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
- 2 adjustable PWM power outputs to control dew heaters, telescope fans, or custom Peltier coolers. The maximum load is 40W per output
- 3 switchable power outputs to power mount, cameras, or filter wheels. The maximum load is 5A per output
- 1 additional permanent power output
- 1 additional regulated 5V output (maximum load for connected USB devices and additional 5V output cannot exceed 3A). This output voltage is galvanically isolated from the input voltage.
- XT60 high current input voltage socket
- temperature/humidity/sky temperature/sky brightness sensors to monitor environmental conditions and calculate the dew point. It is also used for automatic control of dew heaters
- monitor voltage, current consumption, and total energy consumed during the session – useful when working in the field with a battery
- user-defined alerts for voltages, current, energy, and temperature changes conditions
- programmable overcurrent and overvoltage protection
- integrated USB 3.0 hub with galvanically isolated power supply (three outputs available)
- opto-isolated USB 3.0 input
- dedicated AstroLink 4 panel software, ASCOM drivers available, INDI available

Technical data

- dimensions: 162x92x29mm
- weight: 215g
- the maximum current drawn from all outputs: 10A
- AstroLink power consumption: 2W max
- Regulated PWM outputs: 40W max
- Permanent 12V DC output: 5A max
- Switchable 12V DC outputs: 5A max
- Focuser stepper motor output: RJ12 6 pin, 1.5A max
- 5V DC output: 3A max total with USB hub outputs, galvanically isolated from the analog part
- Sensor inputs: RJ11 4 pin I2C digital interface
- Auxiliary input: RJ11 4 pin input
- USB input: USB3.0 opto-isolated from analog part
Device overview

Integrated USB 3.0 hub
The USB 3.0 hub integrated into the AstroLink device is a standard 4 port hub based on the Realtek chipset. One of its outputs is used internally to provide the data stream to the AstroLink processor. Hub is supplied with a galvanically isolated regulator. The data stream between the hub and AstroLink processor is separated by the optoisolator. This way analog and digital parts are completely separated and ground loops risk are minimal.
Hub input and outputs are USB2.0 compatible, so there is no need to use fat USB3.0 cables if you connect USB2.0 peripherals – cameras, mounts, or other accessories.
Hub is not guaranteed to work with all peripherals. It is especially valid for astronomy dedicated cameras, which are known to cause conflicts when connected to the same USB hub. Several steps can be taken to make things work: replace USB cables with shorter or better quality, use the latest camera drivers, connect the hub to another port in the computer, adjust camera driver settings (USB traffic), update the operating system, update computer hardware drivers. If all that fails then the problematic camera needs to be connected to the computer using a separate data cable.

Permanent 12V DC output
This output is connected directly to the input 12V XT60 socket. Can be used to provide power to a mini PC or other device powered with 12V.

5V DC output
This output provides regulated 5V DC voltage from a galvanically isolated internal regulator. This is the same voltage that powers an integrated USB hub. All 5V receivers (including the ones connected to the hub) can consume 3A max. You can use this voltage to power a mini PC, RPi, or other device powered with 5V.

Sensors
AstroLink 4 USB has two equivalent sensor inputs, so you can plug any available sensor into any socket and it will be recognized and properly assigned. Connecting three sensors (two temperature/humidity and one sky temperature) requires an additional sensor bus splitter.

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.
External view
1. 12V DC input – XT60 socket
2. 12V DC permanent output
3. 12V DC switchable outputs
4. 5V DC regulated output galvanically isolated from the analog part
5. USB3.0 hub outputs
6. LED indicator
7. USB3.0 input optoisolated from analog
8. AUX input
9. Sensors inputs
10. RJ12 focuser stepper motor output
11. PWM regulated power outputs
Panel overview

AstroLink 4 panel contains several control sections. Most of the area is occupied by different controller sections, which will be described later on. Below the control section, several other controls are available.

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

Buzzer checkbox controls buzzer activity.

**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 need to check this field when you have connected the manual control box to the AstroLink device
- **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.
- **Settings Load.../ Save...** - these options allow us to save or load all device settings and configurations. All settings, labels, initial PWM, and power output values can be stored.
Status bar
The status bar displays several different information that is visible depending on the context. It is a read-only field.

