settings panel

First select the desired plate solving method from the available choices:

- **Astrometry.Net Blind Solver** requires the access to the Internet because the Plate will be solved by the Astronomy.net engine solver
- **Local Plate Solver** uses a local data base. To perform a Fast LOCAL Solving is needed to check the related check box.

If the Local Plate Solve method is chosen, it will be necessary to enter the telescope focal length and the radius of the search range, expressed in degrees (it is recommended to set it from 20 to 30 degrees).

Next, click on the “Go to the instruction Page” to access the instructions for guided Plate Solve Engine installation and use.

Older model QHYMZ cameras require the “Old QHY/MZ Cameras” box to be checked.

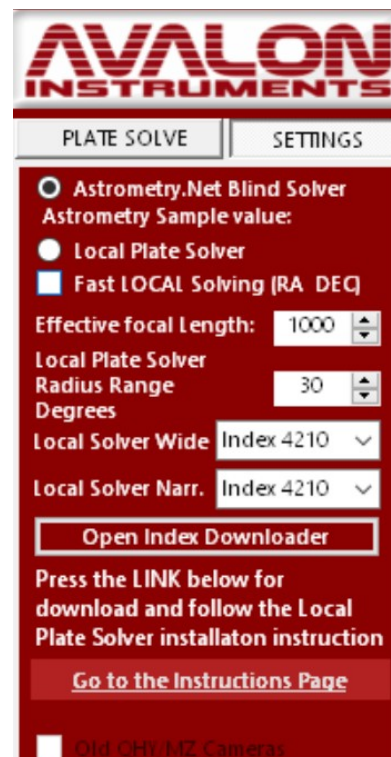


Figure A.2.2: X-Solver settings panel

A2.3 Plate Solve panel

This Panel enables the acquisition and solving functions by selecting the following parameters. The left frame of Fig. A2.3 is related to the plate solving of an existing image whereas the right one is related to an online acquisition of the image.

Exposure: Set a test starting time from 5 sec to 10 sec.

Bin: CCD binning. It is strongly suggested to set this at bin 2.

Stretch Adj.: This slider allows the image stretching

SOLVE (left frame): Clicking on this button will perform a Plate Solve on the current image.

ACQUIRE & SOLVE (right frame): Clicking on it will start the image acquisition and start plate solving after downloading.

SOLVED RA and DEC: The actual coordinates of the solved image.

SOLVE After GOTO (right frame): Acquires an image and solve it just after a GOTO completion.

SYNC After SOLVE (right frame): Performs an automatic sync just after plate solving.

RECENTER After SYNC (right Frame): Moves the telescope to the center coordinates of the just solved image.

TARGET RA and DEC: The required coordinates to which the Goto was performed.

LOAD IMAGE (left frame): Open an already taken image.

Sync mount with solved image (left frame): Force the mount syncing with the Solved Coordinated when the check box is checked.



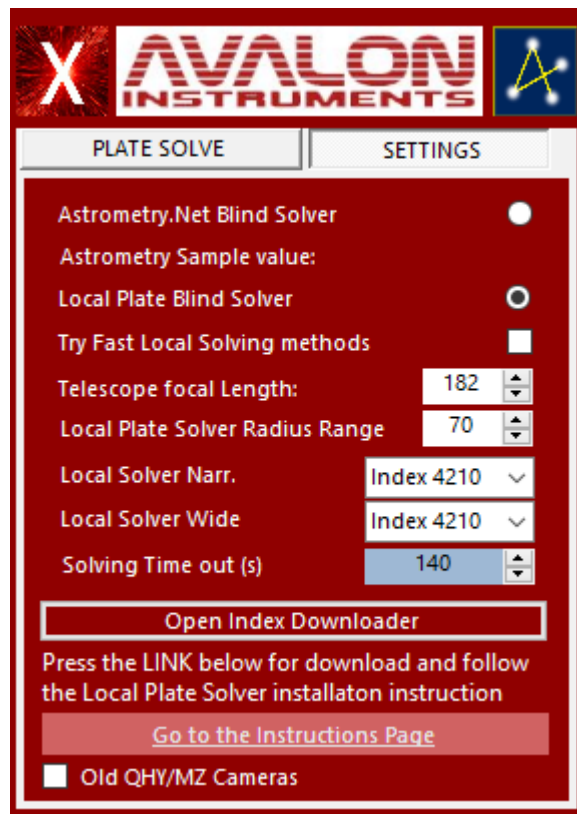
Figure A2.3: Plate Solve panel for existing image (left) and online acquisition (right)

A2.4 The X-solver as single star Plate Solver

The X-Solver application may be used to perform plate solving for precise telescope synchronization in case an advanced modeling with many stars is not strictly required. This is the case of a mobile telescope used for few target shooting in a single night before to move it for future use in other locations. In such a case it is important to speedup the pointing operations for the few objects to take.

