



# FocuserOne

*astrojolo.com @2021*

## **WARNING!**

Do not connect or disconnect stepper motor when power is on. It may damage stepper motor controller.

Make sure the stepper hold torque is set to 0% before replacing stepper motor with motor of different type.

## Main features:

- focuser motor control for *Robofocus*, *Moonlite*, or generic unipolar or bipolar stepper motor
- 1/8 and 1/32 micro-stepping control with 1.5A maximum current
- advanced temperature compensation with scripting support and compensation calculator
- permanent focuser position – no need to park focuser after the session
- optional temperature/humidity sensor to monitor environmental conditions
- dedicated *FocuserOne panel* software, ASCOM drivers available, INDI available soon
- find the home position (with an additional end of travel switch)

## Technical data

- dimensions: 98x62x28mm
- weight: 94g
- Input voltage: regulated 12V DC
- Focuser stepper motor output: DB9 *Robofocus* compatible, 1.5A max

## Device overview

If you look just for the focuser controller to your telescope, then you are in the right place. FocuserOne is simple to use yet powerful device that can control almost any type of focusing stepper motor. It is equipped with dedicated panel software, ASCOM and INDI driver, buttons to control the focus manually, and astro-friendly high contrast OLED display.

FocuserOne device supports unipolar stepper motors (like Robofocus or Moonlite), and bipolar as well. In terms of the motor resolution FocuserOne supports full step mode, half step mode, and two microstepping modes – 1/8 and 1/32 step.

Temperature compensation is possible with additional temperature and humidity sensor. FocuserOne supports linear compensation. Compensation calculator is available, so determining temperature compensation coefficient for the setup is pretty straightforward.

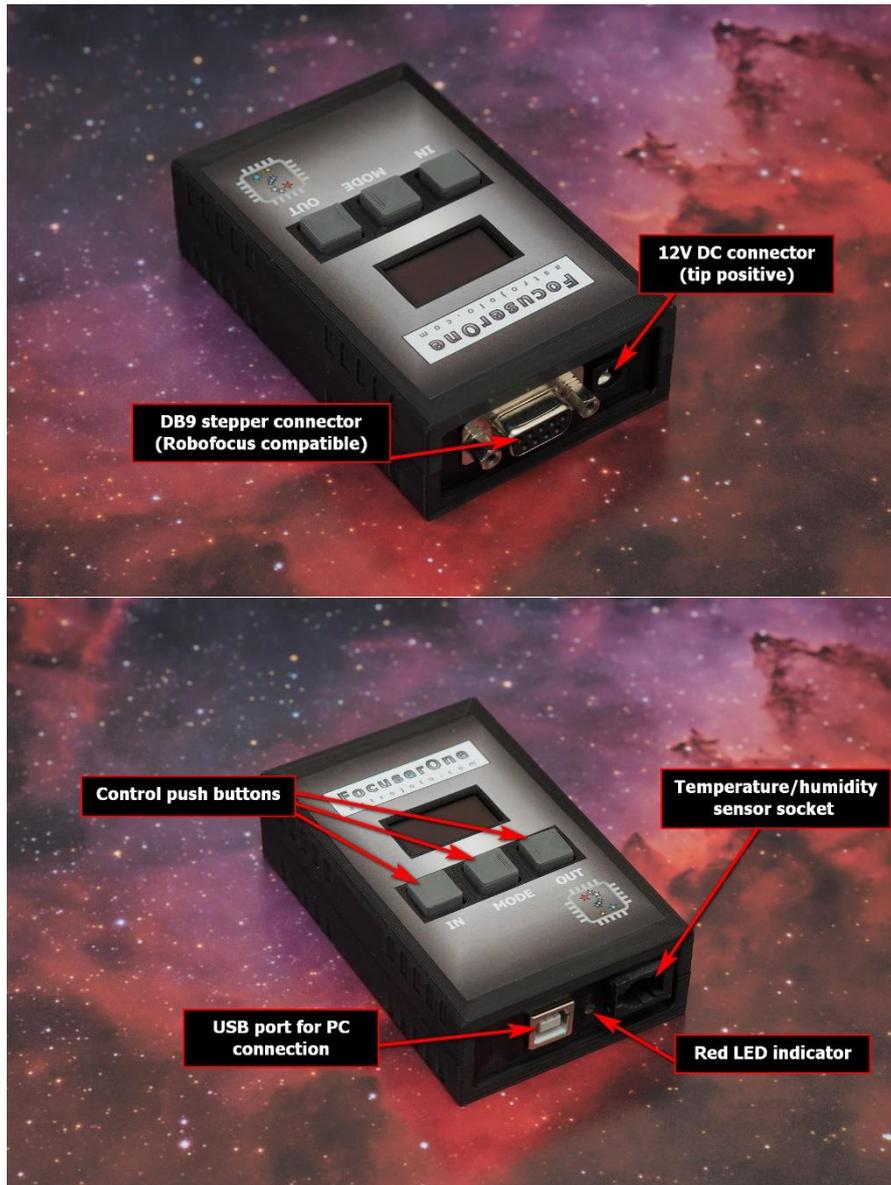
Another useful functionality of FocuserOne panel software is charting. Changes in focuser position, ambient temperature and humidity (with optional sensor) can be presented in a graphical way, but also can be written down to the log file for future processing.

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Make sure the stepper hold torque is set to 0% before replacing stepper motor with motor of different type.