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 AstroLink charts. See the AstroLink 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 AstroLink 4m 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 AstroLink 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 AstroLink device each time using the selected port.
There is another option in the window called reset AstroLink on connect. When this field is checked each time the connection to the device is established AstroLink will reset, so its state will be restored to the power-on state. It can be useful in case when AstroLink 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 AstroLink 4m 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 AstroLink device is connected. This driver is for all members of the AstroLink 4 family, that is why you also need to select connection speed. For AstroLink 4 USB 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 AstroLink on connect works in the same way as in DIRECT connect mode.

There is one more setting available for the ASCOM driver. Under the cogwheel menu in the lower-left corner, there are ASCOM Profile settings. There you can adjust sky temperature cloud coverage mapping points that correspond to clear sky and maximum cloud coverage, and set names for DC and PWM outputs that will be visible in ASCOM Switch client software.

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.

The coarse relative movement factor can be set in settings between 2 and 10.

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 the 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 AstroLink.

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 AstroLink 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.

Acceleration [pps/s] - each time stepper starts to move, it accelerates to the speed selected in the field Speed. Here you can enter the acceleration value. So for example, when the selected speed is 300pps, and you select an acceleration value for 600, then the stepper will accelerate to maximum speed in 0.5 seconds. This value is also used for manual stepper control, but acceleration is divided by 5 for this purpose, so it is possible to do small manual corrections.

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.
PWM section

PWM output value can be set between 0 and 100%. HEAT option controls value automatically basing on current relative humidity. AUTO option controls value automatically to keep Sensor #2 at a given temperature.

The first tab Labels contains labels for each PWM output, so it can be set for example to ‘OTA dew cap’ or ‘Guider cooling’. Another two select boxes determine the startup state of PWM outputs. Any value set here will be set up to PWM output after power is on.

Second tab Automated contains parameters used when HEAT or AUTO option is selected for PWM output:

Heat power at max humidity [%] – select here the heating power when relative humidity reaches 100%. If your heater has correct power you may enter here 100%. But when your heater is oversized, you may put here a lower value.

Temperature preset [C] - PWM output power will be adjusted to keep the selected sensor at the given temperature

Control direction - when the output should increase with increased value (DIRECT) or should decrease with increased measured value (REVERSED)

The last tab is Frequency. Here there is only one select box where you can change the frequency of PWM output. It is usually the best approach to select the highest 31kHz frequency - this frequency is not audible by humans and also requires low-value LC filtering elements if you want to use it. But some receivers may not work well with such high frequency, and then it needs to be adjusted down.
Power section

The power section helps to monitor power conditions. It displays voltage, current, and energy consumption. Under the settings button, there are some more options related to alerts and protection.

*Input voltage* - this field displays the current supply voltage value

*Total current* - this field displays current drawn by the device and all attached gears from the power supplier (also USB devices connected to the integrated hub)

*Energy consumed* - these two fields display energy consumed from the power source since the moment device has been powered on or reset. This information can be used to monitor energy when powering in the field from a battery

When any of the alert values are close to the defined limit corresponding field becomes orange. When any of the alert values exceeded the limit, the corresponding field becomes red. Additionally, if a system sound alert or device buzz alert is enabled there will be an audible sound alert.

*Total current warn level* - when the total current will exceed this value, an alert will be triggered

*Energy warn level* - when energy consumed from the power supplier will exceed this value alert will be triggered

*Low input voltage warn* - when input voltage will decrease below this value alert will be triggered

*High input voltage warn* - when input voltage will increase over this value alert will be triggered

*also buzz with device buzzer* - when one or more alerts is triggered there will be a sound signal emitted from the AstroLink device
also alert with system sound - when one or more alerts is triggered there will be a system sound alert played in the computer

*Overvoltage protection level [V]* - when input voltage will exceed this level for a time longer than specified as protection sensitivity time all PWM and DC outputs will be switched off

*Overcurrent protection level [A]* - when total output current will exceed this level for a time longer than specified as protection sensitivity time all PWM and DC outputs will be switched off

*Protection sensitivity [ms]* - the delay between protected condition and the moment the PWM and DC outputs will be switched off

*V in. ADC coefficient* - this is the voltage of the internal reference source of the device. It should be 1.1V in the perfect world, however, this source is not so precise. There is a real reference voltage value printed in the box, but if you notice that measured in the panel voltage differs from the real voltage value you may adjust this coefficient.

