AstroLink 4 mini
# Table of contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>4</td>
</tr>
<tr>
<td>Specifications</td>
<td>5</td>
</tr>
<tr>
<td>Getting Started</td>
<td>6</td>
</tr>
<tr>
<td>System requirements</td>
<td>6</td>
</tr>
<tr>
<td>Power supply considerations</td>
<td>6</td>
</tr>
<tr>
<td>Installing drivers</td>
<td>7</td>
</tr>
<tr>
<td>Connecting device</td>
<td>8</td>
</tr>
<tr>
<td>PROG jumper</td>
<td>8</td>
</tr>
<tr>
<td>Basic operations</td>
<td>9</td>
</tr>
<tr>
<td>First time connect</td>
<td>9</td>
</tr>
<tr>
<td>3rd party software</td>
<td>10</td>
</tr>
<tr>
<td>Board revisions</td>
<td>10</td>
</tr>
<tr>
<td>Revision 1</td>
<td>10</td>
</tr>
<tr>
<td>Revision 2</td>
<td>11</td>
</tr>
<tr>
<td>Connecting peripherals</td>
<td>12</td>
</tr>
<tr>
<td>Stepper focuser motor</td>
<td>12</td>
</tr>
<tr>
<td>DC focuser motor</td>
<td>13</td>
</tr>
<tr>
<td>Sensors</td>
<td>14</td>
</tr>
<tr>
<td>Power outputs</td>
<td>15</td>
</tr>
<tr>
<td>Regulated PWM outputs</td>
<td>15</td>
</tr>
<tr>
<td>Regulated voltage output</td>
<td>16</td>
</tr>
<tr>
<td>Manual control</td>
<td>17</td>
</tr>
<tr>
<td>Controlling components</td>
<td>18</td>
</tr>
<tr>
<td>Connecting to device</td>
<td>18</td>
</tr>
<tr>
<td>Focuser control</td>
<td>19</td>
</tr>
<tr>
<td>DC focuser control</td>
<td>22</td>
</tr>
<tr>
<td>Power outputs control</td>
<td>23</td>
</tr>
<tr>
<td>Sensors and PWM outputs control</td>
<td>25</td>
</tr>
<tr>
<td>Other functions</td>
<td>28</td>
</tr>
<tr>
<td>3rd party software</td>
<td>29</td>
</tr>
<tr>
<td>Additional modules</td>
<td>31</td>
</tr>
<tr>
<td>Microstepping module</td>
<td>31</td>
</tr>
<tr>
<td>Hand controller module</td>
<td>32</td>
</tr>
<tr>
<td>Sky temperature sensor</td>
<td>33</td>
</tr>
<tr>
<td>AstroLink charts</td>
<td>33</td>
</tr>
<tr>
<td>Overcurrent and overvoltage protection</td>
<td>36</td>
</tr>
<tr>
<td>Temperature compensation</td>
<td>37</td>
</tr>
<tr>
<td>Compensation calculator</td>
<td>38</td>
</tr>
<tr>
<td>Scripting support</td>
<td>41</td>
</tr>
<tr>
<td>Regulated voltage application</td>
<td>43</td>
</tr>
<tr>
<td>Troubleshooting</td>
<td>44</td>
</tr>
<tr>
<td>Ground loops</td>
<td>46</td>
</tr>
<tr>
<td>How to check versions</td>
<td>47</td>
</tr>
</tbody>
</table>
Introduction

AstroLink 4.0 mini device has been created to make astrophotographers’ life easier. This small box merges several useful functionalities in one device:

- focuser stepper motor control (both bipolar and unipolar, Robofocus compatible. Microstepping available with additional module)
- advanced temperature compensation with scripting support and compensation calculator
- DC focuser motor control (compatible with SW Motofocus)
- PWM regulated outputs to control dew/mirror heaters, fans or custom peltier cooling custom adaptations with built in temperature controller
- 12V switchable on/off power outputs to control setup components
- 3-10V regulated voltage output
- temperature/humidity and temperature sensors to monitor these values, calculate dew point and control heaters and peltier cooling
- sky temperature / cloud coverage sensor (optional)
- manual control with optional hand controller
- monitor voltage and current consumption plus energy consumed (for battery powered field setups)
- programmable overcurrent and overvoltage protection
- measured values charts
- compensation calculator

Device can be powered with DC voltage in range 11-14V. Total current drawn from all AstroLink 4 mini outputs cannot exceed 10A. Device is controlled with dedicated software AstroLink 4 panel, but is also exposed four ASCOM interfaces that can be controlled with a 3rd party software in the same time AstroLink 4 panel software is connected. ASCOM interfaces are also available for scripting to automate acquisition process.
## Specifications

*AstroLink 4.0 mini* technical specifications.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power supply</strong></td>
<td>11-14V DC</td>
</tr>
<tr>
<td><strong>Maximum current</strong></td>
<td>10A</td>
</tr>
<tr>
<td><strong>AstroLink power consumption</strong></td>
<td>less than 1W</td>
</tr>
<tr>
<td><strong>Regulated PWM outputs</strong></td>
<td>2 outputs RCA regulated 0-100%, 3A max. current single output</td>
</tr>
<tr>
<td><strong>Switchable power outputs</strong></td>
<td>3 outputs DC 5.5/2.1mm, 5A max. current single output</td>
</tr>
<tr>
<td><strong>Regulated voltage output</strong></td>
<td>1 output DC 5.5/2.1mm, 3-10V, 1.5A max. current (2.5A peak)</td>
</tr>
<tr>
<td><strong>Focuser stepper output</strong></td>
<td>1 output DB9, bipolar or unipolar stepper compatible (Robofocus), 1.2A max. current (microstepping with additional module)</td>
</tr>
<tr>
<td><strong>Focuser DC output</strong></td>
<td>1 output RJ9, SW Motofocus compatible, 1.2A max. current</td>
</tr>
<tr>
<td><strong>Sensors inputs</strong></td>
<td>1 DHT22 humidity/temperatures sensor input Jack 3.5mm, 1 DS1820 temperature sensor input Jack 3.5mm (optional sky temperature sensor)</td>
</tr>
<tr>
<td><strong>Manual stepper control input</strong></td>
<td>1 input RJ9 (see manual for description)</td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td>147x92x36mm</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>190g</td>
</tr>
</tbody>
</table>

| System requirements           | Windows 7 or above, ASCOM platform 6.2, .NET 4.0 platform, USB port    |

| Device control                | - dedicated AstroLink panel software                                    |
|                               | - ASCOM device drivers (primary focuser, DC focuser, Switch, Observing Conditions) |
Getting Started

