



TCF-Leo Low Profile Focuser Installation

Step-by-Step Instructions for Installing the TCF-Leo Focuser on any telescope Optical Tube Assembly (OTA).

The TCF-Leo low profile focuser is a thin, robust focuser controlled by Optec's FocusLynx control system. FocusLynx features PC connection via serial, USB, or Ethernet with options to add a second focuser, hand controller, or 802.11 b/g WiFi connectivity.

Introduction

TCF-Leo measures only 1-1/4" at the full IN position with 0.35" (8.9mm) of overall focuser travel. At the midpoint of travel, TCF-Leo consumes only 36.2mm of the telescope OTA's available back-focus. TCF-Leo features a true 3-inch drawtube with 76.2mm of clear aperture.



In operation, the TCF-Leo delivers extremely fine resolution of 0.08 micron per step. In the Hi-Speed mode Leo can achieve step rates of 2,400 steps per second. Normal Hi-Torque operating speed tops out at a respectable 1,400 steps per second yielding a full IN to full OUT time just over a minute. Like all TCF Temperature Compensating Focusers, a precision digital temperature sensor is included to mount directly on to the telescope OTA for the most precise temperature measurements available. An RJ45 8P8C socket connector on the focuser body allows any Cat-5e Ethernet cable to connect to the FocusLynx control hub.

Standard Optec Interfaces

The telescope side interface for the TCF-Leo is Optec's standard 3.6-inch dovetail system known as the OPTEC-3600. The camera side interface is a 3-inch bore that allows any OPTEC-3000 adapter to be inserted. Optional OPTEC-3000 adapters include a precision 2-inch receiver, T-thread, STL-thread and others.



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TCF-Leo Package Contents

Confirm the contents of your TCF-Leo package with FocusLynx control hub, power supply, cables, and tools. The package should contain the following items:



- TCF-Leo low profile focuser,
- FocusLynx control hub,
- Precision temperature probe,
- USB/Serial communication cable,
- Cat-5e or Cat-6 Ethernet cable x 2
- 12VDC power supply with cord,
- 5/64" T-handle hex key tool.

The second Cat-5e Ethernet cable is for a network connection using the Network port on the bottom of the FocusLynx hub. These cables are interchangeable with any Cat-5e or better cable.

Focuser Drawtube Variants

The standard TCF-Leo focuser includes our low-profile 3-inch drawtube. The standard drawtube can accept our OPTEC-3000 camera adapters. The drawtube can be removed and replaced with other drawtubes or the TCF-Leo can be ordered in one of the variants below with the desired drawtube pre-installed.



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#19741 – Extended Height TCF-Leo Focuser

With a short travel range of 8.9mm, some TCF-Leo installations fall short of the desired back-focus range by just a few millimeters. The Extended Height drawtube is ¼-inch (6.4mm) longer than the standard drawtube to provide just enough extension to better center the optimal focal point within the available focuser travel range.

#19742 – TCF-Leo with Optec-DSI 3.5” Drawtube

For installations where even more extension is required to reach focus, the #19742 variant provides even versatility. The Optec-DSI 3.5” x 24tpi threaded drawtube acts as a female receiver for any of the DSI 3.5” extension tubes which are similar to the Astro-Physics AP2.7 extension tubes, but offer more clear aperture. A variety of camera side adapters from the DSI 3.5 standard are available to complete your imaging setup.

Additional details can be found here: https://www.optecinc.com/astronomy/dsi_3.5_adapters.htm. The Optec-DSI 3.5” Drawtube is also available separately as Optec stock item #19743.

#19744 – TCF-Leo Split-Clamp Drawtube

This variant of the TCF-Leo replaces the standard 3-inch receiver drawtube (which has three oval-point setscrews to hold the camera adapter) with a special split-clamp 3-inch receiver. This version is specially designed to accept large 3-inch Wynne Correctors and other lenses that require a specific spacing from the primary mirror. Camera packages would be attached to the Wynne Corrector and the entire imaging system can be adjusted for optimal spacing inside the TCF-Leo drawtube.

Package Options

Each variant of the TCF-Leo described above is also available in packages with Hand Control and FocusLynx WiFi options described below.