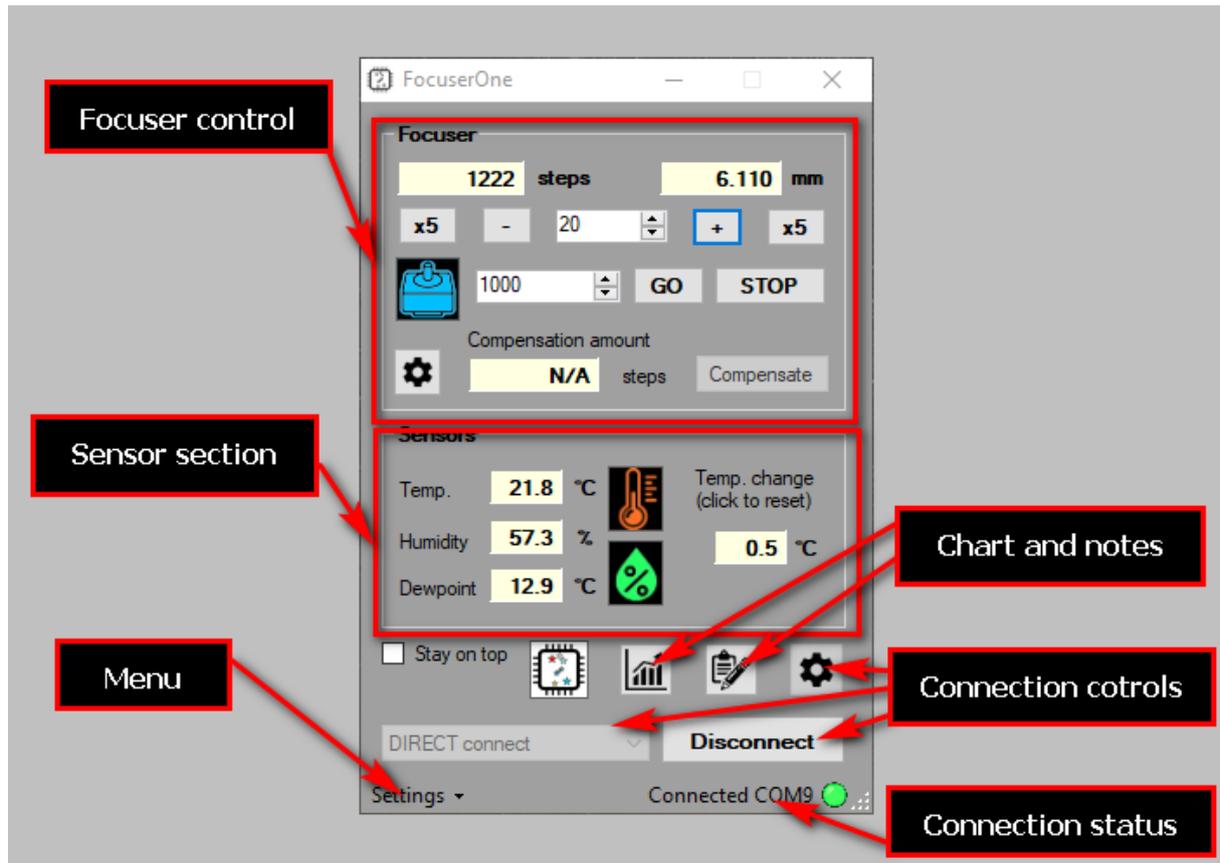
## External view



Stepper motor connector is compatible with *Robofocus* / *Moonlite* standard:

- pins 1 and 2 – coil A of stepper motor
- pins 3 and 4 – coil B of stepper motor
- pin 5 – common (for unipolar motors)

## Panel overview



*FocuserOne* panel contains *Focuser* and *Sensors* sections, that will be described later on. Below the *Sensors* section, several other controls are available.

*Stay on top* checkbox makes the *FocuserOne* panel not go to the background when another application is selected.

### Menu

A small cogwheel menu contains shortcuts to all other settings menu windows, so they can be also opened from here. There is one additional position in this menu:

- *Manual control.* You may disable this if you do not want to use device buttons to control the focuser.
- *Compensation calculator.* This option opens an additional popup window with the compensation calculator. See the *Compensation calculator* section for details
- *Reset device to factory defaults* - this option will reset all device settings to factory default values. The confirmation window will be opened.
- *Connection settings* opens setup dialog where connection settings can be adjusted
- *OLED display settings* opens setup dialog where OLED display settings may be changed (brightness, splash screen, etc.)
- *Find home position* starts the procedure of finding a home position. The home position switch needs to be connected to the device.

## Charts and notes

*Notes* panel - after clicking on this button small editor will popup, where you can note down some information you need during the imaging session (like focuser positions, flat images exposure time, etc.). Its content is saved dynamically.

*Charts* button opens an additional window with the charts. See the *FocuserOne charts* section for details.

## Logo icon

After clicking on the logo icon a small information window will pop up. It contains information about firmware and software versions.

## Connection controls

The panel can communicate with the device in two modes. The first one is *DIRECT connect* - then the panel connects directly to the device and no other interface can control any of the device components at the same time. The second communication mode is *ASCOM connect*. In this mode, the panel connects to the device using the installed *ASTROJOLO Focuser* driver, and as this driver is a part of a multi-driver Local Server instance many other applications can control any of ASCOM interfaces at the same time.

### DIRECT connect

After selecting *DIRECT connect* and clicking on *Settings* button *Direct connect settings* popup will open. Then you need to select the proper *COM port* where the *FocuserOne* device is connected and detected. After selecting the port you can click *Test port* to make sure the device is connected properly. After clicking the *Save button* settings will be saved and the software will connect to the *FocuserOne* device each time using the selected port.

There is another option in the window called *reset device on connect*. When this field is checked each time the connection to the device is established *FocuserOne* will reset, so its state will be restored to the power-on state. It can be useful in case when *FocuserOne* is not responding and you work remotely and cannot switch it off and on. In all other cases, it is recommended to keep this field unchecked.

### ASCOM connect (recommended)

After selecting *ASCOM connect* and click on the *Settings button* *ASCOM Focuser Chooser* window will open. You need to select the *ASTROJOLO Focuser* interface and then click the *Properties* button, so the *ASCOM connection setup* window will open. Here you need to select the *COM port* where the *FocuserOne* device is connected. This driver is for all members of the *ASTROJOLO 4* family, that is why you also need to select connection speed. **For *FocuserOne* it is 38400 bps.** You can also test the connection using the *Test port* button. When the trace check-box is checked *ASCOM log file* will be written with all communication between the device and any software - it can be useful to investigate errors. *Reset on connect* works in the same way as in *DIRECT connect* mode.