Before you start working with AstroLink device make sure your PC/laptop has at least one USB port available and operates under Windows 7 or later. Second thing you need to have is power supplier. Please see below a list of things to follow:

1. install AstroLink 4 panel software (installing software)
2. if you want to use 3rd party software install AstroLink ASCOM driver (installing software)
3. make sure the sensors are connected before turning on power supply (connecting device)
4. turn on power supply. You should hear a double beep after a moment (power supply considerations)
5. connect AstroLink with USB cable to PC/Laptop. After connecting USB cable you can hear several beeps (unless PROG jumper is set to OFF - rev. 2.0 only)
6. start AstroLink 4 panel software. Use DIRECT connect or ASCOM connect mode to connect to device (basic operations)

Details on connecting peripherals are described in Connecting peripherals chapter. Details on using AstroLink 4 panel software are described in Controlling components chapter.

System requirements

AstroLink 4.0 mini device requires a PC computer with Windows 7, 8 or 10 operating system (both 32 and 64 bit are supported) to work. Additionally the following software must be installed:

- ASCOM platform version 6.2 or above
- .NET framework 4.0

Device is connected to computer with USB port - both 2.0 and 3.0 is supported.

Power supply considerations

Power supply is a key element of each electronic device. AstroLink was designed to be powered with single power source and provide power to connected devices (focuser, camera, filter wheel, etc.). That's why quality of the both power supply and connections is crucial. These elements must fulfill following conditions:

- power supply must be able to provide enough current to all connected receivers. But having at least 20% of power margin is always a good idea, especially if we are not completely sure about quality and parameters of the supply we have
- power supply must be regulated (provide constant DC voltage), and output voltage should not change with changing of current that is drawn. It is especially important when using PWM regulated outputs for high current receivers like dewcap heaters with large power consumption or peltier cooling devices
- number of cable connectors must be kept as low as possible. Each connector causes power loss and voltage drop
- main power cable that provides power supply to AstroLink device must be kept as short as possible to minimize voltage drop
- main power cable cross-sectional area must be kept large enough to prevent excessive voltage drop

AstroLink 4 mini device is provided with 2m long power supply cable with cross-sectional area 1.0mm². This is sufficient to all except most demanding applications, when you have both PWM outputs loaded with high power receivers (for example two dew heaters, 50W total power). In this case it is advised to either make short connection between AstroLink and power supply or replace power cable with the one of larger cross-sectional area.
Other option is to use external AstroLink module - Power Switcher, that can be purchased separately. This module is capable to switch high power and can be powered from separate power supply.

Total current drawn from the AstroLink device cannot exceed 10A. There is 10A micro-fuse soldered to the PCB that will break the circuit when over-current will be detected. If it happens, the micro-fuse would need to be replaced. If the micro-fuse was burned due to reverse polarity or over-voltage it is also advised to replace security transil diode, that could be damaged. It is 14V one direction transil diode type.

Another topic worth consideration are ground loops in the astroimaging setup. You can read more about this at [Ground loops](#) section.

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### Installing drivers

Before connecting device to computer you need to install drivers. There is no need to install FTDI drivers in advance, because Windows operating system should find them automatically after connecting AstroLink 4 mini to PC USB port. However, if FTDI drivers will not be found and virtual serial port will not be installed, you need to download drivers from FTDI website and install them manually.

Software that needs to be installed is *AstroLink 4.0 panel*. This is standalone software that can control all functionalities and settings of *AstroLink* device. Software can be downloaded at [http://astrojolo.com/astrolink](http://astrojolo.com/astrolink) website.

If you want to control *AstroLink 4.0 mini* components with a 3rd party software you need to install the following additional driver:

- AstroLink Local Server driver (can be downloaded at website [http://astrojolo.com/astrolink](http://astrojolo.com/astrolink))

This package will install focuser ASCOM driver that allows to connect to the device from a 3rd party software like *MaxIm DL, APT, FocusMax, SGP, CCDSoft* and many others that support ASCOM drivers. The following drivers will be installed:

- AstroLink 4m Focuser
- AstroLink 4m DC focuser
- AstroLink 4m Switch
- AstroLink 4m Observing Conditions

*AstroLink Local Server* driver allows to connect to the device multiple control software simultaneously. This way you can for example monitor sensor values in *AstroLink* panel, control focuser with *FocusMax* and
MaxIm, or any other ASCOM compliant software. Also scripting support is available for automation of acquisition process.

Connecting device

It is general rule of thumb to make all cable connections before turning on power. This also applies to AstroLink device. However DC voltage outputs, PWM outputs, DC focuser output and stepper motor output may be connected and disconnected when AstroLink is powered, however make sure twice that corresponding output is turned off or idle when making connections.

AstroLink device is equipped with power cable ended with screw terminal to DC 5.5/2.1 adapter. This adapter can be used as temporary solution for testing, it cannot handle current higher than 5A. For permanent setup please consider changing it to the connection suited for your power supply output socket.

**BROWN cable** is positive - should be connected to power supply positive (+) connector

**BLUE cable** is negative - should be connected to power supply negative (-) connector

Sensors and remote controller must be connected before power is turned on. Connecting them to powered device may cause them not working and may also cause permanent damage to AstroLink device.

USB connection to PC computer can be made after power is switched on without any side effects. When AstroLink is not powered it will not be recognized by the system.

1) starting from firmware 4.2 it is also possible to connect sensors when power is turned on and sensor is detected properly

PROG jumper

In the Revision 2 of AstroLink board there is one jumper that can be set by user. Jumper is labeled PROG at the board. It is available after opening the case. It can be set to two positions:

- **ON.** It is default setting. In this setting device is reseted each time USB cable is plugged into USB port in computer. This setting allows also to reset device remotely with proper setting in the driver. And also this setting is required for updating AstroLink firmware.