Hand Controller Option -HC

For visual users, a special kit price is available that includes the #19695 FocusLynx Hand Controller at a discounted price. The Hand Controller provides an easy to use, vibration-free method of focusing the telescope. An embedded rotary encoder switch allows one-hand fine focus control while using an eyepiece. Additional details are available online at:

<http://www.optecinc.com/astronomy/catalog/focuslynx/19695.htm>

WiFi Option for FocusLynx -WiFi

This package includes the #19755 FocusLynx 802.11b/g WiFi wireless Ethernet option pre-installed. See <https://www.optecinc.com/astronomy/catalog/focuslynx/19755.htm> for additional details.



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Installation Procedure: Step-by-Step

Step 1 – Identify OTA mount

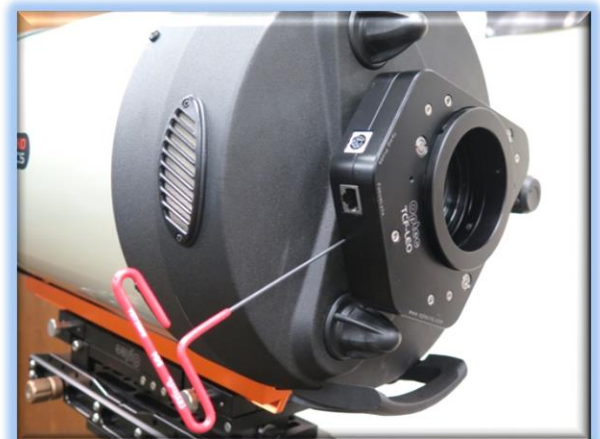
To install the TCF-Leo, you first need to identify the mounting surface on the telescope OTA. For example, the Celestron EdgeHD C-11 and C-14 OTA's share a common large thread. Celestron's thread is a coarse approximately 3.29" x 16 tpi thread. You may need to remove the smaller 2" x 24 tpi thread adapter to reveal the larger thread.

Contact Optec Sales (sales@optecinc.com) or check the Optec website (<http://www.optecinc.com/astromy/catalog/adapters/optec-3600/default.htm>) for a list of suitable mounts from the OPTEC-3600 line of telescope adapters. For the Celestron scopes, Optec stock item #17803 converts the large thread to the Optec 3.6-inch dovetail standard.



Step 2 – Attach Telescope Mount

With a suitable 3600 telescope mount in place, slip the TCF-Leo over the mount. You may need to loosen the three setscrews back slightly if the focuser does not fully seat against the mount.



Step 3 – Align and Tighten

Align the focuser body for suitable clearance. Tighten three setscrews using the 5/64" T-handle hex key tool. Be sure to tighten each setscrew securely against the dovetail on the OPTEC-3600 telescope mount.



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Step 4 – Identify Camera Mount

The TCF-Leo has a standard 3-inch receiver and can accept any of the OPTEC-3000 camera-side adapters. Identify the required mechanical interface for your filter wheel, off-axis guider, ONAG, or camera face (whichever is first in line) and consult the Optec website or Precise Parts for a suitable mount. (<https://goo.gl/3e5JeF>)



Step 5 – Move Drawtube OUT

To gain access to the three setscrews in the focuser drawtube, you will need to move the focuser to the full OUT position, or 112,000 steps. Skip down to [FocusLynx Software Setup](#) below if you do not see the setscrew hex heads at the end of the drawtube.



Step 6 – Tighten Camera Adapter

With the drawtube fully extended, insert the OPTEC-3000 3-inch camera adapter into the drawtube ensuring it seats tightly. You may need to loosen the three setscrews slightly to ensure the mount seats properly. Rotate the camera package for best orientation and tighten each setscrew securely.



Step 7 – Connect Temp Probe and Hub

Now you can insert the temperature probe into the 6-pin DIN socket. Use the thermal foam to attach the temperature probe to the side of your OTA for best results. Next, attach one end of the Cat-5e Ethernet cable into the RJ45 socket labeled FocusLynx. The other end of this cable will connect to the Focuser 1 port on your Focus Lynx hub.