SETUP:

The first operation to be performed just after the device connection is the parameters setting for the plate solving. This is done through the SETTINGS tab of the main window.



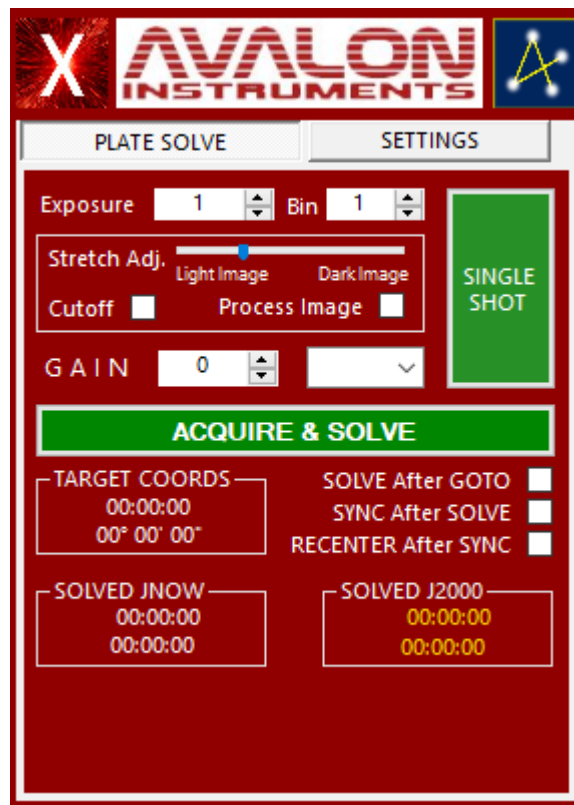
The first setting to do is the choice of the method to be executed for the plate solving. The only difference between the two methods is that the Astrometry.Net Blind Solver requires the access to the Internet whereas the local method uses a local data base. If Internet is available, it is preferable to use the first method. If not the second is the only one possible. In this case be sure that a correct database has been installed in the computer and that the data base indexes, which depends by the characteristics of the photographic setup have been also installed at home before the system is used outdoor. To install the local plate solver engine, visit the site addressed in the “Go to the instruction Page” link. In this page there is the link to the *ans-setup-x.yz.exe* installer and very detailed instructions for its installation. Follow also the instructions needed to download the proper database indexes that depend on the instrumentation FOV.

If Local Plate Solve is chosen it is also needed to introduce the telescope focal length, the CCD pixel size in micron and the Radius of the search range expressed in degrees. This last parameter is very important because from one side it guarantees the solve success (the higher the better) but from the other side it increases the number of the needed indexes and the calculation time (the lower the better). A compromise should be done based on his own experience.

The last three check box of the panel have the following explanation:

Old QHY/MZ Cameras: this choice optimizes the results using the ASCOM version 1 old cameras.

Before to start the shooting for the plate solving it is necessary to set the shooting parameters. This is done in the first panel PLATE SOLVE.



The operations to be performed in this panel are essentially:

The Exposure Time in seconds, depending on the scope aperture and the camera QE, shall be experimentally determined (usually start with 5 sec and increase or decrease on the base of the results).

CCD binning allows adjacent pixels to be combined obtaining benefits in terms of faster readout speeds and improved signal to noise ratios albeit at the expense of reduced spatial resolution. The chosen value depends on the CCD characteristics.

The slider for the Stretch Adj. is useful for better looking at very dark images.

The “Cutoff” option allow to automatically perform an image flattener, erasing the unnecessary shade and noise, allowing to keep the star and the background sky only.

The “Process image” allow to enable/disable the above mentioned option.