- **OFF.** In this setting software reset is disabled. Device will not be reseted when USB cable is plugged in or out to computer or USB hub, remote reset will not work and also updating firmware is not possible.
Basic operations

**AstroLink 4.0** device can be controlled from computer in two modes:

- **Direct control.** Then *AstroLink 4.0 panel* connects to device directly and no other software can control any *AstroLink 4.0* functionality.
- **ASCOM control.** In this case *AstroLink 4.0 panel* connects to device via ASCOM focuser driver. Any number of other 3rd software can control device in the same time.

More details on both solutions can be found in [Controlling components](#) chapter.

First time connect
To connect *AstroLink 4.0 panel* software to the device for the first time follow these steps:

- make sure all cables are connected
- turn on power supply. After a few seconds you should hear a double beep
- in *AstroLink 4.0 panel* select **DIRECT connect** mode
- click cogwheel settings button next to **Connect/Disconnect** button
- select proper COM port. Check **reset AstroLink device on connect** (you can uncheck it later). Click **Test port**. Communication should be established
- click **Save** to close settings window
- click **Connect**. After a moment panel should communicate to the device and should be fully operational

See controlling components chapter for more information on working with *AstroLink 4.0 panel*.

### 3rd party software

There is also a possibility to use *AstroLink panel* software together with other ASCOM compatible software that supports focusing automation (like FocusMax, Sequence Generator Pro or MaxIm DL). In this case you need to connect *AstroLink panel* in ASCOM connect mode. See Connecting to device section for more details.

Additionally any other 3rd party software that supports ASCOM relative focuser, ASCOM Switch or ASCOM Observing Conditions can be connected to the device to control and monitor corresponding values. Another option is to write your own scripts that automates imaging session.

### Board revisions

Here is the PCB board revision one. In this revision regulated voltage module is mounted upside down, so to access voltage regulator potentiometer you need to unscrew board and pull it out from the casing.
Revision 2

Here is the board in revision 2. Changes list:

- regulated voltage module is now oriented correctly, so you can adjust voltage without unscrewing the board
- PROG jumper has been added
- resettable fuses for motor controllers has been added
- additional PWM filter has been added
Connecting peripherals

In the following sections details on connecting peripherals to AstroLink device are described.

Stepper focuser motor

AstroLink device can power both unipolar and bipolar stepper motors. DB9 socket pinout is compatible with Robofocus and Moonlite focusers.

<table>
<thead>
<tr>
<th>DB9 socket pin</th>
<th>Robofocus compatible unipolar stepper motor</th>
<th>Bipolar stepper motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Coil A +</td>
<td>Coil A +</td>
</tr>
<tr>
<td>2</td>
<td>Coil A -</td>
<td>Coil A -</td>
</tr>
<tr>
<td>3</td>
<td>Coil B+</td>
<td>Coil B+</td>
</tr>
<tr>
<td>4</td>
<td>Coil B-</td>
<td>Coil B-</td>
</tr>
<tr>
<td>5</td>
<td>Common</td>
<td>Not connected</td>
</tr>
<tr>
<td>6,7,8,9</td>
<td>Not connected</td>
<td>Not connected</td>
</tr>
</tbody>
</table>

There is available additional microstepping module that allows to control bipolar steppers with resolution up to 1/32 step.
DC focuser motor

DC focuser motor output is compatible with *SW Motofocuser*. DC motor that you want to connect to RJ9 4pin socket can drain maximum 1.2A current. RJ9 socket connection:

<table>
<thead>
<tr>
<th>RJ9 pins</th>
<th>DC motor connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,2</td>
<td>DC motor +</td>
</tr>
<tr>
<td>3,4</td>
<td>DC motor -</td>
</tr>
</tbody>
</table>
Sensors

Two sensors may be connected to the AstroLink 4.0 mini device. One DHT22 temperature/humidity sensor can be connected to port Sensor 1. To the port Sensor 2 DS1820 temperature sensor can be connected. Values read from the sensors can be used for:

- controlling PWM output for dewcap heaters (basing on current humidity - DHT22 is required)
- controlling PWM output for temperature regulator (for example for Peltier cooling)
- focuser position temperature compensation

Port Sensor 2 can be also used to connect sky temperature sensor.

Sensors pin-outs and connections are presented in the diagram below. Sensors must be connected to AstroLink device before power is switched on. Otherwise sensors will not be detected.
### Power outputs

There are three switched DC power outputs in the AstroLink mini device. Each of DC power output can provide up to 5A (however total current drawn from AstroLink mini device cannot exceed 10A). When you plan your connections please keep in mind power supply considerations presented [here](#). Voltage at the DC output is equal to the voltage that supplies AstroLink device (can be in a range 11-14V) - there is no additional voltage regulator in the device for DC outputs.

If you need to switch more than 5A you can use Power switch additional module.

### Regulated PWM outputs

There are two PWM regulated outputs in the AstroLink mini device. Each PWM regulated output can provide 3A of current (however total current drawn from AstroLink mini device cannot exceed 10A). When you plan your connections please keep in mind power supply considerations presented [here](#). PWM regulated outputs can work with four different frequencies that can be set in control panel - these are 122, 490, 3900 and 31000 Hz. To minimize voltage ripple it is usually recommended to use higher frequency, however if PWM receiver cannot for any reason work at high switching frequency, this setting must be adjusted. Default preset value is 31000Hz.
Voltage at PWM output is switched from zero to the voltage that AstroLink mini device is supplied (so it can be in a range 11-14V). There is no additional voltage regulator for PWM outputs.

If you need to switch more than 3A you can use Power switch additional module.

Regulated voltage output

There is one additional voltage regulator in the AstroLink mini device. This regulator is DC/DC step down switching regulator that can provide up to 1.5A of continuous current to any customer device (2.5A peak). This regulated output cannot be turned on and off - it is always on. Voltage at this output can be set using small potentiometer at switching module (see picture below). Output voltage can be set to any value between 3V and 10V.