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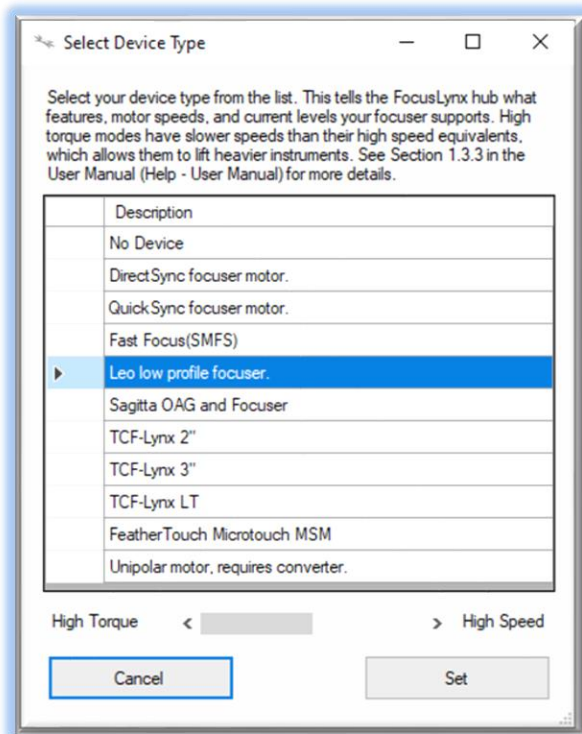


FocusLynx Software Setup

Your TCF-Leo focuser is now installed. Consult the **FocusLynx Quick Start Guide** to install the FocusLynx Commander software. Visit <http://www.optecinc.com/astrometry/downloads/focuslynx.htm> for the latest version of FocusLynx Commander and ASCOM driver. Once installed, you should configure FocusLynx Commander for your new **TCF-Leo**. Configuration within FocusLynx Commander will also configure the ASCOM driver so that the same settings will apply when using auto-focusing software such as Maxim D/L, TheSky X, SGP or FocusMax.

FocusLynx Commander Focuser Type selection

Open the Focuser Setup dialog for Focuser 1 (or Focuser 2 if you have installed the optional second stepper board) and choose the **TCF-Leo** Focuser Type option. Use the slide bar to set for **High Speed** or



High Torque. With stepper motors, speed and torque typically work inversely. That is, higher speeds will usually result in lower torque. The TCF-Leo **High Torque** option can reliably handle payloads up to 10 kg or about 22 lbs.

If you prefer faster movement from your focuser, move the slider bar for **High Speed** instead. There will be a reduction of available torque but the focuser will typically home under a minute. The recommended maximum payload for the **TCF-Leo Hi-Speed** device type is 5 kg or 11 lbs.

Homing Procedure

Upon power up, the FocusLynx controller will automatically home the focuser by moving all the way in to position 0. A limit switch will be triggered which immediately begins an outward travel to the last parked position.

At any time you may wish to re-home the focuser and move to Center for coarse focus adjustment. If you do not have enough travel, you will need to add or remove spacers between the focuser and camera package or between the telescope and the TCF-Leo focuser.



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Set the Position Units

In the main form of the FocusLynx Commander window, you may left-click directly on the red Position digital read-out to toggle units between Steps, Microns, and Millimeters. Note that only the step count is passed through to the ASCOM driver. The iFocuserV2 standard for ASCOM absolute focusers relates all focuser movements to actual step counts with the higher level client responsible for making the conversions to real-world measurements. FocusLynx Commander extends the property to easily convert the units to mm and microns.

Set the Temperature Units

Like the Position units, you can left-click directly on the red Temperature display at any time to toggle through degrees Celsius, Fahrenheit, and Kelvin.

Step Range

The TCF-Leo has a fixed number of total steps. Full IN is at step position 0 while full OUT is at step position 112,000. Upon initial power up the focuser will move to position 0 and then outward to the last parked position prior to power down. We recommend that the imaging package be configured initially at the focuser center position (click the Center button) of 56,000. Once at center, adjust your telescope's coarse focus knob (if available) or use spacer rings to achieve best focus. This ensures your normal focal travel is within the available travel range for the TCF-Leo drawtube which is about 8.9mm.

Temperature Compensation

TCF-Leo includes a precision temperature probe for temperature compensation. Within FocusLynx Commander click File – Temp Comp Wizard to automatically determine the “TC” or Temperature Coefficient for your particular telescope configuration. After completing the wizard, turn on temperature compensation by selecting “On” just above the Sync button. The FocusLynx controller will automatically adjust the telescope focus for changing temperatures.