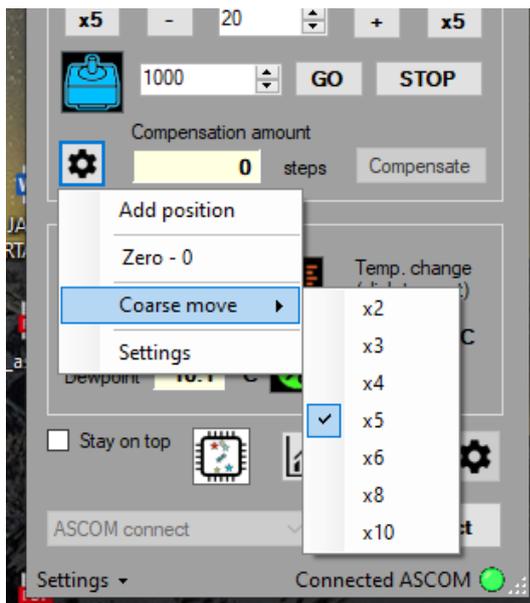
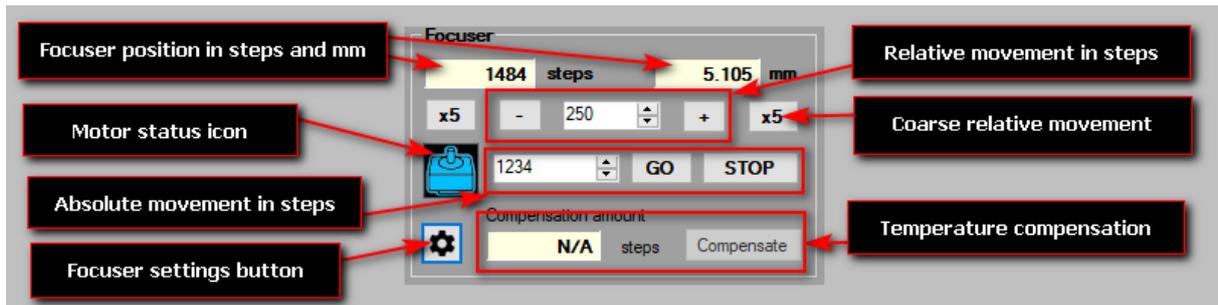
Both connection modes offer the same functionality. The only difference is that *DIRECT connect* works exclusively, so no other software than the panel can communicate with the device. *ASCOM*

connect mode allows other 3rd party software to operate with the device at the same time - see 3rd party software section.

### Connection status

Small indicator field with selected COM port number and light. Gray means not connected, green means connected, red means active communication.

## Focuser section



The focuser position in mm is calculated based on the focuser position in steps and step size defined in settings.

Clicking on the cogwheel button opens additional menu:

*Add position* - can be used to store current value in absolute focuser move under selected name, so it can be restored quickly during the session

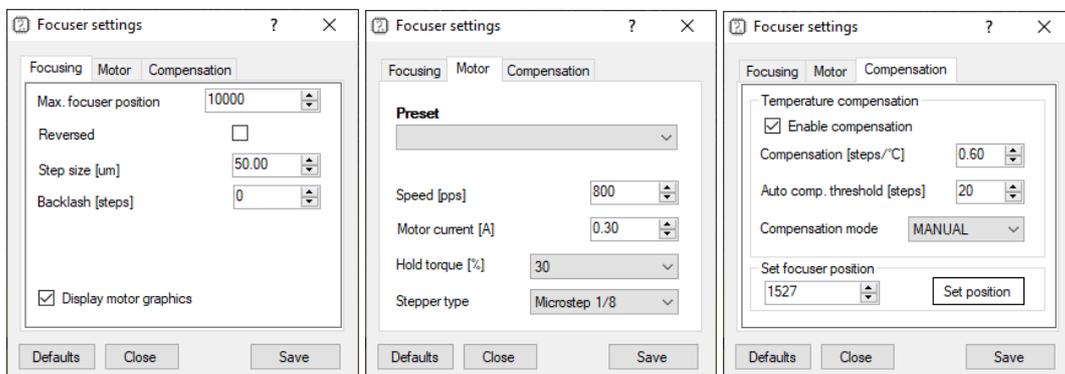
These are stored positions. After selecting any of them its value will be copied to absolute focuser move field, and then after button GO is pressed focuser will move to this position. When you right click on any position you can edit or delete it.

*Coarse move* multiplier selection. Here any value between 2 and 10 can be selected to use for coarse relative movement

*Focuser settings button*. Clicking here opens Focuser settings window

The motor status icon may be in three colors: red means the motor is rotating, blue means the motor is idle but holding current is applied, and green means idle and no holding current is applied.

Temperature compensation and focuser settings are described below.



*Max. focuser position* - here you need to enter the maximum focuser position, so focuser will not move to any larger value. This is to prevent any mechanical damage to the focuser.

*Step size [um]* - this value is stored in the driver and can be provided to any 3rd party software when requested. It is not used internally in FocuserOne.

*Reversed* - you can check this box when to select proper behavior of the focuser, so decreasing the focuser position will cause the focuser tube to move into the telescope

*Backlash [steps]* - this is for focuser motor backlash compensation. You may enter here backlash value that will be applied to focuser moves to cancel the stepper motor gearbox backlash. This value may be positive or negative. A positive value means, that backlash compensation will be applied for outward moves, and a negative value will be applied to inward moves. **This compensation is applied only when the motor is controlled with the FocuserOne panels button. When you use 3rd party software for focusing (FocusMax, MaxIm DL, and others) use this software backlash compensation!**

*Display motor graphics* – toggles displaying stepper motor status icon

*Preset* – select any of the predefined settings for common motor parameters. Other fields at this tab will be filled with values, but settings will be saved after the *Save* button is pressed.

*Speed [pps]* - focuser stepper speed in pulses per second. You need to select the appropriate value, so the focuser will move with reasonable speed, but no steps will be lost during the move. For popular unipolar stepper motors with a 7.5-degree step, it should be usually no more than 120-150. Bipolar steppers with a 1.8 degree step usually can operate at a faster rate, up to 400-500pps. Micro stepping can operate at rates up to 2000pps.

*Motor current [A]* – this is the current limit set to the motor. Refer to your motor technical data to set proper current. For 12V unipolar geared motors offered in shop.astrojolo.com set it to 0.4A or use preset.

*Hold torque [%]* - when this is selected to any value greater than zero, the stepper motor will be powered when stopped. It can then provide additional holding torque to your focuser, however more current will be drawn, and motor temperature will increase. **Make sure the stepper motor you use is designed to be powered constantly if you want to use this option.**

*Stepper type* - can be selected between Unipolar (like Robofocus compatible) or Bipolar motor full or half step motors. It can be also bipolar motor controlled with micro-steps – two options 1/8 and 1/32 stepping are available.