Voltage in the regulator is set to 5 or 8V by default (depending on version). It can be however adjusted by end client. There is small potentiometer in the DC regulator module. To access it you need to:

- in board Revision 1 - open AstroLink device, unscrew four screws that holds board inside. Then pull it out and you can access potentiometer in the module
- in board Revision 2 - open AstroLink device and you will see potentiometer in the area next to regulated voltage output at small separate module

You will find how to check board revision in How to check versions chapter. You can check how both boards look like in Board revisions chapter. To adjust voltage you need 2mm flat-blade screwdriver. You can read mode about regulated voltage output at Regulated voltage application topic.
Manual control

There is five button remote controller available (sold separately) for AstroLink 4.0 mini device. Controller needs to be connected to the proper input socket (labeled as Control), and manual control option needs to be enabled in AstroLink 4 panel software.
Controlling components

AstroLink 4 mini device functions can be controlled using dedicated software - AstroLink 4 mini panel. When opened for the first time and connected to the device panel may look like this:

Panel is divided into several sections that are responsible for specific functions control. In the next chapters each section will be described in details starting from the connection to the device.

Connecting to device

Panel can communicate with the device in two modes. First one is DIRECT connect - then panel connects directly to the device and no other interface can control any of device components in the same time. Second communication mode is ASCOM connect. In this mode panel connects to the device using installed AstroLink ASCOM Focuser driver, and as this driver is a part of multi-driver Local Server instance many other applications can control any of ASCOM interfaces in 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 proper COM port where AstroLink device is connected and detected. After selecting port you can click Test port to make sure the device is connected properly. After clicking Save button settings will be saved and software will connect to AstroLink device each time using selected port. There is another option in the window called reset AstroLink device 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. See also PROG jumper chapter.

ASCOM connect (recommended)
After selecting ASCOM connect and clicking on Settings button ASCOM Focuser Chooser window will open. You need to select AstroLink 4m Focuser interface and then click Properties button, so ASCOM connection setup window will open. Here you need to select COM port where AstroLink device is connected. You can also test connection using Test port button. When trace check-box is checked ASCOM log file will be written with all communication between 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.

Both connection modes offers the same functionality. The only difference is that DIRECT connect works exclusively, so no other software than panel can communicate with device. ASCOM connect mode allows other 3rd party software to operate with device in the same time - see 3rd party software section.

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Focus control
Once AstroLink panel is connected to the device, stepper focuser motor can be operated with corresponding controls:
1. These fields are read only. First field presents current focuser position in steps, second presents focuser tube position in mm.

2. These buttons can be used to relative movement of the focuser. Once '+' or '-' button is pressed focuser will be moved with the selected number of steps in the desired direction. Minus button moves focuser inwards (so focuser tube moves into the telescope, and distance between detector and optics decreases). Plus button moves focuser outwards. Two additional buttons with 'x' prefix allows to coarse focuser movement. Each time one of these buttons is pressed focuser moves with the selected number of steps times the selected multiplier. So when relative move field shows 20 steps and you click x4 focuser will move 80 steps. Multiplier can be chosen with value from 2 to 10 (see Coarse move selection).

3. STOP button can be used to stop focuser movement at any moment.

4. Compensate button can be used to compensate focuser position with the steps number displayed in Compensation amount box. This way we can do compensation in a convenient moment in time, for example when camera is idle between exposing subframes. You can also reset calculated compensation amount to zero steps by clicking on the compensation amount window. Confirmation dialog will appear for this operation. See Temperature compensation section for more details on this subject. Another option is use script to trigger compensation between subframes - see Temperature compensation section.

5. Settings button. This button opens additional menu with several options:
   1. 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.
   2. 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.
   3. Coarse move multiplier selection. Here any value between 2 and 10 can be selected to use for coarse relative movement.
   4. Focuser settings button. Clicking here opens Focuser settings window (see below).

6. Absolute focuser move. You can enter any value between 0 and maximum focuser position (see Settings section) and when you press GO focuser will move to this position.

---

**Focuser settings**

Settings window contains two tabs. First tab contains stepper motor related settings:

- **Max. focuser position** - here you need to enter maximum focuser position, so focuser will not move to any larger value. This is to prevent any mechanical damage to focuser.
- **Speed [pps]** - focuser stepper speed in pulses per second. You need to select appropriate value, so focuser will move with reasonable speed, but no steps will be lost during move. For popular unipolar stepper motors with 7.5 degree step it should be usually no more than 120-150. Bipolar steppers with 1.8 degree step usually can operate with faster rate, up to 400-500pps.
- **Acceleration [pps/s]** - each time stepper starts to move, it accelerates to the speed selected in the field Speed. Here you can enter acceleration value. So for example, when selected speed is 300pps, and you select acceleration value for 600, then stepper will accelerate to maximum speed in 0.5 seconds from move start. 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.
• **Hold motor on idle** - when this is checked 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. When using microstepping module motor will always be powered when stopped. **Make sure the stepper motor you use is designed to be powered constantly if you want to use this option.**

• **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 focuser position will cause focuser tube move into the telescope

• **Stepper type** - can be selected between Unipolar (like Robofocus compatible) or Bipolar motor. Check [Stepper focuser motor](#) for connection details. Third option is Microstepping control - make sure you have corresponding module connected.

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

There are a few more settings in the second tab (named **Compensation**):

• **Enable compensation** - switch compensation on or off

• **Temp. compensation cycle [s]** - here you can enter compensation cycle time in seconds. So every selected number of seconds temperature will be read and compared to initial value, and focuser will be moved to adjusted position

• **Compensation steps [steps/C]** - this is the number of steps the focuser will move when temperature will change from the initial value. So if you put here 35 and the temperature will drop 2°C, then focuser will move 70 steps (outwards). This value usually must be determined in practical way, 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 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 **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 **Auto compensation threshold** value

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

There are also four buttons at the windows bottom:

- **Defaults** will cause all fields to be populated with default values.
- **Close** will close settings window without saving values to the device.
- **Save** will store settings into the AstroLink device EEPROM memory. They will be preserved when power is down.
DC focuser control

DC focuser motor is controller by sending two parameters: move time in milliseconds and PWM duty cycle in %. Move time is the time the DC motor will rotate. PWM duty cycle parameter is responsible for torque of the DC motor. When set to 100% motor will rotate with full torque and speed. When PWM will be lowered the torque of the motor will decrease and also rotational speed will be lower. This behavior is not consistent across different DC motor types. Usually decreasing PWM to value lower than 20-30% will cause DC motor not even to start rotation. Check DC focuser motor for connection details.

