



# TCF-Lynx 2-inch Focuser Installation

*Step-by-Step Instructions for Installing the TCF-Lynx 2-inch Focuser on any telescope Optical Tube Assembly (OTA).*

## Introduction

The TCF-Lynx continues the long tradition of the TCF-S focuser - a robust, 2-inch Crayford style focuser capable of handling 10-lb. (4.5 kg) camera packages without flexure. As a true absolute ASCOM homing focuser, the TCF-Lynx is capable of fully unattended telescope focus control with unprecedented positional accuracy.

Coupled with Optec's FocusLynx dual-focus control hub, the TCF-Lynx provides the strength and durability that TCF-S owners have come to expect from Optec instruments. FocusLynx features PC connection via serial, USB, or Ethernet with options to add a second focuser, hand controller, or 802.11b/g WiFi connectivity.

Like its predecessor, the TCF-Lynx features a full 2-inch bore with 0.6-inches (15.2mm) of drawtube travel. With a step resolution of 2.2-microns per step, the TCF works elegantly with any auto-focus software application. 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-Lynx is Optec's standard 2.4-inch dovetail system known as the OPTEC-2400. The camera side interface is a 2-inch bore that allows any 2-inch eyepiece or camera adapter to be inserted. Optional 2-inch accessories include a 1-1/4" compression adapter, T-thread and STL-thread adapter.



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## TCF-Lynx Focuser with FocusLynx

### TCF-Lynx Package Contents

Confirm the contents of your TCF-Lynx 2-inch focuser package with FocusLynx control hub, power supply, cables, and tools. The package should contain the following items:



- TCF-Lynx 2-inch 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" ball driver 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.



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## TCF-Lynx Focuser with FocusLynx

### Special Package Options

#### TCF Focuser Only

For current owners of the FocusLynx controller, contact Optec Sales ([sales@optecinc.com](mailto:sales@optecinc.com)) for special pricing to purchase the TCF-Lynx focuser only. The TCF-Lynx focuser can be used with any FocusLynx controller hub as either Focuser 1 or Focuser 2.

#### Remote In/Out Keypad

Optec's original red [Remote In/Out Keypad](#) wand temporarily replaces the temperature probe for use at the telescope. This is an ideal low-cost solution for the TCF-Lynx during visual use. Optec stock item #17680 is available separately or at a special kit price when purchasing the TCF-Lynx focuser.



#### Hand Controller Option

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 and is tightly integrated into the FocusLynx controller. 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>

#### Optec WiFi 802.11b/g Network Option

The Optec WiFi wireless networking option eliminates the need for any communication wires to the control PC or tablet. Taking advantage of the 802.11b/g networking standard, the Optec WiFi option allows true wireless networking connectivity. Additional details are available online at:

<http://www.optecinc.com/astronomy/catalog/focuslynx/19755.htm>

#### TCF-S Upgrades

For owners of the original TCF-S focuser, Optec offers a special upgrade package which replaces the original unipolar motor with a high-torque bi-polar motor and new endcap. The TCF-S Upgrade package can be purchased with or without the FocusLynx controller hub. Contact Optec Sales for details.



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## TCF-Lynx Focuser with FocusLynx

### Installation Procedure: Step-by-Step

#### Step 1 – Identify OTA mount

To attach the TCF-Lynx focuser to your telescope, you first need to identify the most appropriate mounting surface on the telescope OTA. For example, the Takahashi TOA-130NS telescope shown at right includes an M72 x 1mm threaded dust cap. Removing the cap reveals a female M72 thread where we can attach the TCF-Lynx.

We can add an adapter to convert this female thread to the OPTEC-2400 2.4-inch dovetail onto which the TCF-Lynx will mount. Optec's stock item #17453 is the



correct adapter to make this mechanical conversion and is shown attached to the Takahashi OTA at left.

Bear in mind the available back-focus for your particular OTA. The TCF-Lynx body will consume between about 84 and 99mm of back-focus with just over 15mm of drawtube travel. For the Takahashi shown, the TOA-130 has plenty of back-focus and the native rack-and-pinion focuser can be used to set the TCF-Lynx into the desired range. Similarly, the popular Schmidt-Cassegrain Telescope design features a coarse focus knob that should be

used to set the TCF-Lynx into a suitable focal zone for imaging and auto-focus.

Optec offers a wide variety of stock OPTEC-2400 adapter s to fit most any telescope OTA. Contact Optec Sales ([sales@optecinc.com](mailto:sales@optecinc.com)) or visit the Optec website for a full list of available adapters:

[http://www.optecinc.com/astronomy/optec-2400\\_adapters.htm](http://www.optecinc.com/astronomy/optec-2400_adapters.htm)

Occasionally, a custom adapter must be made to fit the TCF-Lynx to the telescope OTA. Optec recommends Precise Parts to quickly provide a suitable adapter. Visit [www.preciseparts.com](http://www.preciseparts.com) for details.



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## TCF-Lynx Focuser with FocusLynx

### Step 2 – Attach Telescope Mount

With a suitable OPTEC-2400 telescope mount in place, slip the TCF-Lynx body over the mount. You may need to loosen the three setscrews around the base of the focuser slightly first.

### Step 3 – Align and Tighten

Align the focuser body for suitable clearance and preferred orientation. Tighten three setscrews using the 5/64" ball-driver hex tool. Be sure to tighten each setscrew securely against the dovetail on the OPTEC-2400 telescope mount.

### Step 4 – Attach FocusLynx Cable

Now plug one end of the 8P8C cable (Cat-5e or better) into the RJ45 modular socket on the side of the TCF-Lynx. The other end will connect to the Focuser 1 or Focuser 2 port on the FocusLynx control hub.