Third-Party Software

Visit the Optec website for the additional information describing FocusLynx configurations for ASCOM clients such as **FocusMax** and **Maxim D/L**, as well as non-ASCOM software such as Software Bisque's **TheSky X** native X2 drivers for FocusLynx.



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ASCOM Alpaca Driver Setup

For many years ASCOM has been the definitive standard for astronomy device control. The ASCOM Initiative defines the standard interfaces that device drivers expose, allowing client applications to use them without any device specific code. Up until now these drivers are built only on COM, a Windows software technology that allows a program written in any language to control the device. However, COM is limited as this technology only capable of running on Windows.

Alpaca is a new technology, supported by the ASCOM Initiative, which is built on the foundation of these standards. Instead of COM, Alpaca uses REST to allow clients to communicate with devices. Unlike COM, which is cross language but not cross platform, REST is both cross platform and cross language. Even beyond that, computers on the same network can control Alpaca devices as if the hardware was directly attached. Because REST can operate across a network any devices exposing the Alpaca standard have a great deal of flexibility. A device can be attached to one computer (like a Raspberry Pi) and controlled by a separate computer.

Optec offers Alpaca drivers for several different platforms. In addition, clients on the same network can access these drivers for device control without needing to install anything. Currently Optec is offering drivers (depending on the device) for Windows, Linux (including Raspberry Pi) and MacOS.

Alpaca Driver Download

Visit the Optec FocusLynx download page to obtain the installer package to match your control computer operating system.

<https://www.optecinc.com/astronomy/downloads/focuslynx.htm>

Full documentation for setup and use of Alpaca drivers is available separately in the Optec Alpaca Quick Start Guide available for download here:

https://optec.us/resources/documents/Alpaca/Alpaca_Quick_Start_Guide.pdf

Focuser Selection and Setup

For the TCF-Leo, setup can also be performed through the Alpaca webpage interface. Alpaca drivers create a local webserver that can be accessed through any browser. After installing the FocusLynx Alpaca application, open the localhost webpage. For example, in Windows, click the start button – **Optec** – **FocusLynx Alpaca**. Your default browser will open a webpage similar to the one shown on the next page.

Click **Settings** to configure the COM port assigned to the USB/Serial cable and then click **Connect**.

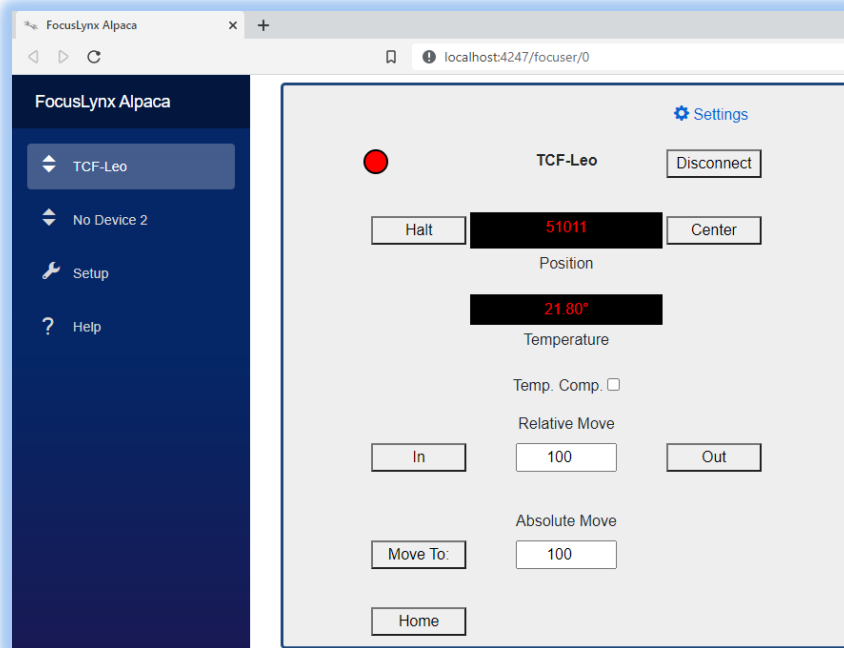
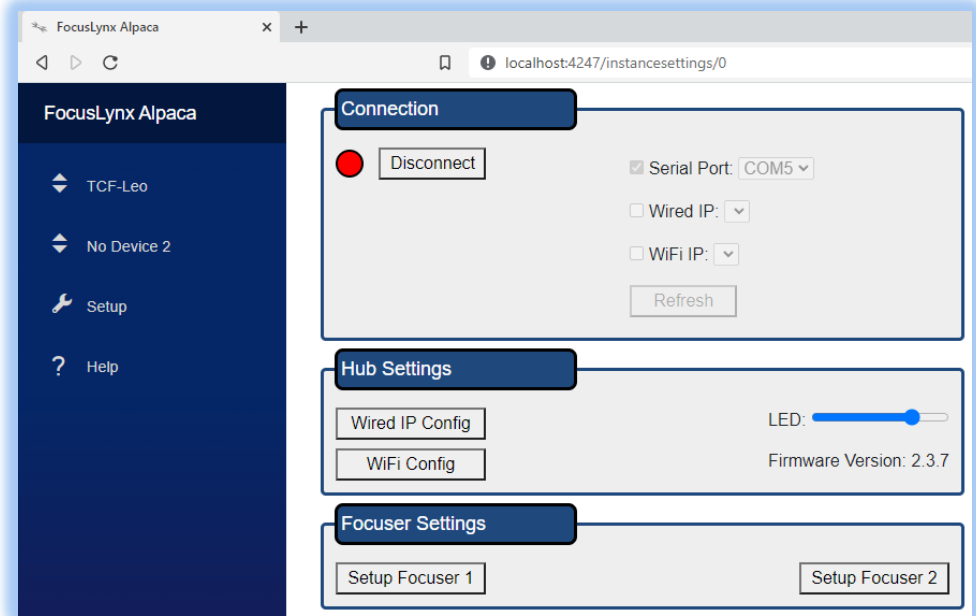