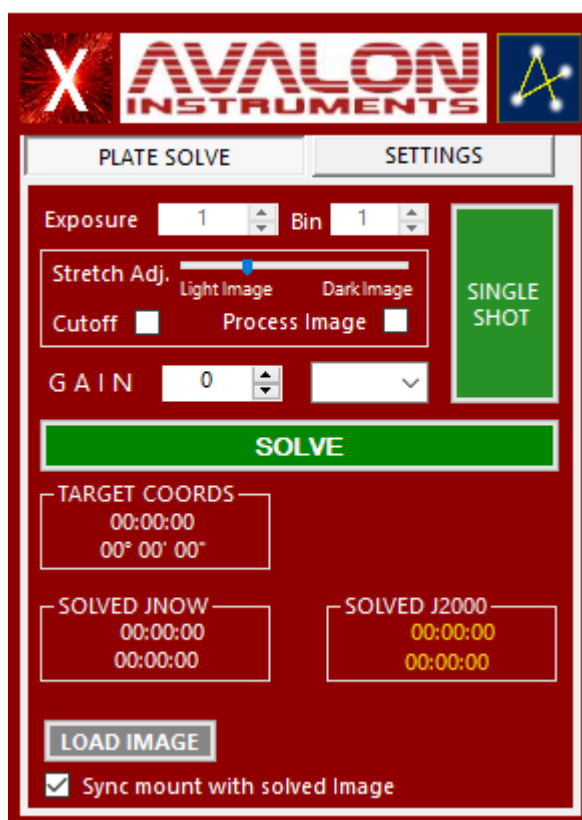
The three check boxes under the target coordinates allow performing some fine-tuning operations:

The first, “SOLVE After GOTO”, enables the start of the solving process (image shooting and solving) immediately after the GOTO, without any operator manual request.

The second, “Sync After GOTO”, enables the syncing of the mount to the center of the target just resolved.

The third check box, “RECENTER After GOTO”, allows the telescope to move again to the original target coordinates to exactly center the target.

The grey “LOAD IMAGE” button, placed on the bottom left side of the panel, allows loading an available picture to perform its plate solving. This function, which can be useful in the setup phases of the system for defining the coordinates of an image, is enabled if the “LOAD image file acquisition” option has been selecting before choosing a camera (see fig. A.2.1.c).



Below the button there is another check box enabling the syncing of the mount to the loaded image solved position.

OPERATIONS FOR A QUICK CENTERING OF THE CHOSEN TARGET:

The use of the X-Solver application for performing a very quick and precise centering of the chosen target is quite simple:

1. Put the telescope in Home position (CWD) and perform a “Sync Home Position” using the ALIGN tab of the StarGO setup panel.
2. Perform the GOTO to the chosen target using the preferred planetary program connected to the telescope and wait it reaches the stop. You will note that at this point the Target RA and DEC indication on the “PLATE SOLVE” panel are now populated with a value related to the target.
3. Take a single shot, using the SHOT button in the menu bar above the image screen, to verify if the exposition time and the binning chosen are suitable to a good plate solving. If very few stars appear increase the exposition. If too many stars are present, decrease it.

- Now there are two options: if you want just to verify how far is your target from where the telescope is pointing (your image), leave the “SOLVE and Center After GOTO” check box unchecked and press the “ACQUIRE & SOLVE” button. The X-Solve will take an image and will start performing the calculation. After a number of seconds (depending on several factors) the solution will appear under the form of telescope coordinates in the SOLVED RA and DEC below the “ACQUIRE & SOLVE” button. The X-Solver windows will look like:

Note the solver time given below the image and the solved RA and Dec that are few arcmin different from those of the go to target

If you want the telescope automatically sync to the target after the Plate Solve succeeded, using the above calculated RA and Dec offsets, check the “Sync mount with solved image” check box before initiate the acquisition and solving process. In this case, after the solving succeeded, the telescope will be automatically aligned.

- You may repeat the point 4 if deemed necessary to improve the pointing. Our experience is that, after the first attempt, the target is within few arcsec.

A2.5 The X-Solver as a pointing model for as many as 24 stars/points

The X-Solver is a powerful tool that allow to build a sky model for up to 24 stars by clicking over the SKY MODEL label on the top menù.

A window will appear showing a 2D representation of the entire sky.