Buttons '-' and '+' will start DC motor rotation with given parameters. Button STOP will stop rotation at any given moment.

Clicking cogwheel button will open small settings window. There is one option that can be set:

- **DC motor reversed** - checking this box will effect in reversing rotation direction

There are also four buttons at the windows bottom:

- **Defaults** will cause all fields to be populated with default values.
- **Close** will close settings window without saving values to the device.
- **Save** will store settings into the AstroLink device EEPROM memory. They will be preserved when power is down.
There are two sections related to power control in AstroLink 4.0 mini device. Power section is mainly informative - it contains following fields:

- **V in.** - this field displays current supply voltage value
- **V reg.** - this field displays current regulated voltage output value
- **I total** - this field displays current drawn by the device and all attached gears from the power supplier
- **Energy consumed** - these two fields displays 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 battery

Clicking at cogwheel button in the Power section opens settings dialog. This window contains following fields:

- **Total current warn level** - when total current drawn will exceed this value 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
- **Low reg. voltage warn** - when output voltage will decrease below this value alert will be triggered
• *also buzz with device buzzer* - when one or more alerts is triggered there will be sound signal emitted from the AstroLink device
• *also alert with system sound* - when one or more alerts is triggered there will be system sound alert played in the computer

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

These last two settings also are valid for *Protection* tab (you can read more about protection in AstroLink at [Overcurrent and overvoltage protection](#) topic:

• *Overvoltage protection level [V]* - when input voltage will exceed this level for 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 time longer than specified as protection sensitivity time all PWM and DC outputs will be switched off
• *Protection sensitivity [ms]* - delay between protected condition and the moment the PWM and DC outputs will be switched off

Third tab is called *Advanced*:

• *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 ADC coefficient also current sensor needs to be calibrated. To do it you need to disconnect all receivers from AstroLink device and click this button. After a moment current sensor will be calibrated.

Second section is called *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. See *power outputs* section for connection details. Lock outs check-box can be checked and then three boxes above will be locked (not clickable). This way you can prevent from accidentally turning on or off any of connected devices.

Under cogwheel button settings windows is hidden. There are not much options however. You can label each power output, so it can have meaningful name like 'Mount' or 'CCD main camera'. On the second tab there are three check-boxes that control power on behavior. If check-box is checked then corresponding output will be on after turning on the power or reseting device.
There are also four buttons at each setting window's bottom:

- **Defaults** will cause all fields to be populated with default values.
- **Close** will close settings window without saving values to the device.
- **Save** will store settings into the AstroLink device EEPROM memory. They will be preserved when power is down.

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**Sensors and PWM outputs control**

Sensors and PWM sections are separate ones, although they work together to provide some combined functionalities. **Sensors section** contains four read-only fields that labels may be changed:

- **#1 Temp.** - displays DHT sensor measured temperature
- **#1 Humidity** - displays DHT sensor measured humidity
- **#1 Dew-point** - displays DHT sensor calculated dew-point temperature
- **#2 Temp.** - displays DS sensor measured temperature
- **Temp. change (click to reset)** - that is simple temperature change monitor. It displays difference between current temperature and temperature at defined point of time. By default it is device power-on moment, but starting point can be reset to current temperature by clicking at this field and confirming temperature change monitor reset.

When the optional sky temperature sensor is connected, instead of **#2 Temp.** there will be sky temperature sensor data displayed:

- **Sky temp.** - it is measured sky temperature value
- **Difference** - it is difference between sky and ambient temperature. Large difference indicates clear sky, when the difference is close to zero cloud coverage is full.
- Additionally one of five icons is displayed that presents current cloud coverage
There is settings window available after clicking on cogwheel button. In this window you can change sensor labels, so it can have some meaning, like 'OTA temp.' or 'Mirror dew-point'.

An in the second tab called **Temp. change 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 device
- **Temp. change warning** - it is the difference between the current temperature and start temperature that causes alert to be triggered. When temperature difference is close to this value, temperature window becomes orange. When the limit is reached, temperature window becomes red and alerts are emitted (if activated)
  - **also buzz with device buzzer** - when temperature change limit is reached alert signal will be emitted from AstroLink device buzzer
  - **also alert with system sound** - when temperature change limit is reached system alert sound will be played

Following options are only available, when optional sky temperature sensor is connected:

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

Cloud sensor tab contains threshold levels that changes icon representing sky conditions. Default values 8, 12, 18 and 25 degrees are usually suitable for average location. However if sensor is used in specific conditions (desert, mountains, lake or river proximity) these threshold levels may need to be adjusted.
Another section is PWM. In this section each of two PWM outputs has corresponding field where current PWM output value can be read. Additionally there is select-box, where you can set required PWM value for each output. Value can be set from 0 to 100% and there are two additional operation modes:

- **HEAT** - when this option is selected PWM output will be automatically adjusted according to the current measured humidity. The larger humidity is, the more power is set on PWM output. This can be used for example to control dewcap heaters.

- **AUTO** - when this option is selected the PWM output is controlled with simple controller, so it will work to keep given sensor in preselected temperature. It can be used for example to control peltier cooling ATM solutions.

Additional settings for these two operation modes are available in settings popup window under cogwheel button. This window contains five tabs.

First tab **Labels** contains labels for each PWM output, so it can be set for example to 'OTA dewcap' or 'Guider cooling'. Another two select boxes determines the start up state of PWM outputs. Any value set here will be set up to PWM output after power is on.

Second tab **HEAT** contains parameters used when HEAT option is selected for PWM output:

- **Start heat at humidity [%]** - when humidity reaches given value the PWM output will start to work at minimum power

- **Full heat at humidity [%]** - when humidity reaches given value the PWM output will work at full 100% power
Third tab **AUTO** contains parameters used when AUTO mode is selected for PWM output:

- **Temperature sensor** - selected sensor will be used to measure temperature for PWM control
- **Temperature preset [C]** - PWM output power will be adjusted to keep selected sensor at the given temperature
- **Control direction** - when output should increase with increased value (DIRECT) or should decrease with increased measured value (REVERSED)

Last tab is **Frequency**. Here there is only one select box where you can change 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.

