CONTROL OF A MOONLITE FOCUSER

Revision 2020.02.22
The MoonLite focusers are among the bests on the market. Above all, they are configurable and there are models for all types of telescopes:

- Refractors
- Newton's reflectors
- Catadioptrics and Cassegrains
- Etc.

For each of these types of instruments, there are flanges for all available instrument diameters.

The model used in this document is a 2.5 inch focuser for Newtonian telescope, with the option of a precision stepper motor. It is easily able to support a load including a camera with filter wheel and other instruments without slipping.

MoonLite provides a controller for this unipolar stepper motor, but you can also easily control it with a system including an Arduino and a Skypikit. This solution is cheaper, especially if your Arduino is already used to control the motors of the mount.
Connection of the motor coils to the DB9 male connector of the MoonLite

Inside the MoonLite focuser, the male DB9 connector is connected to the coils of the unipolar stepper motor as shown in the diagram above.

Pins 6 to 9 are not used.

The resistance of each coil, for example between the COM terminal and terminal 2B, is around 70 ohms.
Control of a MoonLite Focuser

A female DB9 cable is used to connect the unipolar stepper motor of the MoonLite focuser to the Arduino shield board for unipolar stepper motor.

Using a multimeter, you can find out what colors of wires are connected to each of the pins on the connector.

The COM, 2B, 2A, 1A and 1B terminals of the cable connector are connected to the corresponding terminals of the P5 (MOTOR) connector on the board.

See the document "Skypikit Arduino Shield Boards" for more information on this board.
Control of a MoonLite Focuser

If you choose to use the PLEIADES set of boards, you can use the TAYGETA-3 board with the SPK-Unipolar module to control the motor of the MoonLite focuser.

As in the previous case of the Arduino shield board, the COM, 2B, 2A, 1A and 1B terminals of the cable connector are connected to the corresponding terminals of the PS1 connector on the board.

See the document "The Pleiades set of boards" for more information on this board.

PLEIADES set of boards with two MEROPE-3 boards to control the R.A. and Decl. motors of the mount, and a TAYGETA-3 board with SPK-Unipolar module to control the motor of the MoonLite focuser.
Control of a MoonLite Focuser

With the TB67S142NG module found on both models of boards, we can use a higher voltage than the nominal motor voltage, since this circuit can actively limit the current in the coils. This allows the motor to run much faster than if only the nominal voltage were used.

The maximum current that can pass through each motor coil is equal to the nominal motor voltage indicated by the manufacturer divided by the resistance of the coil which you can measure with a multimeter:

\[ I_{\text{max}} = \frac{V_{\text{nominal}}}{R_{\text{coil}}} \]

For example, if you measure 70 ohms across each coil of the MoonLite 12-volt stepping motor, the maximum current allowed will be 12 volts / 70 ohms, or 0.171 amps or 171 mA.

The maximum current is adjusted with a small current limit potentiometer (blue on the images). The adjustment is similar for the two boards models.

To know the adjusted current limit, you must use a multimeter on the 2000 millivolt scale, and measure a voltage \( V_{\text{ref}} \) proportional to this current using the following formula:

\[ V_{\text{ref}} = 1.33 \times I_{\text{max}} \]

where \( I_{\text{max}} \) is the maximum wanted current.

For example, for a wanted current of 131 mA, we obtain

\[ V_{\text{ref}} = 1.33 \, \text{mV/\text{mA}} \times 131 \, \text{mA} = 175 \, \text{mV} \]

It’s a choice that seems to work well with the tests we’ve done.

See the documents on these boards models for more details.
Control of a MoonLite Focuser

Adjustment of the number of micro-steps per step of the TB67S142NG driver

The TB67S142NG power driver can be configured to operate with different micro-step per step values.

The board is delivered with the configuration to have 4 micro-steps per step, which is recommended, with jumpers already installed in positions MS1 and MS2. The MS3 jumper is not used.

If you want to modify this configuration, you can do so by removing certain jumpers according to the positions given in the table.

The table shows the positions where jumpers must be installed for each configuration.

The table shows the positions where jumpers must be installed for each configuration.

<table>
<thead>
<tr>
<th>MS1</th>
<th>MS2</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>OFF (motor free)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Full step</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Half step</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 micro-steps/step</td>
</tr>
</tbody>
</table>

Check the results using the SKYPIKIT MOTOR TESTER TUNER app.
Control of a MoonLite Focuser

AJUSTMENTS IN SKYPIKIT FEX

The adjustments are as follows in the FOC SETTINGS tab for the MoonLite focuser:

The motor type is Stepper and the I2C address is 64 + 4, the default address for a focuser.

The number of steps to move the focuser by 1 mm is 972. This value was found using the Skypikit Motor Tester Tuner app to find the number of steps needed to make a 10 mm shift. We found 9720 steps and we divided this value by 10. This value is correct with the controller adjusted to 4 micro-steps per step.

Invert DIR Signal is at YES so that the focuser moves in the right direction according to the button pressed on the simple handbox and according to what is programmed in the Arduino sketch.

The other values to work properly were also found using the same application. The PI section adjustments are not used because it is a stepper motor.
CONTROL IN SKYPIKIT FEX

When the OUT and IN buttons are clicked, the focuser moves in the requested direction and by a distance equal to the value selected in the FOCUSER STEPS section.

The position of the focuser is displayed in the FOCUSER POSITION section.

The Reset Position button is used to reset the position to zero after placing the focuser in a safe position in the middle of its travel.

If the focuser moves beyond the maximum allowable value of 10 mm chosen on the previous page, the focuser stops and a warning message appears.

The two boards models described in this document also allow the option of adding limit switches for improved security.
Control of a MoonLite Focuser

A 6-wire cable can be used for connections to the simple handbox. See the controller diagram on the next page.

If you prefer to use the PLEIADES boards, use a cable with a modular RJ12 6p6c connector that you insert into the handbox socket on the ALCYONE-3 board.

The effects of actions when the buttons are pressed are programmed in the ARDUINO sketch.

Manual control of the focuser with the simple handbox

Here is the handbox with all the buttons to control the right ascension, declination and focuser motors. You could build a simplified handbox with only the two (black) buttons to control only the focuser.
If you are using the handbox to control only a focuser, you can remove the right ascension and declination buttons and ignore the sections of those buttons in the electronic diagram.
END