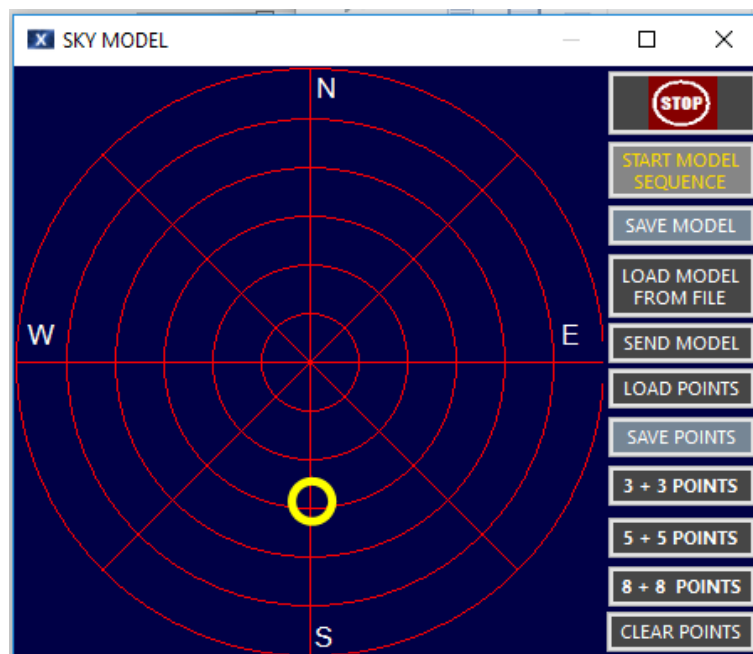


Figure A2.5a: X-Solver Sky Model

The yellow circle indicates the current telescope position.

It is possible to populate the diagram with other points (up to 24) with a double click of the mouse in any point of the sky.

To simplify the sky point choice it is possible to automatically generate points using one of the three buttons on the menu (3+3, 5+5, 8+8) and, eventually, manually complete the point generation up to 24 positions. After the scheme has been completed, we are able to build a **personalized model of the sky** by performing the following operations:

1. BEGIN SEQUENCE. Clicking on the green ACQUIRE AND SOLVE button will initiate the sequence
 - a) The telescope will slew to the first point.
 - b) If the "Solve After GoTO" box is selected a plate solve will be performed when the goto is completed.
 - c) If the plate is successfully solved, a Sync will be performed, the PMF file will be updated and the point color change to green.
 - d) If the plate solving failed, the point color become red.
 - e) In any case the telescope will slew to the next point repeating the operation a) to d) for all points.

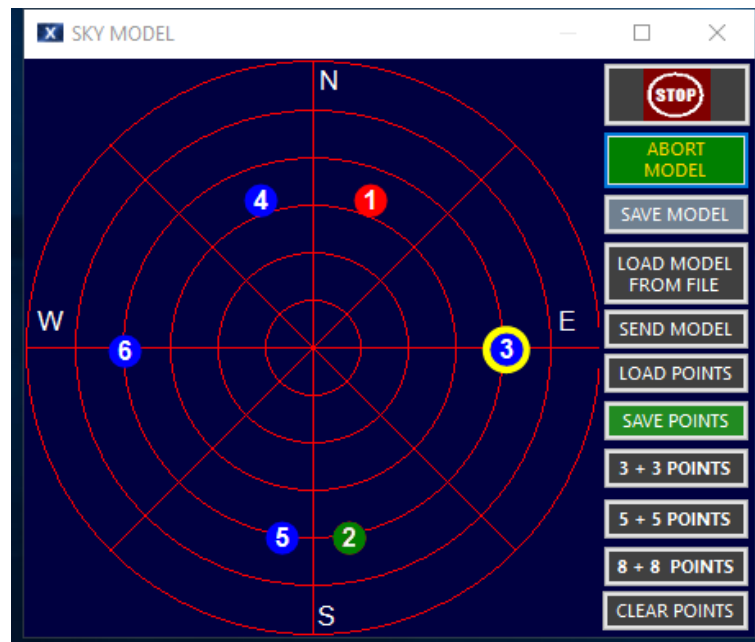


Figure A2.3.c: X-Solver Sky Model

2. Click SAVE MODEL button: The model just build, present in a temporary file named temp.pmf, will be saved with a choosen name.
3. LOAD MODEL FROM FILE: with this button it is possible to load a previously saved sky model file in the X-Solver to be used for any correction or addition o to be forward to the StarGO (see point 5).
4. CLEAR POINTS: This button clears all the points on the sky map.
5. SEND MODEL TO STARGO. Clicking on this button the model just built (point 1) or the model just loaded from file (item 3) will be sent to the StarGO.

A2.6 Image management

Some of the commands in the top menu are useful AIDS to PERFOM a preliminary focusing, to manage the image itself and to optimize target framing.



Figure A2.6a: X-Solver top menu string

The first commands of the string have been already described in the previous sections.

The second button allows to take a single imagine to work with.

The LIVE VIEW button initiate the live view function on the base of the shooting parameters defined in the PLATE SOLVE tab (Figure A2.6b)

The ABORT button will immediately stop the operation of any acquisition and/or solving operation in progress.