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Once connected, you can click the Back button or the TCF-Leo label in the left panel to reload the main page. From here you have all the functionality of the FocusLynx Commander windows interface. However, these pages are available to any computer or smart device attached to the same network.



Refer to the Alpaca Quick Start Guide for additional details regarding set up and use of the FocusLynx Alpaca interface.

Importantly, Alpaca exposes the TCF-Leo and FocusLynx drivers to ANY client connected to the same network.



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Telescope Auto-Focus

Auto-focus in astronomy is a bit more challenging than typical digital camera auto-focus because of the extremely low light levels available with astronomical imaging. Steve Brady pioneered a technique of measuring the HFD or Half Flux Diameter which is similar to the Full-Width Half Max measurement of the Gaussian profile of a single star's light. By creating a calibration profile known as the "V-curve" software can fairly quickly take a series of short exposures and move the focuser to best focus.

This technique has been proven over the years to be extremely effective for unattended auto-focus operations and is the basis for [FocusMax](#). A full discussion of the technique is beyond the scope of this document but full details are available here:

http://www.focusmax.org/Documents_V4/Precision%20Focusing%20Using%20FocusMax.pdf

Many high level observatory control packages use this same V-curve technique for auto-focus including [Maxim D/L](#), [TheSky X](#), and [Sequence Generator Pro](#) to name a few. Software Bisque has developed a new technique for TheSky X called [@Focus3](#) that uses FFT calculations to determine best focus. Consult your imaging software documentation for the best way to configure your software for auto-focus operations.

When configuring your auto-focus software, remember that the step size for the TCF-Leo is extremely small. Each step moves the focuser drawtube only 0.08 microns compared to a typical focuser step size around 1 micron. Therefore, when performing a V-curve calibration you will want to increase your step count or increment about 10 times more than typical to accommodate for the smaller step size. (Note that Sequence Generator Pro defines the step count or step increment as "step size" which can lead to confusion. Step Size should be measured in microns of movement per step, while step count is the number of those steps for a particular move of the auto-focus software.)