*Enable compensation* - switch compensation on or off

*Compensation steps [steps/C]* - this is the number of steps the focuser will move when the temperature will change from the initial value. So if you put here 35 and the temperature will drop 2C, then the focuser will move 70 steps (outwards). This value usually must be determined practically, so you can note focuser positions over long night session together with corresponding temperatures, and then calculate this coefficient

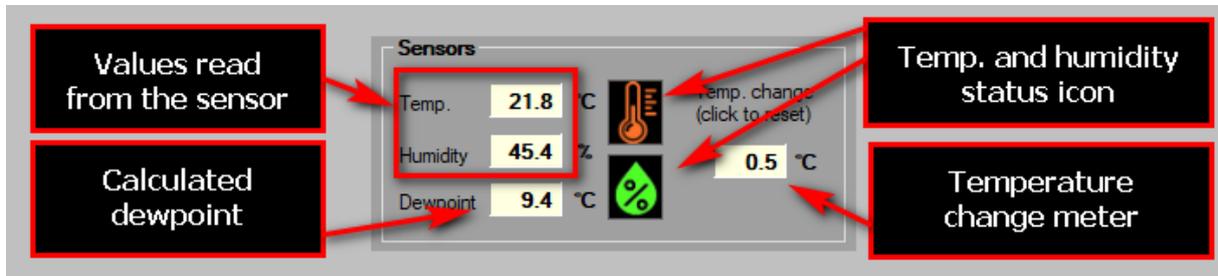
*Auto compensation threshold [steps]* - when compensation mode is set to *AUTO* and the calculated compensation error will exceed this value, then compensation will be automatically applied

*Compensation sensor* - here you can select the sensor that will be used for temperature measurements for focuser compensation

*Compensation mode.* When set to *MANUAL* the calculated compensation will be displayed in *Compensation difference* window, however, no compensation will be performed - it must be triggered manually with the *Compensate button* (or using script - see *Temperature compensation* section). When this option is set to *AUTO* then manual compensation will still work, but it will also be performed automatically each time when calculated compensation error will exceed the *Auto compensation threshold* value

*Set focuser position* - you can set any desired focuser position to calibrate it. Usually, it will be used to set a zero position. For this case you need to move the focuser tube inwards as much as possible, then enter 0 value into the field and press the *Set position* button

## Sensors section



The sensors section displays information measured with (optional) humidity and temperature sensor. The dewpoint value is calculated basing on the measurements.

Temperature and humidity status icons color depends on the measured values.

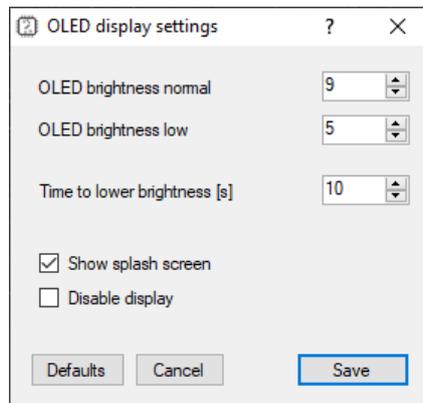
Temperature change meter can be reset by clicking on that label box.

## OLED display

The device is equipped with the high contrast OLED display that presents current focuser position in steps and millimeters, and also temperature / humidity (if an optional sensor is connected).



OLED driver can be configured by selecting *OLED settings* in the bottom left *Settings* menu:



*OLED brightness normal* – this is OLED brightness when the device is active

*OLED brightness low* – this is OLED brightness when the device is idle for some time

*Time to lower brightness [s]* – time in seconds after last activity, when the display brightness will be lowered

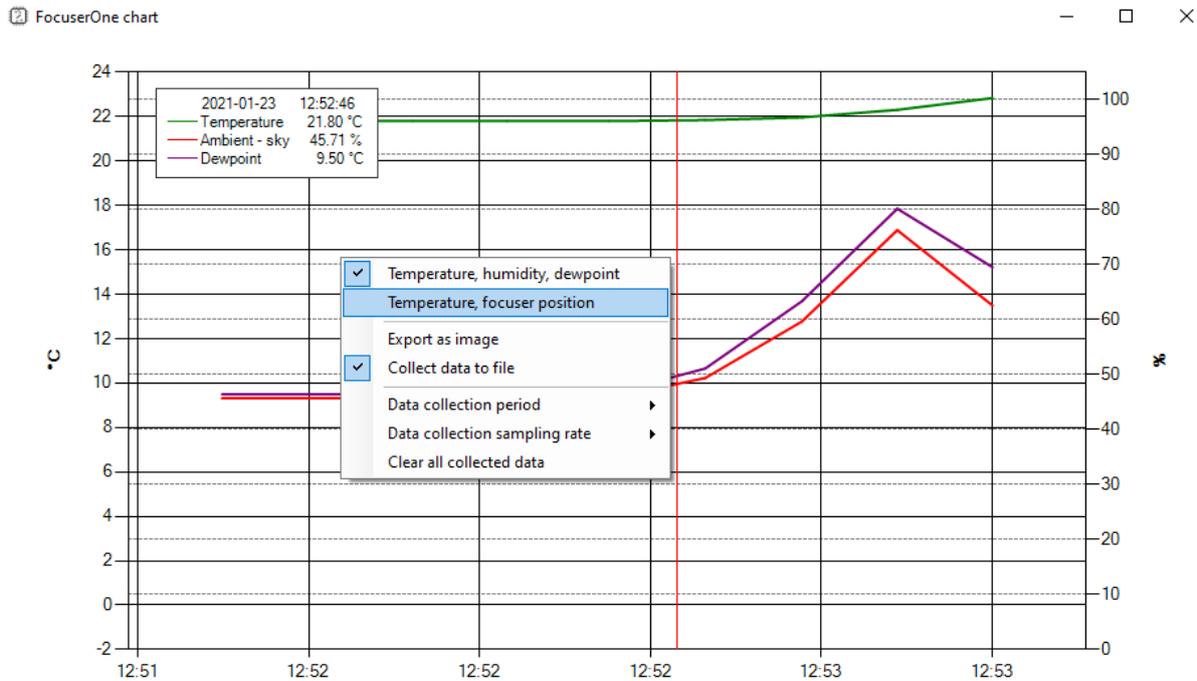
*Show splash screen* – shows splash screen image when device is powered on or after reset

*Disable display* – turns off the display completely

## FocuserOne charts

FocuserOne charts are the tool that allows you to monitor the following data that is collected by the FocuserOne device:

- temperature, humidity, and dewpoint measured by connected sensors
- focuser position in steps



Charts start to collect data at the moment FocuserOne panel software connects to the FocuserOne device. You can open the charts window by clicking the corresponding button in the lower-left of the panel. After opening the charts window the default view is opened - that is a mixed plot of the temperature and focuser position. The chart scale is calculated automatically. You can zoom any selected chart range by selecting it with a mouse. Then the scroll bar will appear, so you can pan the graph. To cancel zoom you need to press a small button at the left side of the scroll bar. After clicking with the right mouse button in the chart area the context menu will be opened. In this menu following options are available:

- first two options can be used to switch between different views of plots that present different data in a combined way
- *Export as image* - this option saves the current graph as a PNG image in the folder selected by the user in the dialog. The saved image will contain exactly what is visible on the chart
- *Collect data to file* - this checkbox indicates if data is saved to the file. This is checked on by default, and data files are saved in My Documents/FocuserOne folder. Saved files may be later imported for example to an Excel sheet and processed
- *Data collection period* - here you can set the time span of the graph. If the new selected period is shorter than already collected data, then data will be truncated. This setting does not affect data collected in files.