*Calibrate AstroLink current sensor.* Every time you adjust the ADC coefficient also current sensor needs to be calibrated. To do it you need to disconnect all receivers from the AstroLink device and click this button. After a moment current sensor will be calibrated.
Sensors section

Sensors and PWM sections are separate ones, although they work together to provide some combined functionalities. The sensors section contains four read-only fields that labels may be changed. Sensor sockets in AstroLink are equivalent, so it does not matter where you connect the given sensor. The temperature/humidity sensors enclosures are numbered, and the sensor marked with 2 will be displayed in the #2 column in the panel. Sky brightness sensor refresh rate depends on the actual sky brightness. Darker sky requires longer integration time. Up to 30s for 21 mag/arcsec² sky, or up to 60s if darker.
In the tab called Alerts you can set temperature change monitor parameters:

Enable temperature alert - here you can enable or disable temperature alerts

Temp. change sensor - it is the sensor that temperature is taken to monitor its value. Make sure the selected sensor is connected to the device

Temp. change warning - it is the difference between the current temperature and start temperature that causes an alert to be triggered. When the temperature difference is close to this value, the temperature window becomes orange. When the limit is reached, the temperature window becomes red and alerts are emitted (if activated)

also buzz with device buzzer - when the temperature change limit is reached alert signal will be emitted from the AstroLink device buzzer

also alert with system sound - when the temperature change limit is reached system alert sound will be played

Enable sky temperature warning - when the difference between sky and ambient temperature drops below the specified threshold alert will be triggered. It usually indicates a scenario, when the sky is covered with clouds

Cloud sensor tab contains threshold levels that change the icon representing sky conditions. Default values 8, 12 18 and 25 degrees are usually suitable for the average location. However, if the sensor is used in specific conditions (desert, mountains, lake, or river proximity) these threshold levels may need to be adjusted.

Third tab called Icons controls the displaying of environmental status icons.

Temperature icon source and Humidity icon source determines if icon color is controlled with values that come from the first or second sensor, from the sensor that provides higher or lower value or averages both sensor readings.

Display temperature icon toggles temperature status icon displaying

Display humidity icon toggles humidity icon displaying

Display cloud sensor graphics toggles displaying sky temperature status graphics

The last tab – SQM controls settings of the optional sky brightness sensor. Numeric fields are used for the sensor reading calibration. If you want to calibrate the sensor to a reference sky brightness sensors, usually it is enough just to determine offset. If after applying the offset there are still significant differences between the sensors, please contact us, so we can analyze the case and provide a way to determine Coefficient parameter.

Offset – the difference between the AstroLink sensor reading and reference sensor reading

Coefficient – second parameter that controls sensor calibration

Reset sensor – reset sky brightness sensor parameters to the factory defaults (confirmation window will popup)

Dark calibrate – determines the dark signal of the sensor that will be then applied to sensor readings. Process requires sensor cover and no stray or ambient light available. It may take up to three minutes (confirmation window will popup).
12V output section

The second section is called the 12V output. Here we have three check-boxes that control DC outputs where you can connect supply voltage to peripheral devices like mounts, cameras, or filter wheels. Lock outs check-box can be checked and then three boxes above will be locked (not clickable). This way you can prevent accidentally turning on or off any of the connected devices.

Under the cogwheel button settings windows is hidden. There are not many options, however. You can label each power output, so it can have a meaningful name like 'Mount' or 'CCD main camera'. On the second tab, there are three check-boxes that control power-on behavior. If the check-box is checked then the corresponding output will be on after turning on the power or resetting the device.
AstroLink charts

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

- temperature, humidity, and dewpoint measured by connected sensors
- sky temperature and the difference between sky and ambient temperature (if the sky temperature sensor is connected)
- focuser position in steps
- PWM outputs power in %
- switchable DC outputs states
- input voltages value
- total current draw
- total energy consumed

Charts start to collect data at the moment AstroLink panel software connects to the AstroLink 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 on 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:

- the first five 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/AstroLink* 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.
Overcurrent and overvoltage protection
AstroLink panel contains settings to provide overcurrent and overvoltage protection. Both input voltage and total output current are monitored 200 times per second and measured values are compared to user settings. If any of these values exceeds settings for some specified time (also configured by the user) then all PWM and DC outputs will be switched off. Default protection settings are:

- voltage: 14.0V. It is also the maximum allowed input voltage for AstroLink device
- current: 10.0A. It is the maximum output current that the AstroLink device can handle safely
- protection sensitivity: 100ms

Overvoltage setting
The value here should be adjusted to the voltage that our power supply provides. If we use a regulated 12V power supply, then a reasonable value here could be 12.5 or 13V. For 13.6V regulated voltage, we can stay at the default value of 14V.