Clicking on the MAGNIFYING GLASS icon on the top left of the window will start the zoom function. It will open a new window as follows:

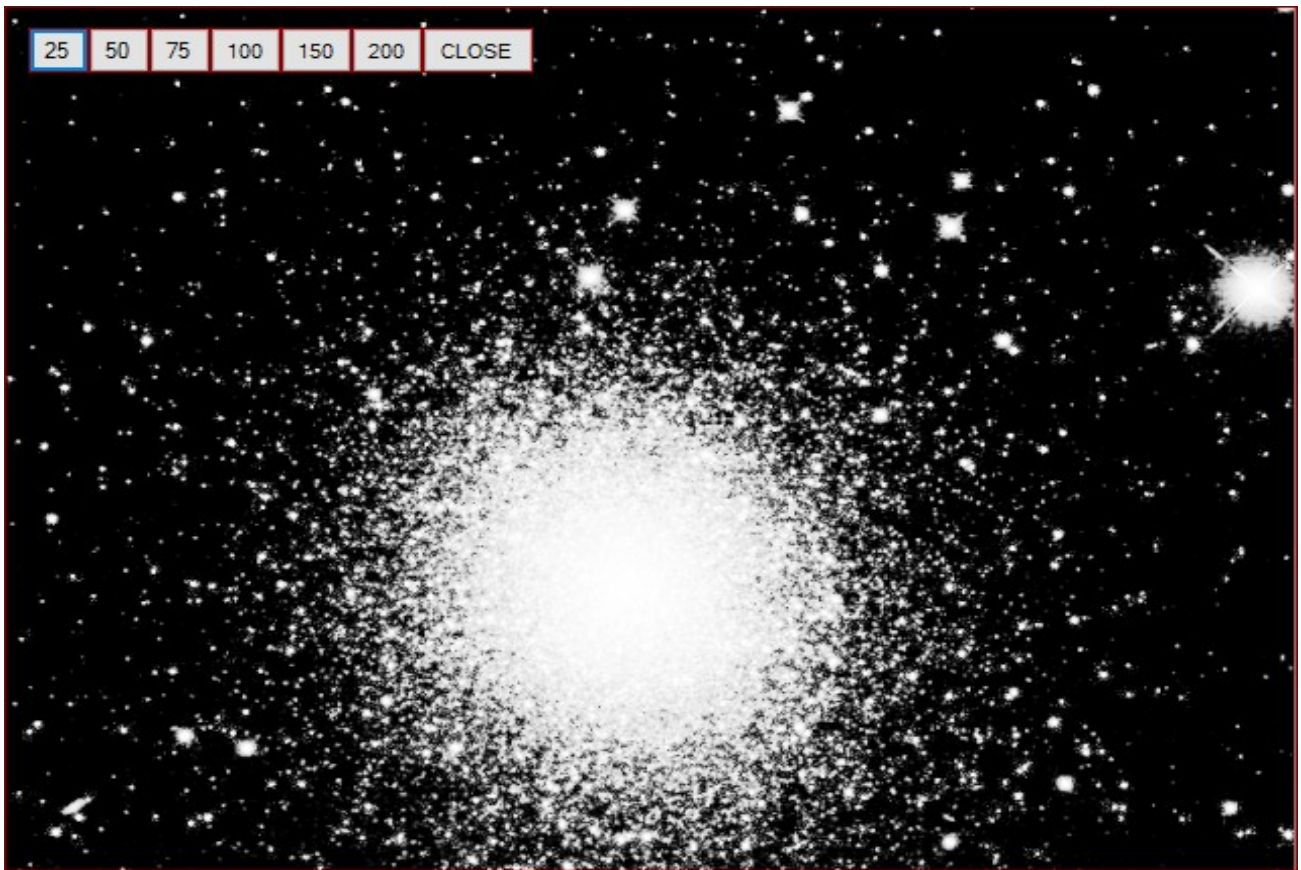


Figure A2.4.c: X-Solver zoom tool

The desired magnifying ratio can be adjusted by clicking on the appropriate buttons on top.

A2.7 POLAR ALIGNMENT TOOL

A precise and fast Polar Alignment of the mount can be performed using the plate solving. This process is initiated by clicking on the P. ALIGN button tool (Fig. A.2.7a).