- *Data collection sampling rate* - you may choose here how often data should be collected. Actual data is always sampled two times per second. This setting determines how many samples are averaged to create data points in the chart. Recommended values are 5 or 10 seconds unless you need to have it collected more often.
- *Clear all collected data* - clicking here causes all data in the chart to be cleared. It does not affect data collected in files.

## Temperature compensation

Temperature compensation in FocuserOne is implemented linearly. So there is only one parameter that describes how temperature affects the focus point. It is not a perfect approach, however, its accuracy is good enough for most amateur setups.

### How to determine the temperature compensation coefficient?

The best way is to note the focuser position at different temperatures. When during session temperature changes, the focuser position needs to be adjusted to maintain a sharp focus. When you note these points of temperature and corresponding focuser position, then it is pretty straightforward to calculate the compensation coefficient, i.e. the number of focuser steps required to compensate for one-degree temperature change. And this value needs to be entered into the *Compensation* field in the focuser settings. When decreasing temperature requires the focuser position to decrease, then the value will be positive.

### How to use compensation?

Once you enter the compensation value into the *Compensation* field of focuser settings, you need also to set the *Auto compensation threshold*. Here you need to specify a value that causes significant focus change and requires refocusing. You can determine it basing on your experience, or use some CFZ (critical focus zone) calculators available on the web (<http://www.wilmslowastro.com/software/formulae.htm#CFZ> for example). Then you need to select a sensor that will be used to monitor temperature and select operation mode.

**AUTOMATIC** mode means, that when the compensation amount will exceed the *Auto compensation threshold* then compensation will be applied immediately. So it may happen (and usually happens) during the exposure and may affect image quality. When automatic mode is selected you can still monitor the compensation amount in the corresponding field and use the *Compensate* button to apply for compensation in a convenient moment.

**MANUAL** mode on the other hand allows you to manually apply compensation using the *Compensate* button. You can do it in a convenient moment, for example between subsequent exposures.

Another way is to apply calculated compensation using the script. An example script that can be used to apply compensation may look like this:

```
' FocuserOne compensation trigger script
' 2021 astrojolo.com
dim focuser
set focuser = CreateObject("ASCOM.AstroLink4m.Focuser")
focuser.Connected = true
focuser.CommandString("S:20")
focuser.Connected = false
```

The number 20 in the command string "S:20" is the compensation threshold in steps. So actual compensation will be applied only if the compensation amount will exceed the threshold value. You

need to adjust this threshold value in the script according to your setup specifications, in a similar way to the *Auto compensation* threshold described before

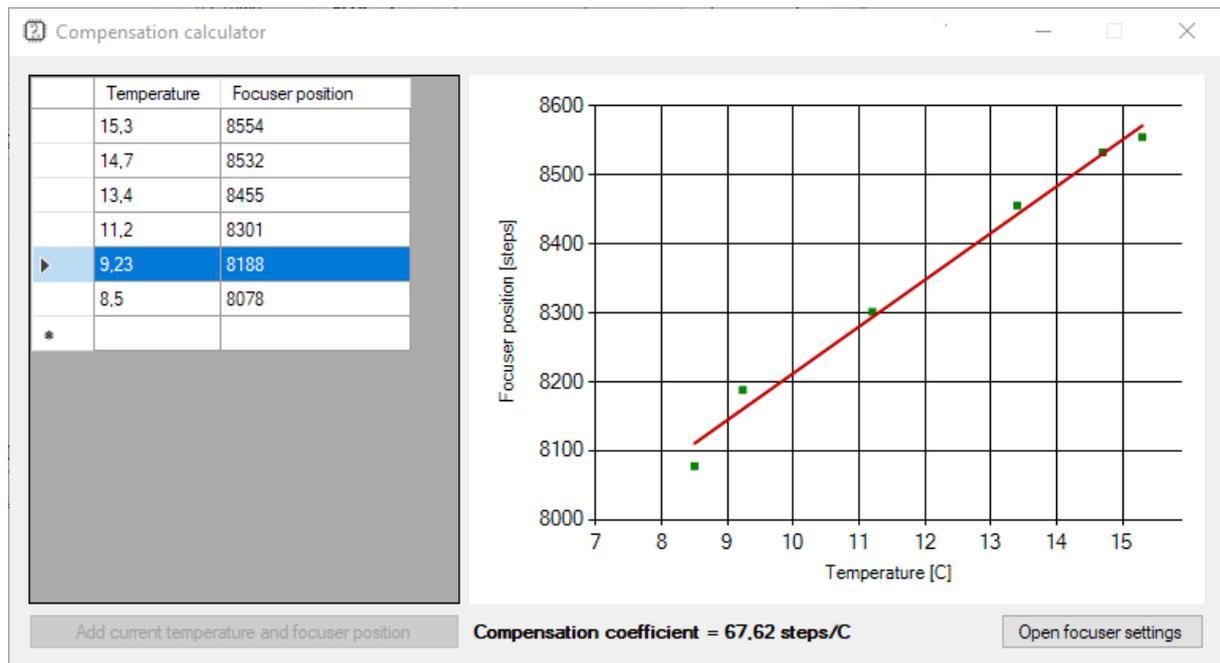
You can save the script to the file with *VBS* extension (*astrolink-compensate.vbs* for example), so it can be executed. Of course, there is little point in running this script manually. But you can point to that script your acquisition software (like *MaxIm DL* or *Sequence Generator Pro*), so that script can be executed after every single exposure. And compensation will be applied not every time, but only when the given threshold will be exceeded. This way you can avoid changing focus point during exposure.

**You can use the script only when FocuserOne panel software is connected to the device in ASCOM mode.**

## Compensation calculator

A compensation calculator is a simple tool that can be used to calculate the compensation coefficient basing on temperature and focuser position points read from the FocuserOne panel. The compensation calculator can be found in the bottom left menu.

There is a two-column table on the left part and data points plot. Each table row is one point of data - the first cell contains temperature, and the second contains the corresponding focuser position in steps. You can either enter data manually or click *Add current temperature* and focuser position button to add current values from the FocuserOne panel to the last table row. When there are two or more data points available, there will be a plot visible on the right side of the window. Data points are represented as green dots, and the red line is calculated compensation line. There is also a compensation coefficient calculated and displayed below the plot.