---

**Other functions**

There are several other options available in the AstroLink panel software.

1. This is Notes panel - after clicking at this button small editor will popup, where you can note down some information you need during imaging session (like focuser positions, flat images exposure time, etc). Its content is saved dynamically.
2. This check-box controls buzzer - if you uncheck this field, buzzer will not beep
3. After clicking at the logo icon small information window will popup - it contains firmware version information
4. Status bar displays several different informations, that are visible depending on context. It is read only field
5. 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 manual control box to AstroLink device
   - **Compensation calculator**. This option opens additional popup window with compensation calculator. See **Compensation calculator** section for details
   - **Reset device to factory defaults** - this option will reset all device settings to factory default values. Confirmation window will be opened.
   - **Settings Load.../ Save...** - this options allows to save or load all device settings and configuration. All settings, labels, initial PWM and power output values can be stored.
6. **Stay on top**. Checking this box makes AstroLink panel not to go to background when other application is selected
7. This button opens additional window with AstroLink charts. See **AstroLink charts section** for details

---

**3rd party software**

When *AstroLink* device is connected in **ASCOM connect** mode, all ASCOM compatible software can control *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 in 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) connected to *AstroLink 4m Focuser* interface, so you can focus automatically
- other focusing software that supports relative ASCOM focuser can be connected to *AstroLink 4m DC focuser* interface
- other software that supports ASCOM Switch can be connected to *AstroLink 4m Switch* interface
- other software that supports ASCOM Observing Conditions can be connected to *AstroLink 4m Observing Conditions* interface
Additional useful option is to run your own scripts, where you can control all AstroLink functions.
Microstepping module

Microstepping module is a small box that can be used to control bipolar stepper motors with high accuracy (up to 1/32 step). Stepper motor is connected directly to screw terminal connector, and module is equipped with 1.5m length cable ended with DB9 plug that should be connected to *AstroLink* stepper socket. Last thing to do is to set proper option in focuser settings window:

Microstepping allows to achieve higher precision when setting focus, so theoretically it is possible to get rid of mechanical gear box, however this solution has several drawbacks:

- microstepping controller draws current when motor is idle. It is necessary to keep motor in stable position at fraction of the step
- when you use microstepping then motor torque is lower - it requires much less torque to move stepper shaft between 1/32 step than between 1 step
- if you get rid of mechanical gears then you need to use larger and heavier stepper motor to have enough torque to move main focuser shaft

Microstepping module can work in several modes: full step, 1/2, 1/4, 1/8, 1/16 and 1/32 steps. To set required resolution you need to open module casing and set proper combination with built in DIP switch. If you set for example 1/16 step resolution, and you stepper has nominal 200 steps per rotation, then for one stepper revolution you need 3200 steps in AstroLink panel. After turning microstepping on you probably will want also to increase stepper speed and acceleration in focuser settings window.

<table>
<thead>
<tr>
<th>DIP1</th>
<th>DIP2</th>
<th>DIP2</th>
<th>DIP4</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>Full step</td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>Half step</td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>1/4 step</td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>1/8 step</td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>1/16 step</td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>1/32 step</td>
</tr>
<tr>
<td>ON</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>Disabled</td>
</tr>
</tbody>
</table>

What stepper can be used? Any bipolar stepper would work, however it is required to set up current limit (it is set by default to 0.5A). For the microsteps mode to work correctly the current limit must be set low enough, so that current limiting is engaged. Otherwise the intermediate current levels will not be correctly maintained and the motor will skip microsteps. For the same reason, when you want to use microstepping resolution, you should not use motors that require supply voltage higher than 7-8V. You can adjust current limit to your stepper specifications, you need to measure voltage between the pins shown at the image below and adjust this reference voltage with potentiometer:

And the current limit will be equal to doubled measured voltage (https://www.pololu.com/product/2133).

\[
\text{Current Limit} = V_{\text{ref}} \times 2
\]

Maximum current the module is able to provide is 1.0A per coil, so you should not set reference voltage higher than 0.5V.
Hand controller module

Hand controller module is simple five buttons keyboard that allows to perform basic operations. Hand controller needs to be connected to device before power is turned on. Then it must be enabled in context menu options (press small cogwheel button at low left corner of application:

Buttons functions are:
- two buttons to control stepper focuser motor (yellow - plus, blue - minus)
- two buttons to control DC focuser motor (green - plus, white - minus)
- one (middle) button to cycle speed (red)

There are four speed settings. Each time speed button is pressed speed is changed up, and when there is maximum speed set, then it goes back to lowest speed. Each speed change is confirmed with beep signal - number of beeps indicates current speed. One beep is lowest, four beeps is highest speed. For stepper motor speeds are 1/8, 1/4, 1/2 and full speed, where full speed is the one set in the AstroLink panel focuser settings window. For DC motor speeds are mapped to PWM settings: 30, 50, 70 and 100%.

There is no confirmation beep signal after motor is stopped in manual mode.

When hand controller is not connected make sure Manual control option is off. Otherwise some random motor movement may occur (only in revision 1.0 of device).
Sky temperature sensor

Sky temperature sensor is additional module available for AstroLink 4 device. It contains remote temperature sensor (pyrometer) that can sense sky temperature. Basing on this information cloud coverage can be determined. When cloud coverage is high, then difference between ambient temperature and sky temperature is low. And when the sky is clear, then this difference is large, can be 20 °C or more.

Sky temperature sensor needs to be plugged into Sensor 2 socket. You can use sky temperature sensor together with temperature/humidity sensor. Both AstroLink 4 firmware and panel software must be at least at version 4.2 to work with sky temperature sensor properly (how to check version).

To avoid dew condensation on the sensor it is equipped with small heating element. However this element must be separately powered with voltage in the range 4 to 14V. The power to heating element must be connected to additional jack 3.5mm socket in the sky temperature sensor. Socket is tip positive. Heating element power consumption is less than 0.1W. You can power heating element from 12V outputs of AstroLink or regulated output or any other power supply that is available.