- The top frame shows the current RA and DEC position of the mount which has been already determined by plate solving.
- The second frame establish the minimum elevation in degrees above the horizon to be used in the process. Double clicking on the white rectangles above and under the number will change the desired value.
- The third frame allows the choice of the meridian side EAST OR WEST where to perform the operations.
- The “START POLAR ALIGNMENT” button initiates the procedure. After pressing this button the mount will take 4 images to be Plate Solved. At the end an internal algorithm will generate the Azimuth and Altitude error in arcminutes.

Figure A.2. 7a: X-Solver Polar Alignment tool

The errors shown on the bottom frame shall be compensate by means of the Alt-Az knobs following the indications of the table shown below, valid for all Avalon mounts.

MOUNT	LINEAR		M-UNO		M-ZERO	
MOUNT AXIS	ALT	AZ	ALT	AZ	ALT	AZ
ARC MINUTES PER KNOB TURN	91,2	79,2	78,74	79,2	61,8	110,4

The fraction of turn to be applied may be calculated dividing the values of the errors provided by the X-Solver by the number of the table for each avalon mount.

A2.8 TIPS & TROUBLESHOOTING

THE AVALON INSTRUMENTS [Support web page](#) provides information and suggestions on installation and troubleshooting.

APPENDIX B

B.1 Software Updating

The StarGO software and firmware are subject to continuous improvement and updating, with additional functions being added all the time. We therefore advise users to frequently consult the Avalon Instruments website [Support page](#) to be assured that their StarGO software and firmware are the latest updated versions.

The updating process consists of repeating the installation operations previously described in Software Installation, Section 2 related to the serial/USB driver installation need not be performed for updating.

Firmware Warning

When a new StarGO software application is first launched and connected, a warning message will appear indicating that the existing StarGO firmware within the hardware is obsolete and incompatible with the newly installed software.



Figure B.1a. Obsolete firmware warning message

If this message appears, it will be necessary to update the firmware following the instructions given in Section B.2. The file containing the newest firmware to be chosen will be the most recent one among those available in the StarGO folder. **When the firmware updating has been completed it is necessary to restart the StarGO application and verify that the “Obsolete StarGO Firmware” warning does not re-appear.**

B.2 Firmware Updating – StarGOLoader

The first time StarGO is launched, after the software is updated, a check is performed to verify if the firmware is compatible with the latest version of the software. If the result of this check indicates incompatibility, the same warning reported in [figure B.1a](#) will be shown. In this case it is necessary to open the setup panel and to activate the firmware updating routine by pressing the Firmware Upload button (see [figure 3.2.1a](#)). This will cause StarGo to close immediately and the StarGO Loader application window to open, as below:

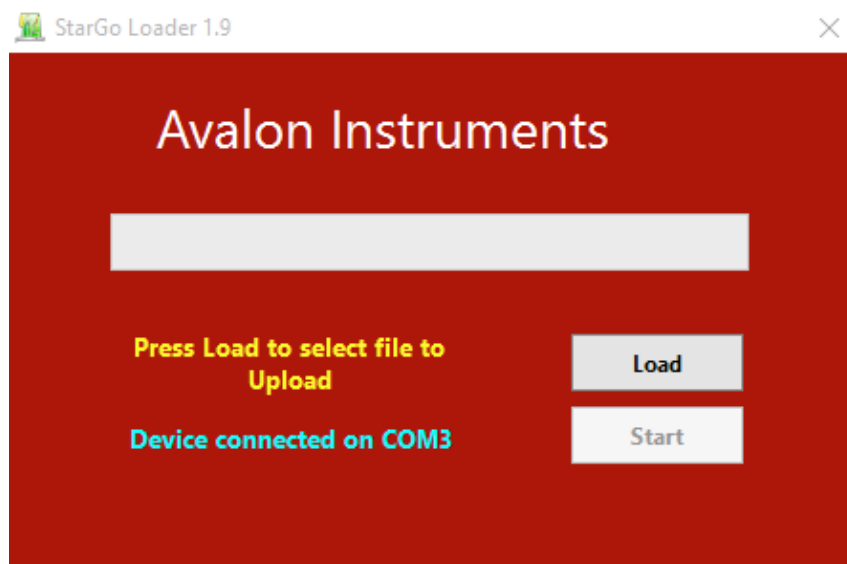


Figure B.2a: Firmware Upgrading loading window

NOTE: Avalon Instruments provides the firmware to be installed pre-set with generic parameters so that the existing settings will not be lost. For that reason, it is recommended to save the “Mount Configuration File” before completing the updating operation, as explained in section 3.2.1. When the updating is completed, you should re-load the saved file as explained in that section.