In the bottom right corner, there is the *Open focuser settings* window button that can be used to open the focuser settings window. There you can check the current compensation coefficient, enter a new value, and save data to the device.

Data points in the table are persisted in the file, so they will be available when you close and open the FocuserOne panel again. So you can collect data to the calculator over several imaging sessions. You can edit data directly in the table. You can also remove a row or more rows by selecting them in the first column and clicking the *Delete* button.

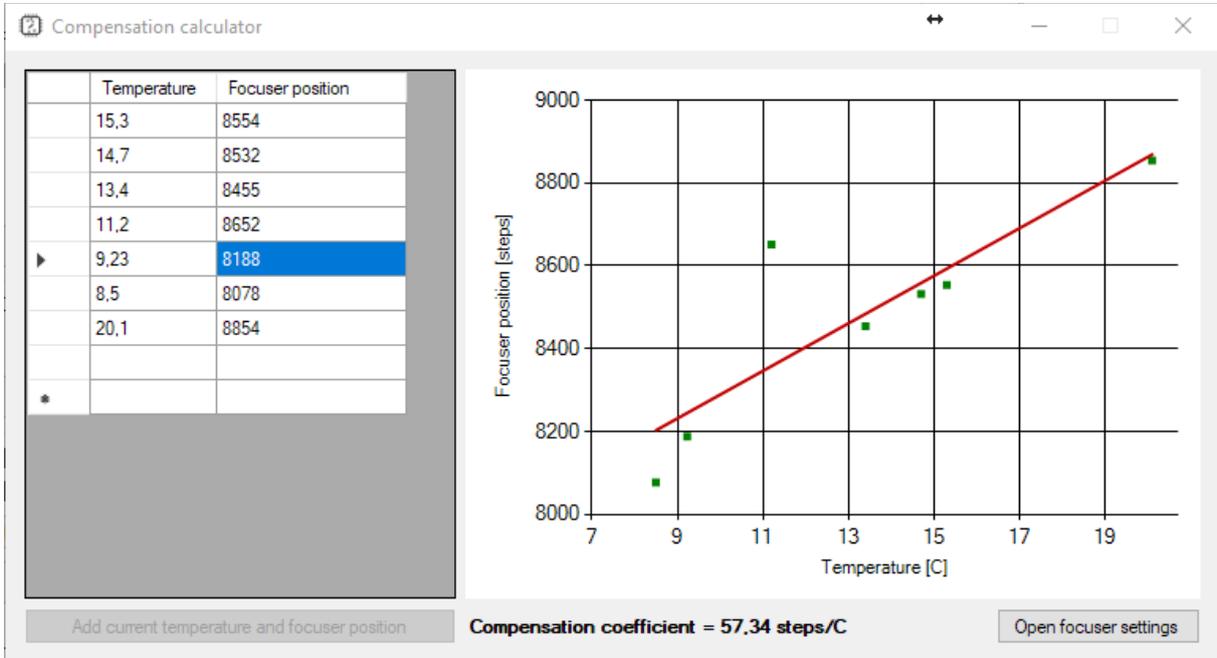
The calculated compensation coefficient may be used in several ways - you can read more on this topic at the *Temperature compensation* section.

### Data points quality

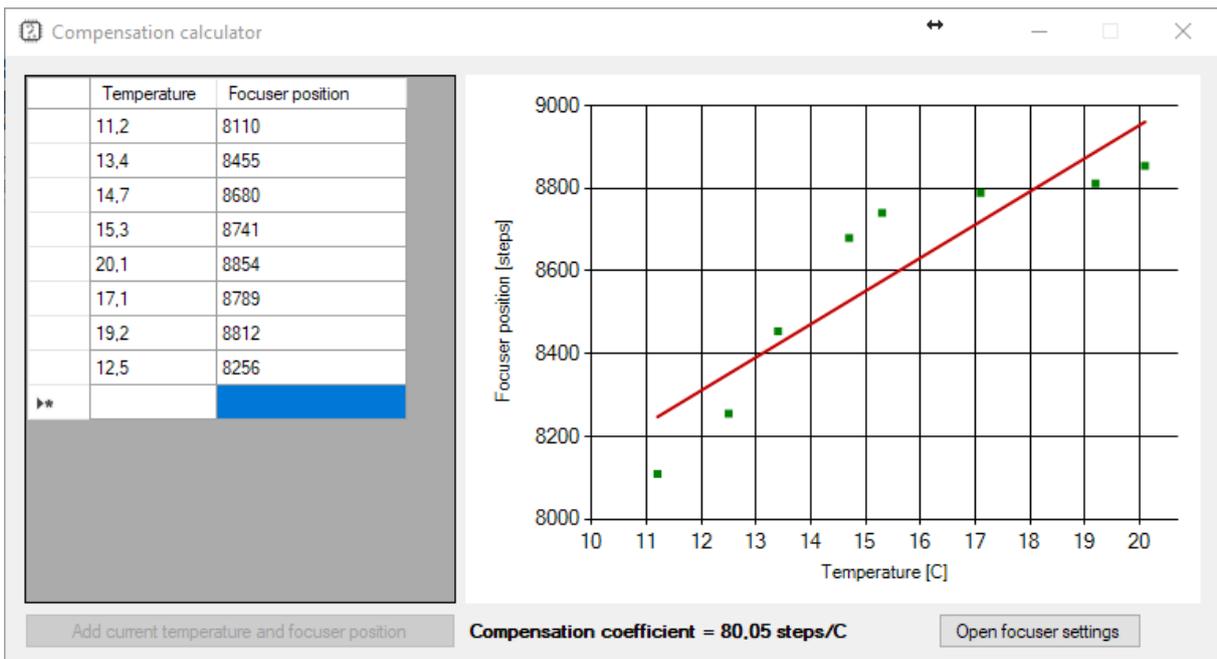
It is recommended to collect data points in a reasonably wide range of temperatures. If data points cover a temperature range of 1 or 2 degrees, then the compensation coefficient may not be accurate. It is much better to have a temperature range of 5 or 10 degrees covered.

If all points are relatively close to the calculated line (like in the example above) then the calculated coefficient should be of good quality.