Overcurrent setting
This preset should be adjusted to the receivers that we power from AstroLink. If we have a mount that drains 2A when doing GoTo, a camera that drains 2.5A at maximum cooling power, and a dew cap heater that consumes 1.5A, then the maximum current will be 6A. Plus some current for focuser, and then 7A can be reasonable value for such configuration. Probably it is the best way to monitor the actual total current drawn in AstroLink panel software during one session, and then determine overcurrent value basing on this. You can use charts for this and look for maximum power consumption.

Protection sensitivity setting
When either overcurrent or overvoltage occurs, the device is waiting for this amount of time and checks if this condition still occurs. If so, then an alert is triggered. However if during this time overcurrent or overvoltage will end, then no alert will be triggered. Usually, it is the best approach to set a short time, however, it is not always possible. When the receiver connected to AstroLink (like mount or camera) consumes much power at the moment it is switched on, then this protection sensitivity time may be increased. But it is recommended to keep this setting low, like 30 or 50ms.
Temperature compensation

Temperature compensation in AstroLink 4 USB 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 at 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:

```
' AstroLink 4 compensation trigger script
' 2017 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 AstroLink 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 AstroLink 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 AstroLink 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 the 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 AstroLink 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 in 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 others 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:

![Compensation calculator](image)

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. The 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 the 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 output from AstroLink
- imaging camera is powered from DC AstroLink output
- the camera is connected to a USB hub with a 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 AstroLink. The second loop is from 5V output in AstroLink 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

AstroLink 4 USB device was designed in a way that it protects against most common ground loop scenarios. Digital and analog parts were separated with a galvanically isolated power regulator and opto-isolated data transmission.
Scripting support

You can also control the AstroLink 4 USB 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 AstroLink 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:

```vbs
' AstroLink 4 focuser move script
' 2020 astrojolo.com
dim focuser
set focuser = CreateObject("ASCOM.AstroLink4m.Focuser")
focuser.Connected = true
focuser.move(3455)
focuser.Connected = false
```

and example script that turns switches on DC out 1 and 2 and sets PWM outputs values to 30 and 18%:

```vbs
' AstroLink 4 switch example
' 2020 astrojolo.com
' 0,1,2 - are DC outputs. 3,4 are PWM outputs
dim switch, result
set switch = CreateObject("ASCOM.AstroLink4m.Switch")
switch.Connected = true
result = switch.SetSwitch(0, true)
result = switch.SetSwitch(1, true)
result = switch.SetSwitchValue(3, 30)
result = switch.SetSwitchValue(4, 18)
switch.Connected = false
```

The script needs to be put into the file with VBS extension (for example astrolink-script.vbs) and then it can be started just by double click.
Troubleshooting

AstroLink log files
All AstroLink log files are created in the My Documents/AstroLink folder. Files that name contains only the current date are data collections from AstroLink charts and can be imported to any other software (like MS Excel) for further processing. Files that name start with AL4mini-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 AstroLink 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.

AstroLink device does not beep after connecting to the power supply
- check if the power supply voltage is within the range of 11-14V DC
- check if the polarity is correct

AstroLink 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 AstroLink device on connect" check-box in the driver options
- if there is no AstroLink 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 the 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 AstroLink panel.

Some fields in AstroLink panel software are red and there are window system sound and device beeps
One or more alert levels have been exceeded. See Power outputs control section or Sensors and PWM outputs control section for details.

The stepper motor does not rotate after clicking the plus or minus button and one beep is heard
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 AstroLink power, disconnect the stepper motor, turn on the power, connect the AstroLink panel and make sure the stepper motor settings are correct. Then turn off the power and connect the stepper motor back.

AstroLink device disconnects and restarts when any power or PWM out is turned on
The reason is too much voltage drop at the moment of switching power to any connected peripherals. It can be also caused by EM interferences.

• make power cables shorter or use power cables with larger cross-section area
• use USB cables with at least one shield

The voltage or current values are not correct
You need to adjust the ADC coefficient and calibrate the current sensor. See Power outputs control topic.

Outputs are switched off and a popup window with a message opens
You need to adjust protection parameters according to your setup. See the Overcurrent and overvoltage protection topic.
Connections

Power input

![Power input Image]

Stepper motor output

1, 2 – +12V
3, 4 – coil A
5, 6 – coil B

Sensors inputs

1 – 5V DC, 2 – SDA, 3 – SCL, 4 - GND

PWM outputs

PWM outputs are regular RCA sockets, tip positive.

12V DC outputs

These outputs are regular 5.5/2.1mm sockets, tip positive.

5V DC output

This output is a regular 5.5/2.1mm socket, tip positive.
Third-party software

When the AstroLink device is connected in **ASCOM connect** mode, all ASCOM compatible software can control the AstroLink focuser. To make it working in 3rd party software you need to select in ASCOM chooser AstroLink 4m Focuser interface and connect to it. Many programs (including of course AstroLink panel) can control focuser stepper at the same time. The most common scenario is to have simultaneously connected to AstroLink device:

- **AstroLink panel in ASCOM mode**, so you can control all AstroLink functions
- other focusing software *(Maxim DL, FocusMax, SGPro, N.I.N.A., CCDCiel)* connected to AstroLink 4m Focuser interface, so you can focus automatically
- other software that supports ASCOM Switch can be connected to the AstroLink 4m Switch interface *(MaxIm DL, N.I.N.A.)*
- other software that supports ASCOM Observing Conditions can be connected to AstroLink 4m Observing Conditions interface *(SGPro, N.I.N.A.)*

In the image below – AstroLink 4 USB is connected to the panel software, focuser, and switch are connected to Maxim and N.I.N.A software at the same time.
Software and firmware update

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

- download installer from the page
- disconnect AstroLink 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 the AstroLink 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/astrolink/ 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.
# Table of contents

Main features: .................................................................................................................. 2  
Technical data .................................................................................................................. 2  
Device overview .............................................................................................................. 3  
  Integrated USB 3.0 hub ................................................................................................... 3  
  Permanent 12V DC output ............................................................................................ 3  
  5V DC output ................................................................................................................ 3  
  Sensors .......................................................................................................................... 3  
  External view .................................................................................................................. 4  
Panel overview .................................................................................................................. 6  
  Menu .............................................................................................................................. 6  
  Status bar ....................................................................................................................... 7  
  Charts and notes ............................................................................................................ 7  
  Logo icon ...................................................................................................................... 7  
  Connection controls ..................................................................................................... 7  
    DIRECT connect ......................................................................................................... 7  
    ASCOM connect (recommended) ................................................................................ 7  
  Connection status ......................................................................................................... 8  
Focuser section.................................................................................................................... 9  
PWM section ................................................................................................................... 12  
Power section .................................................................................................................. 13  
Sensors section ............................................................................................................... 15  
12V output section ......................................................................................................... 17  
AstroLink charts .............................................................................................................. 18  
Overcurrent and overvoltage protection ........................................................................ 20  
  Overvoltage setting ....................................................................................................... 20  
  Overcurrent setting ....................................................................................................... 20  
  Protection sensitivity setting .......................................................................................... 20  
Temperature compensation ............................................................................................ 21  
  How to determine the temperature compensation coefficient? ................................... 21  
  How to use compensation? ........................................................................................... 21  
Compensation calculator ................................................................................................. 23  
  Data points quality ....................................................................................................... 23  
Ground loops ................................................................................................................... 26  
Scenario one .................................................................................................................... 26  
Scenario two .................................................................................................................... 26

Rev. 1.3
Scripting support ........................................................................................................................................ 27
Troubleshooting ..................................................................................................................................... 28
AstroLink log files .................................................................................................................................. 28
AstroLink device does not beep after connecting to the power supply ............................................... 28
AstroLink device is not recognized by the system after connecting to the computer - no COM port visible ........................................................................................................................................ 28
Connection was lost .................................................................................................................................. 28
The stepper motor buzz but does not rotate ......................................................................................... 28
The stepper motor becomes hot .................................................................................................................. 28
The sensor is not recognized - no value is read ..................................................................................... 29
Some fields in AstroLink panel software are red and there are window system sound and device beeps ........................................................................................................................................ 29
The stepper motor does not rotate after clicking the plus or minus button and one beep is heard 29
AstroLink device disconnects and restarts when any power or PWM out is turned on ...................... 29
The voltage or current values are not correct ......................................................................................... 29
Outputs are switched off and a popup window with a message opens ............................................... 29
Connections .............................................................................................................................................. 30
Power input ................................................................................................................................................. 30
Stepper motor output ................................................................................................................................. 30
Sensors inputs ............................................................................................................................................ 30
PWM outputs .......................................................................................................................................... 30
12V DC outputs ......................................................................................................................................... 30
5V DC output ............................................................................................................................................ 30
Third-party software ................................................................................................................................. 31
Software and firmware update ................................................................................................................. 32

Rev. 1.3