To update the firmware follow these step by step operations:

1. Press Load button to open the loading window where the firmware file is located.

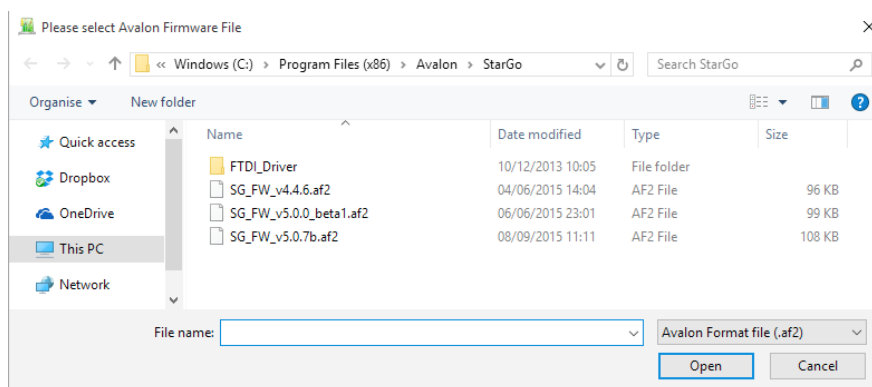


Figure B2.b: StarGO Firmware selection

2. Choose the most recently updated file with .af2 extension among those shown in the window. Press Open to confirm. The StarGo loader window will show the name of the chosen file. Verify that it is correct and then press Start to begin the uploading process.

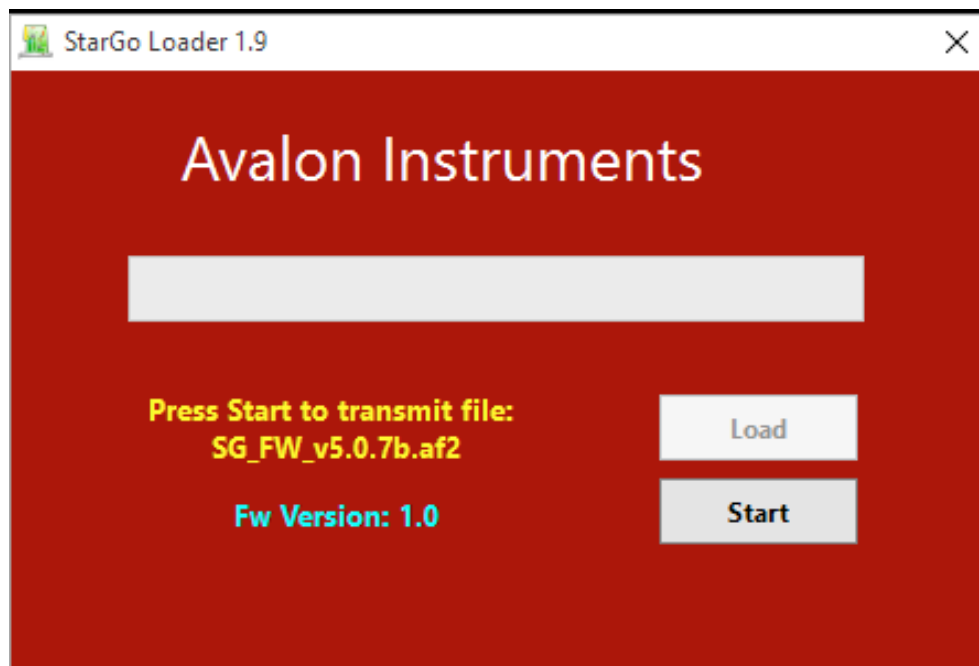


Figure B2c: Firmware upgrading starting window

3. A warning window will appear informing the user that the uploading utility will set the default configuration, overwriting the current settings. So the user will be invited to save his own configuration if necessary.