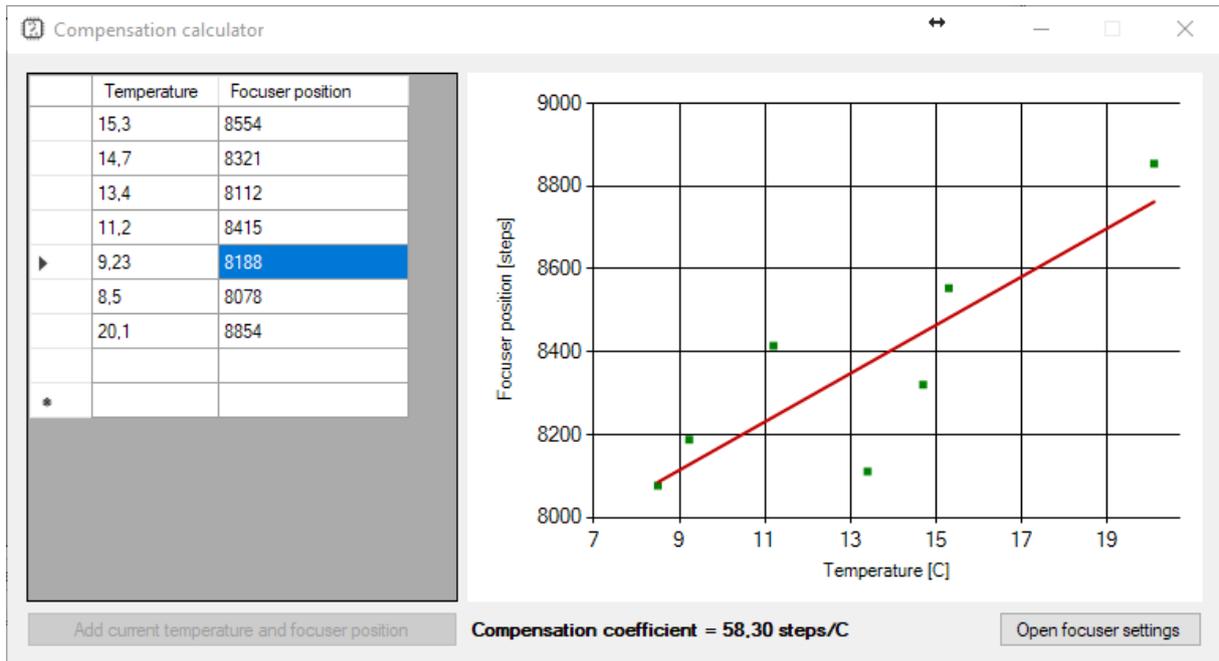
If one or two points are incorrect, and all other fit straight line nicely, then these bad points may be a result of a mistake and can be removed from the data point set. You need to select them in the data table and remove them using the *Delete* key.



If the collected data points make the shape of a curve that crosses the calculated compensation line, it indicates that your setup focus point does not change linearly in the temperature range you choose. But you may still use compensation with a different value for different temperature ranges. In the example below the points in the range 11 to 15 degrees and 15 to 20 degrees fit straight line quite precisely:



If all points do not fit the calculated line in any reasonable way, then they are all bad quality. The coefficient calculated with these points probably should not work well. You can try to collect another set of data points during another imaging session. If the new points will still indicate such behavior, then probably the setup you use cannot be set for compensation:



**You need to enter data points collected with one filter only! There can be a focus shift between different filters, and the calculated coefficient may not be accurate.**

## Ground loops

The ground loop in the electrical system occurs when two points that should have the same potential have different voltages. Ground loop in astroimaging setup may occur when ground (i.e. minus of power supply voltage) is connected to one receiver with more than one cable path. Here are two example scenarios:

### Scenario one

- newtonian telescope has a mirror cooling fan, and this mirror fan socket is fixed in the metal mirror cell. Its minus is connected to a metal telescope tube
- the imaging camera case is also connected to the power supply minus.

Now, when you power both fan and camera from the same power supply, then power supply ground will be connected to the camera with power supply cable, but also via the fan power socket, then metal telescope tube, focuser, and camera case.

### Scenario two

- an active USB hub is powered from the regulated voltage power supply
- imaging camera is powered from the same power supply
- the camera is connected to a USB hub with cable

In this scenario, a negative voltage is supplied to the camera also in two ways. The first one is the main power cable between the camera and power supply. The second loop is from the power supply to the USB hub and then with the USB cable to the camera.

The ground loop may cause some problems with connections, that are hard to investigate. The best way is to avoid them. Possible solutions for the second scenario are:

- connect the imaging camera to the computer without an additional USB hub
- power camera from a separate supply
- power USB hub from a separate supply
- do not power the USB hub at all - maybe it is not required
- use a USB cable with galvanic isolation

## Scripting support

You can also control the FocuserOne device using scripts to automate the acquisition process. All ASCOM interfaces are available and can be controlled from the script. You can find a simple script example in the *Temperature compensation* section. Please remember that you can run scripts only, when *FocuserOne* panel software is connected in ASCOM mode (or is not connected at all).

A simple script that moves focuser to position 3455 may look like this:

```
' FocuserOne move script
' 2021 astrojolo.com
dim focuser
set focuser = CreateObject("ASCOM.AstroLink4m.Focuser")
focuser.Connected = true
focuser.move(3455)
focuser.Connected = false
```

## Troubleshooting

### FocuserOne log files

All FocuserOne log files are created in the *My Documents/FocuserOne* folder. Files that name contains only current date are data collections from FocuserOne charts and can be imported to any other software (like MS Excel) for further processing. Files that names start with *FocuserOne-log-* contains errors and warnings generated by the software. You can check its content if something is not working properly. If you connected to the FocuserOne device using ASCOM mode (recommended) then you can also check the *trace* option in the ASCOM driver selector, and then in the folder *My Documents/ASCOM* you will find ASCOM log files with all the communication and messages there.

### FocuserOne device does not work (red LED is off)

- check if the power supply voltage is within the range 11-14V DC
- check if the polarity is correct

### FocuserOne device is not recognized by the system after connecting to the computer - no COM port visible

- check if power is supplied (red LED is on)
- check another USB cable and another USB port in the computer
- install FTDI drivers manually from the FTDI page

### Connection was lost

- usually, you can just reconnect to the device
- if the device is not responding you may check the "*reset device on connect*" check-box in driver options
- if there is no FocuserOne COM port in the system you need to plug out and plug in the USB cable or scan Windows Device Manager for new devices
- if the problems occur more often you may try to replace the USB cable you use, USB hub, or try another USB port in the computer

### The stepper motor buzz but does not rotate

- check if proper option Unipolar/Bipolar/Microstepping is selected
- check if wiring is correct
- lower *Speed* parameter for stepper motor

### The stepper motor becomes hot

*Holding current* option is enabled. Check if the stepper motor you use is designed to work under constant load. Verify if you need holding torque at all. If you use some gearbox, then it may not be necessary.