When you connect sky temperature sensor to the AstroLink corresponding section in the AstroLink panel is displayed:

![Sky temperature sensor display](image)

Displayed values are: measured sky temperature and difference between sky temperature and ambient temperature. Additionally an icon is shown that reflects the actual situation. The temperature difference thresholds for different icon types can be set in the Cloud sensor tab of Sensor settings window. Depending on your local environment (mountains, large water reservoirs, sea, forest) these threshold values may be different that default ones. They need to be determined by actual observations.

Sky temperature sensor is designed to work with AstroLink 4 device only. Connecting it to other device type may damage the sensor and/or the device.

Connecting any voltage higher than 14V to heating element may damage the sky temperature sensor.

AstroLink charts

AstroLink charts is the tool that allows you to monitor following data that is collected by AstroLink device:
- temperature, humidity and dewpoint measured by DHT22 sensor (if connected)
- temperature measured by DS1820 sensor (if connected)
- sky temperature and difference between sky and ambient temperature (if sky temperature sensor is connected)
- focuser position in steps
- PWM outputs power in%
- switchable DC outputs states
- input and regulated voltages value
- total current draw
- total energy consumed

Charts start to collect data in the moment AstroLink panel software connects to AstroLink device. You can open charts window by clicking corresponding button in the lower left part of the panel (see Other functions topic). After opening charts window the default view is opened - that is a mixed plot of the temperature and focuser position. Chart scale is calculated automatically. You can zoom any selected chart range by selecting it with mouse. Then scroll bar will appear, so you can pan the graph. To cancel zoom you need to press small button at the left side of scroll bar. After clicking with right mouse button in chart area the context menu will be opened. In this menu following options are available:
- First five options can be used to switch between different views of plots that presents different data in combined way
- Export as image - this option saves current graph as PNG image in the folder selected by user in the dialog. The saved image will contains exactly what is visible at 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 Excel sheet and processed
- Data collection period - here you can set 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 point 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 is 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 user) then all PWM and DC outputs will be switched off. Default protection settings are:

- Voltage: 14.0V. It is also maximum allowed input voltage for AstroLink device
- Current: 10.0A. It is maximum output current that 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 regulated 12V power supply, then reasonable value here could be 12.5 or 13V. For 13.6V regulated voltage we can stay at default value of 14V.

Overcurrent setting
This preset should be adjusted to the receivers that we power from AstroLink. If we have mount that drains 2A when doing GoTo, camera that drains 2.5A at maximum cooling power and dewcap heater that consumes 1.5A, then 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 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, then device is waiting this amount of time and checks if this condition still occurs. If so, then 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 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 mini is implemented in a linear way. So there is only one parameter that describes how temperature affects the focus point. It is not perfect approach, however its accuracy is good enough to most amateur setups.

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

**How to use compensation?**
Once you enter the compensation value into Compensation field of focuser settings, you need also to fill two more parameters. First one is Temperature compensation cycle. This parameter determines how often temperature change is monitored and compensation amount is calculated. Reasonable values here are between 15 and 60 seconds. Second parameter is Auto compensation threshold. Here you need to specify 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 in the web (http://www.wilmslowastro.com/software/formulae.html#CFZ for example). Then you need to select sensor that will be used to monitor temperature and select operation mode.

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

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

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

```vbs
' AstroLink 4 mini 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 compensation threshold in steps. So actual compensation will be applied only, if compensation amount will exceed threshold value. You need to adjust this threshold value in the script according to your setup specifications, in the similar way like 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 each single exposure. And compensation will be applied not every time, but only when given threshold will be exceeded. This way you can avoid changing focus point during exposure. You can use script only when AstroLink panel software is connected to the device in ASCOM mode.
Compensation calculator

*Compensation calculator* is simple tool that can be used to calculate compensation coefficient basing on temperature and focuser position points read from *AstroLink panel*. *Compensation calculator* can be found in the menu as shown below:

There is two column table on the left part and data points plot. Each table row is one point of data - first cell contains temperature, and second contains 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 *AstroLink panel* to the last table row. When there are two or more data points available, there will be plot 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 compensation coefficient calculated and displayed below the plot.

In the bottom right corner there is *Open focuser settings* window button that can be used to open focuser settings window. There you can check current compensation coefficient, enter 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 *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 row or more rows by selecting them in the first column and clicking *Delete* button.

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

**Data points quality.**

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

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

If one or two points are clearly incorrect, and all other fit straight line nicely, then these bad points may be result of mistake, and can be removed from data point set. You need to select them in the data table and remove using *Delete* key.
If the collected data points make a shape of a curve that crosses calculated compensation line, it indicates that your setup focus point does not change in linear way in the temperature range you choose. But you may still use compensation with 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 of bad quality. 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 focus shift between different filters, and calculated coefficient may not be accurate.
Scripting support

You can also control AstroLink 4 mini device using scripts to automate acquisition process. All ASCOM interfaces (AstroLink 4m Focuser, AstroLink 4m DC focuser, AstroLink 4m Switch, AstroLink 4m Observing Conditions) are available and can be controlled from the script. You can find 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).

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

```vbs
' AstroLink 4 mini focuser move script
' 2017 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 mini switch example
' 2017 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
```

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

Besides standard ASCOM interface methods there are several raw commands that you can invoke using commandString method on any of AstroLink 4 ASCOM interfaces. These commands are:

**commandString("q")**

This command will return concatenated string with multiple monitoring values. It may look like this