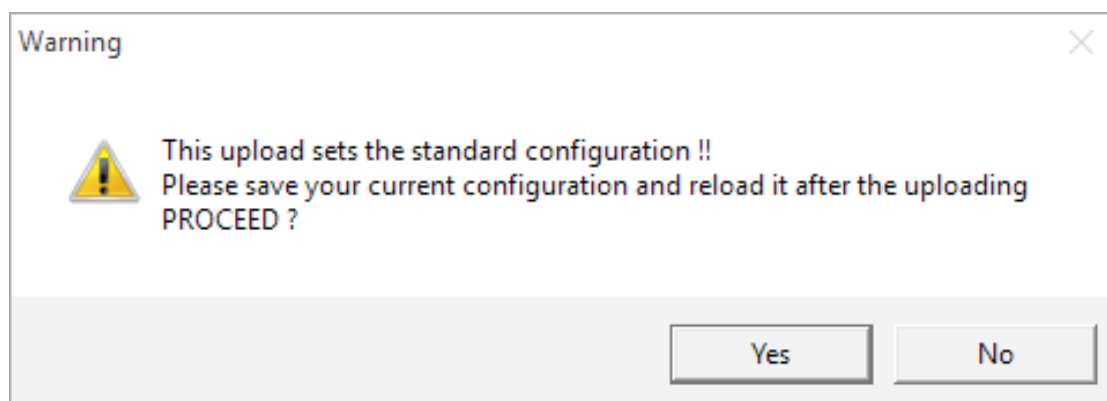


Figure B2d: StarGO Firmware Upload warning message

4. If everything is correct, press the Yes button. The uploading will start and its progress will be indicated by the green bar.

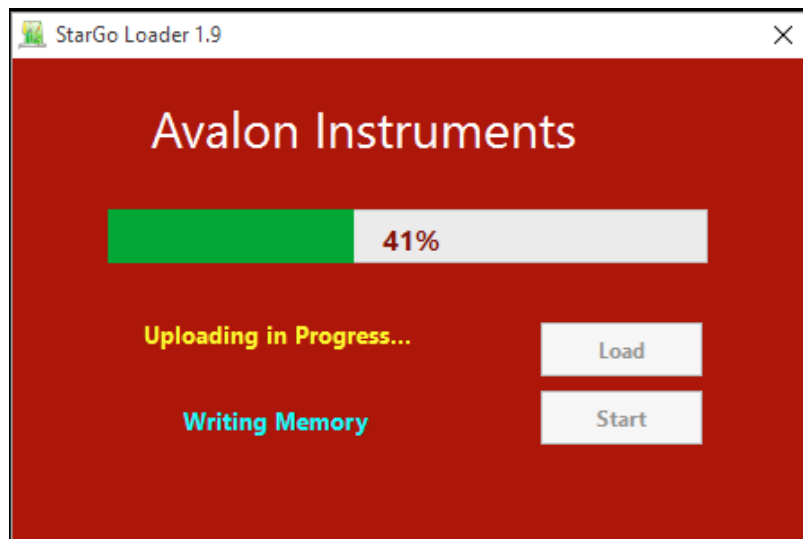


Figure B2e: StarGO Firmware Upgrading bar window

5. When the process is completed, the successful uploading is announced. Press **Close** button to exit the application.

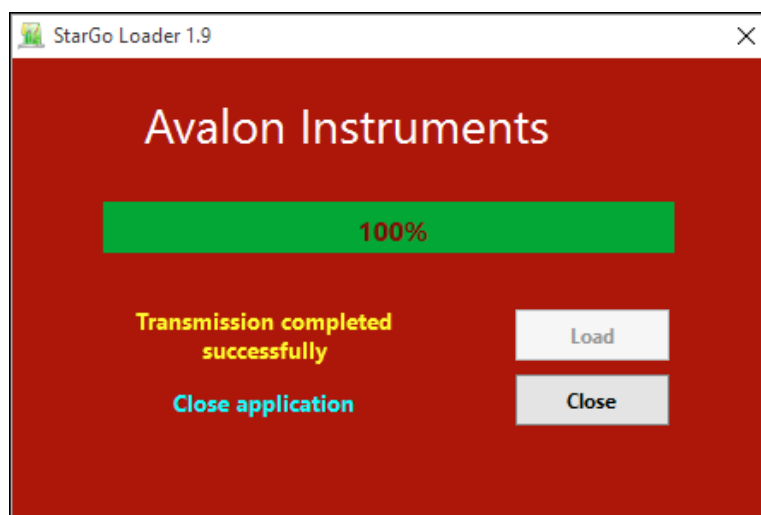


Figure B2f: StarGO Firmware upgrading completed

6. Restart StarGO and connect it. A warning will appear informing that the mount is not configured asking to reload the Mount Configuration File previously saved:
7. Pressing OK will cause the opening of the loading windows for the available configuration files.



Figure B.2.g: StarGO Misconfiguration Warning



Figure B.2.h: StarGO Mount Configuration File selecting

8. Choose the correct configuration file. When loading is finished, the StarGO will be ready to work with the newly installed firmware and the correct configuration,

NOTE: The uploader is able to restart its function, even after an accidental interruption of the uploading process, without any risk of StarGO hardware damage. In this case the led does not blink, simply restart the operations from the beginning.