### The sensor is not recognized - no value is read

Disconnect the device, turn off the power, plug out and plug in sensor and reconnect power and FocuserOne panel

### The stepper motor does not rotate after clicking the plus or minus

The next move position exceeds limits (is either below zero or over *Maximum* position setting). See *Focuser control* section for details.

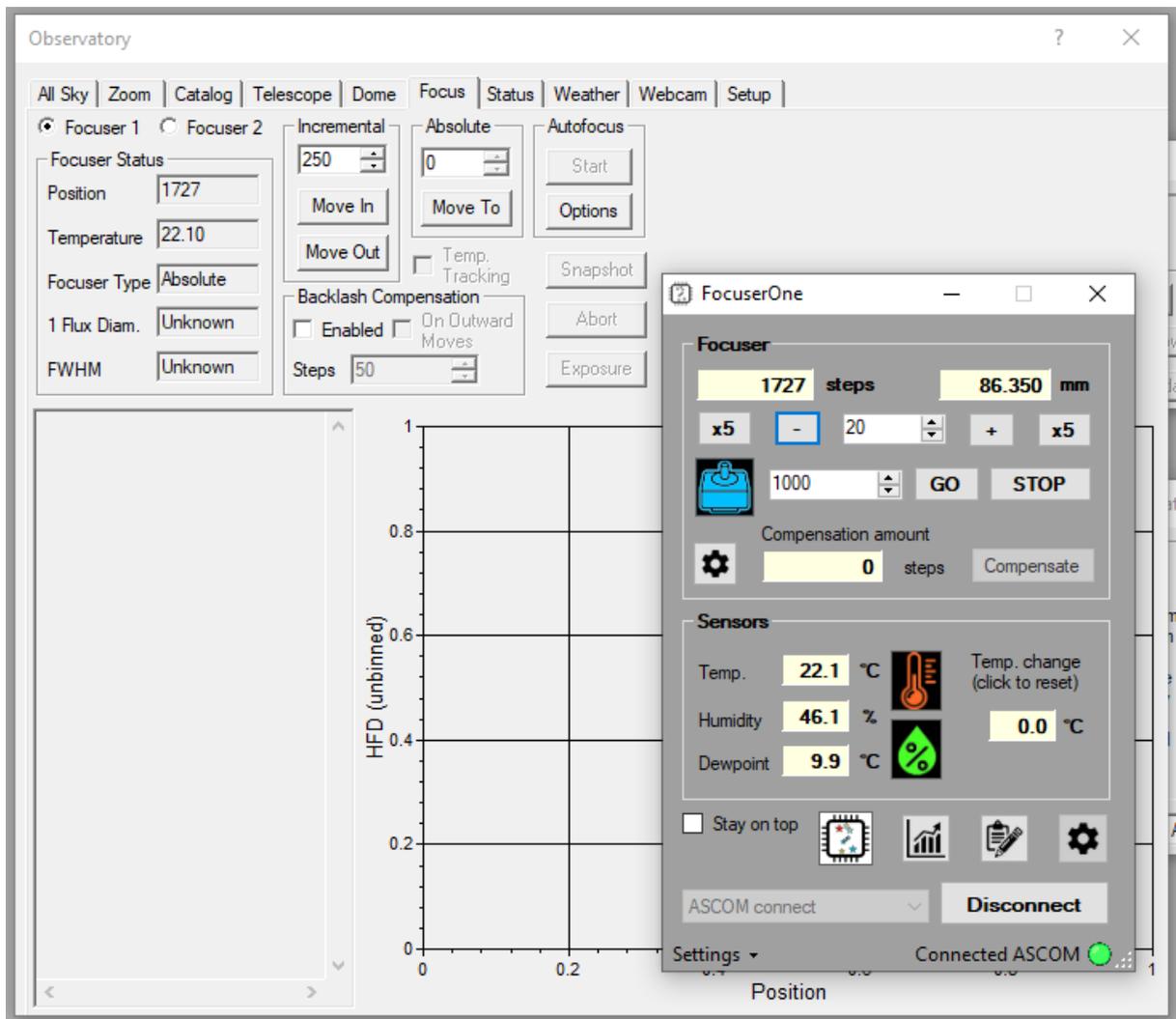
Stepper motor driver protection was triggered and the driver needs to be restarted. Turn off FocuserOne power, disconnect stepper motor, turn on power, connect FocuserOne panel and make sure the stepper motor settings are correct. Then turn off power and connect the stepper motor back.

## Third-party software

When the FocuserOne device is connected in **ASCOM connect** mode, all ASCOM compatible software can control the FocuserOne focuser. To make it working in 3rd party software you need to select in ASCOM chooser **ASTROJOLO Focuser** interface and connect to it. Many programs (including of course FocuserOne panel) can control focuser stepper at the same time. The most common scenario is to have simultaneously connected to FocuserOne device:

- *FocuserOne panel* in *ASCOM mode*, so you can control all FocuserOne functions
- other focusing software (*MaxIm DL*, *FocusMax*, *SGPro*, *N.I.N.A.*, *CCDCiel*) connected to *ASTROJOLO Focuser* interface, so you can focus automatically

In the image below - FocuserOne is connected to the panel software, focuser, and switch are connected to Maxim software at the same time.



## Software and firmware update

The new software version can be found at <https://shop.astrojolo.com/focuserone/> page. There are two software components: ASCOM Local Server driver and FocuserOne Panel. To update the software you need to:

- download installer from the page
- disconnect FocuserOne device from the computer
- uninstall previous software version (in MS Windows Control Panel)
- install the new updated version
- after connecting check if all your settings have been preserved

It may happen, that the new software update will require new firmware to be uploaded as well - in this case, you will see a warning message after connection. Please read the release notes for details.

When you notice that ASTROJOLO Local Server driver was not updated properly after installation, you need to perform the following steps: uninstall it again, remove manually folder *C:\Program Files (x86)\Common Files\ASCOM\Focuser\AstroLink* (or *C:\Program Files\Common Files\ASCOM\Focuser\AstroLink* in 32 bit systems) and all its content, and install local server driver one more time.

Up to date firmware can be found at <https://shop.astrojolo.com/focuserone/> page. You need to download the zip archive with the latest firmware, unpack it and follow the instructions in the *README* file to update the firmware. Make sure the PROG jumper is set to ON position during the firmware update. After the update set PROG jumper to OFF.

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