```
q:999:0:0.06:2:21.9:53.9:12.1:0:0.0:0:0:0:0:0:12.1:5.0:0.00:0.01:0:0
```

and values in this string are:

- stepper position
- stepper distance to go (when moving)
- current in A
- sensor 1 type
- sensor 1 temperature
- sensor 1 humidity
- sensor 1 dew point
- sensor 2 type
- sensor 2 temperature
- sensor 2 humidity
- sensor 2 dew point
- PWM out 1 value
- PWM out 2 value
- DC out 1 value
- DC out 2 value
- DC out 3 value
- input voltage
- regulated voltage
- total energy consumed in Ah
- total energy consumed in WH
- 1 when DC motor is running
- calculated compensation amount

commandString("t") - returns temperature in C
commandString("h") - returns humidity in %
commandString("d") - returns dew point in C

commandString("S:value") - described in Temperature compensation section

Please do not try to use raw string commands other than listed above, because it may lead to unexpected device behavior.
Regulated voltage application

Regulated voltage output in AstroLink 4 mini device is built on DC to DC converter. It can provide 1.5A maximum continuous current, and 2.5A peak current (for less than 3s). Output voltage can be set in the range from 3 to 10 volts. This is perfectly suitable for powering:

- DSLR cameras (using battery adapter). In this case you need to check in camera manual what should be correct voltage. For Canon cameras it is usually 7.6-7.8V
- USB2.0 active hubs. 1.5A continuous current is enough to power 3 active USB2.0 devices, but not all devices connected to USB hub drains power from the hub. If the device has its own power supply, then it probably do not drain power from the hub
- USB3.0 active hubs. 1.5A current is enough to power 1 active USB3.0 device (USB3.0 device can drain up to 1A current from the port)

When you power your active USB hub from regulated voltage output please read ground loops topic. If you have any communication problems with devices connected to USB hub try to power USB hub from separate power supply. If devices work well with separate power supply, but do not work when USB hub is powered from AstroLink regulated output, then it most probably means that you have ground loop in this latter configuration. Take a look to ground loops topic for possible solutions.
Troubleshooting

AstroLink log files
All AstroLink log files are created in the *My Documents/AstroLink* folder. Files that name contains only current date are data collections from *AstroLink charts* and can be imported to any other software (like MS Excel) for further processing. Files that names starts with *AL4mini-log-* contains errors and warnings generated by software. You can check its content if something is not working properly. If you connected to AstroLink device using ASCOM mode (recommended) then you can also check trace option in 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 power supply.**
- check if power supply voltage is within the range 11-14V DC
- check if polarity is correct
- check if micro-fuse is not broken, see *Power supply considerations* (it could happen when too much current has been drawn from device, power supply voltage was too high or polarity was reversed)

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

**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

**Stepper motor becomes hot**
- *Hold on idle* 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 gear box, then it may not be necessary.

**DC motor does not rotate**
- increase *PWM* value
- check if wiring is correct

**Sensor is not recognized - no value is read**
- disconnect device, turn off power, plug out and plug in sensor and reconnect power and AstroLink panel

**Some fields in AstroLink panel software are red and there is window system sound and device beeps**
- one or more alert levels has been exceeded. See *Power outputs control* section or *Sensors and PWM*
AstroLink 4 mini

outputs control section for details

Stepper motor does not rotate after clicking plus or minus button and one beep is heard
- next move position exceeds limits (is either below zero or over Maximum position setting). See Focuser control section for details

Stepper motor and DC motor do not rotate when pressing manual control buttons
- check if manual controller is connected properly
- check if Manual control option is turned on - Hand controller module

Stepper or DC motor rotates randomly
Make sure Manual control option is turned off when hand controller is not connected - Hand controller module

AstroLink device disconnects and restarts when any power or PWM out is turned on
The reason is too much voltage drop in the moment of switching power to any of connected peripherals.
- make power cables shorter or use power cables with larger cross-section area
- consider using Power Switch module to switch power for heavy loads. Then you can use separate power supply.

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

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

Does AstroLink need to beep so many times after plugging in USB cable into PC?
Unfortunately yes. All possible outputs of internal controller has been used and one of them is also used by controller bootloader that after turning on power waits for possible firmware update. This is indicated by a few pulses at one of outputs and this output was connected to buzzer. If you have board revision 2 or later you can set PROG jumper to OFF to disable this soft reset.
Ground loops

Ground loop in electrical system occurs, when two points that should have the same potential actually 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 mirror cooling fan, and this mirror fan socket is fixed in the metal mirror cell. Its minus is connected to metal telescope tube
- imaging camera case is also connected to power supply minus.

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

**Scenario two**
- active USB hub is powered from the regulated voltage output from AstroLink
- imaging camera is powered from DC AstroLink output
- camera is connected to USB hub with cable

In this scenario negative voltage is supplied to camera also in two ways. First one is main power cable between camera and AstroLink. Second loop is from 5V output in AstroLink, to USB hub and then with USB cable to camera.

Ground loop may cause some problems with connections, that are hard to investigate. The best way is to avoid them. Possible solutions for second scenario are:
- connect imaging camera to the computer without additional USB hub
- power camera from separate supply
- power USB hub from separate supply
- do not power USB hub at all - maybe it is not required
- use USB cable with galvanic isolation
How to check versions

If you want to check current version of software, firmware and device revision you need to connect to the device and then click on the logo image next to Connect button. Then small window will be displayed with following information:

You can also check how different board revisions look like in Board revisions chapter.
Software update

New software version can be found at [http://astrojolo.com/astrolink-4-0-mini/](http://astrojolo.com/astrolink-4-0-mini/) page. There are two independent software components - *AstroLink Local Server* and *AstroLink Panel*. To update your 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 new updated version
- after connecting check if all your settings have been preserved

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

When you notice that *AstroLink Local Server* driver was not updated properly after installation, you need to perform 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.
Firmware update

Up to date firmware can be checked and downloaded from page [http://astrojolo.com/astrolink-4-0-mini/](http://astrojolo.com/astrolink-4-0-mini/). To upload new firmware to AstroLink device you need also to download XLoader software. Then you need to perform following steps:

1. if you have device with revision 2 or higher board make sure PROG jumper is set to ON (this is factory default setting). [How to check board revision?](#)
2. disconnect USB cable, power supply and all peripherals from AstroLink device
3. connect power supply back to AstroLink device
4. connect USB cable to AstroLink device and to the computer
5. unzip XLoader software to a folder
6. start XLoader.exe program and choose following options:
   1. as *Hex file* select firmware file that you downloaded from page
   2. as *Device* select Duemilanove/Nano(ATmega328)
   3. as *COM port* select the port AstroLink is connected to
   4. as *Baud rate* select 57600

Then press *Upload* button. The process should take less than minute. After firmware is uploaded you can close XLoader program, start AstroLink panel and verify if all the settings have not changed. Sometimes new firmware will require new AstroLink panel software or new AstroLink Local Server driver. Please read information at the download page.