Takahashi Epsilon Kits for TCF-Leo

Optec offers several specialty configurations for the TCF-Leo to swap-and-replace a native focuser. This is especially true for the Takahashi Epsilon scopes where our custom packages provide a direct replacement for the native focuser. Current available packages include:

#19740-E130	TCF-Leo package for Takahashi Epsilon 130mm ED Astrograph
#19740-E160	TCF-Leo package for Takahashi Epsilon 160mm ED Astrograph
#19740-E180	TCF-Leo package for Takahashi Epsilon 180mm ED Astrograph



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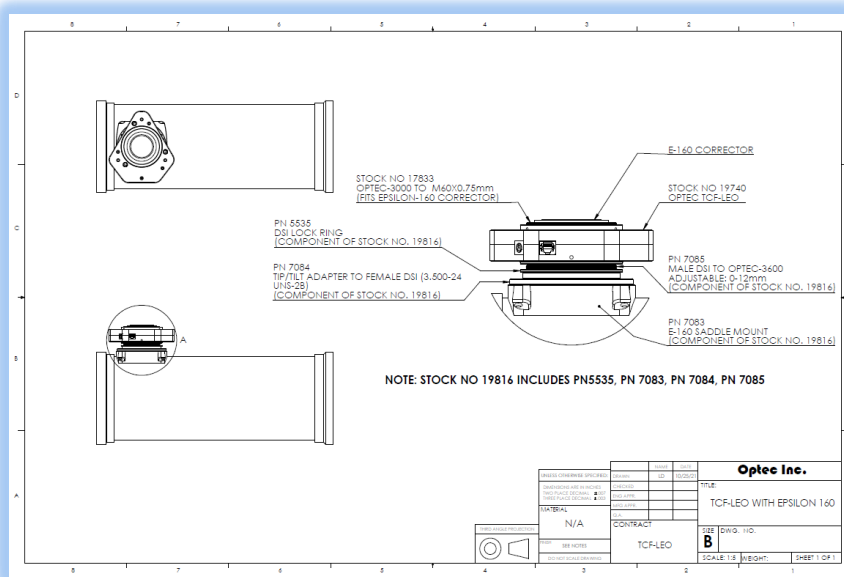
Each package includes a telescope side adapter and a drawtube receiver for the native Takahashi Epsilon field flattener lens. The packages are designed for direct replacement of the native focuser while maintaining the proper spacing for the field flattener lens. Telescope and Field Flattener adapters can be purchased separately or in kit form directly from Optec's website: www.optecinc.us.



The Epsilon 180 package uses the native saddle plate while the Epsilon 160 and 130 packages require replacement of the native saddle with an adjustable assembly as part of the kit. These replacement saddle assemblies include a push-pull tilt adjustment system.



Contact [Optec Sales](mailto:sales@optecinc.us) for full details regarding any of our Takahashi Epsilon focuser replacement kits designed for the TCF-Leo focuser.



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Video Channel

Optec is developing videos for installation and configuration of our many products for various software packages. Visit our Rumble video channel by searching “Optec” or clicking the link below.



<https://www.optecinc.com/video>

Optec User Group

The Optec User Group is now located at Groups.io which provides a forum to communicate with other users of Optec instruments. Other end-users can often provide answers to specific configuration questions and Optec staff routinely follow and answer many questions as well. Click the banner below to subscribe.

The screenshot shows the Groups.io interface for the 'Optec, Inc. User Group'. The header includes 'Groups.io', 'Your Groups 1', 'Find or Create a Group', and the user 'Jeff Dickerman'. The left sidebar contains navigation options: Home (Owner), Subscription, Admin (1), Pending (1), Members, Invite, Direct Add, Integrations, Settings, and Aliases. The main content area features a banner image of a galaxy with the 'Optec Optical and Electronic Products' logo. Below the banner, the group name 'Optec, Inc. User Group' and email 'Optec@groups.io' are displayed. A description states: 'The OPTEC user group exists to promote the proper usage of all of Optec's astronomy and telescope related products.' Under 'Group Information', it lists: 'www.optecinc.com', '736 Members', '748 Topics, Last Post: Jan 6', 'Started on 10/01/02', and 'Feed'.

Or visit the Groups.io Optec User Group here: <https://groups.io/g/Optec>.

FocusMax is available through CCDWare - <http://www.ccdware.com/products/focusmax/>

Maxim D/L is copyright Diffraction Limited - <http://diffractionlimited.com/product/maxim-dl/>

TheSky X is offered by Software Bisque - <http://www.bisque.com/>

Sequence Generator Pro by Main Sequence Software - <https://www.mainsequencesoftware.com/>



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