### Step 5 – Attach Temperature Probe

The TCF-Lynx temperature probe has a 6-pin DIN style plug for connection to the circular port on the side of the TCF-Lynx motor housing. Use the included thermal foam for adhering the temperature sensor to the side of the optical tube assembly. In almost every instance the most linear zone of

temperature response for any telescope is the tube. As aluminum and even carbon fiber tubes cool down they tend to shrink causing the focus to shift.



Optec's Gerald Persha was granted an original [U.S. Patent](#) in May 2000 in which he described the temperature / focus effect and how the Temperature Compensating Focuser can automatically correct for temperature induced focal shifts. The key to successful temperature compensation is to find the linear zone of the telescope and place the temperature sensor there.



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## TCF-Lynx Focuser with FocusLynx

While using the temperature probe is not required for operation, most users find the **TC at Start** feature of the TCF-Lynx will put their scope right at or near the best focus each night. Subsequent auto-focus routines can confirm best focus. While in temperature compensation mode, additional focus should not be required thereby increasing your total imaging time on your target each clear night.

Contact [Optec Sales](#) for a replacement temperature probe or additional thermal foam.

### Step 6 – Add a Camera Adapter

The TCF-Lynx 2-inch drawtube can accept any 2-inch diameter accessory such as star diagonals, 2-inch eyepieces, telecompressors, and camera nosepieces. We recommend using the Optec 2-inch Drawtube Adapters available from our website here:

[http://www.optecinc.com/astronomy/2-inch\\_adapters.htm](http://www.optecinc.com/astronomy/2-inch_adapters.htm)

Notice the TCF-Lynx includes a notched drawtube that matches a precisely machined brass screw included with each Optec telecompressor or 2-inch accessory. The purpose of the notch and screw arrangement is to ensure repeatable rotational alignment when re-installing a camera each night. For example, the Optec 2-inch nosepiece with T-thread can couple to a Canon bayonet mount as shown. Note the brass



registration screw mounted in the flange and rotate the camera until the screw drops into the notch. This makes removing and re-installing cameras simple and repeatable – even in the dark.

The TCF-Lynx focuser is now installed and ready for software configuration. Optec's FocusLynx Commander and ASCOM driver software is available any time by download directly from our website.



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## TCF-Lynx Focuser with FocusLynx

### FocusLynx Software Setup

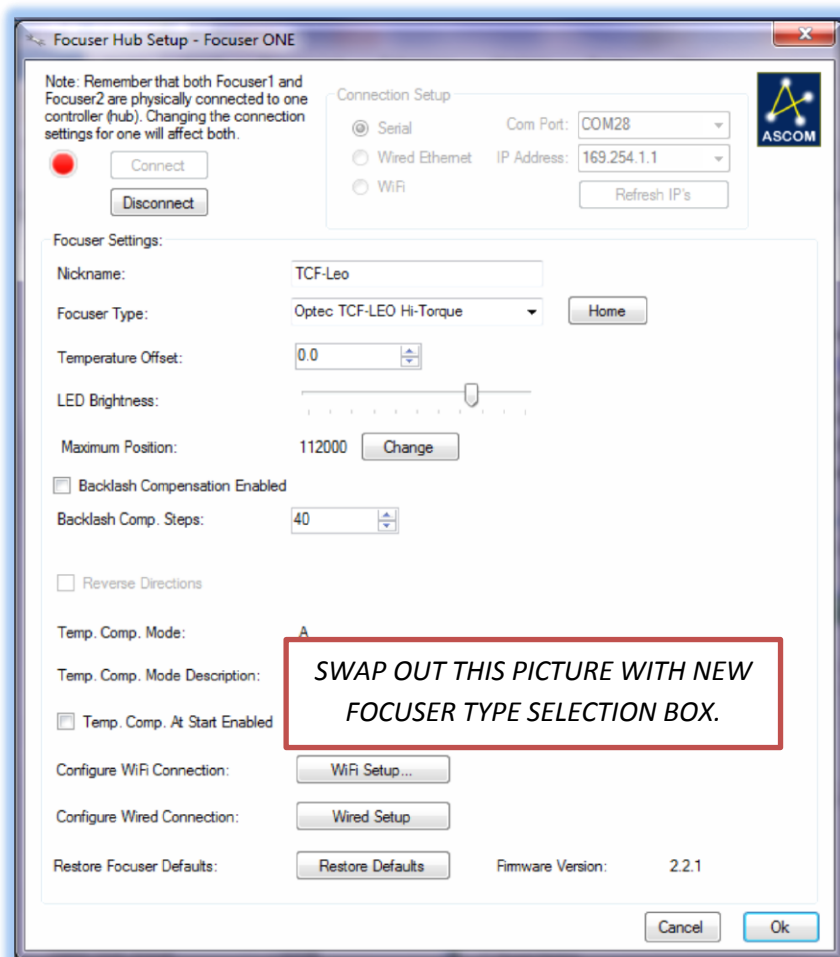
Visit <http://www.optecinc.com/astronomy/downloads/focuslynx.htm> for the latest version of FocusLynx Commander and ASCOM driver. Consult the **FocusLynx Quick Start Guide** available on the same page for guidance when installing the FocusLynx Commander software. After installation, you should configure FocusLynx Commander for your new **TCF-Lynx** focuser. 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 Hub Setup dialog for Focuser 1 (or Focuser 2 if you have installed the optional second

stepper board) and choose the **Optec TCF-Lynx 2"** Focuser Type option. The Focuser Type option will automatically set the correct step size and full travel of 7,000 steps. We recommend firmware version v2.3.0 or later for best motor performance.

In the Nickname field, type a description to easily identify which telescope OTA is being focused. This nickname will appear in FocusLynx Commander and the FocusLynx webpages.



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## TCF-Lynx Focuser with FocusLynx

### 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. The FocusLynx Commander client 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.

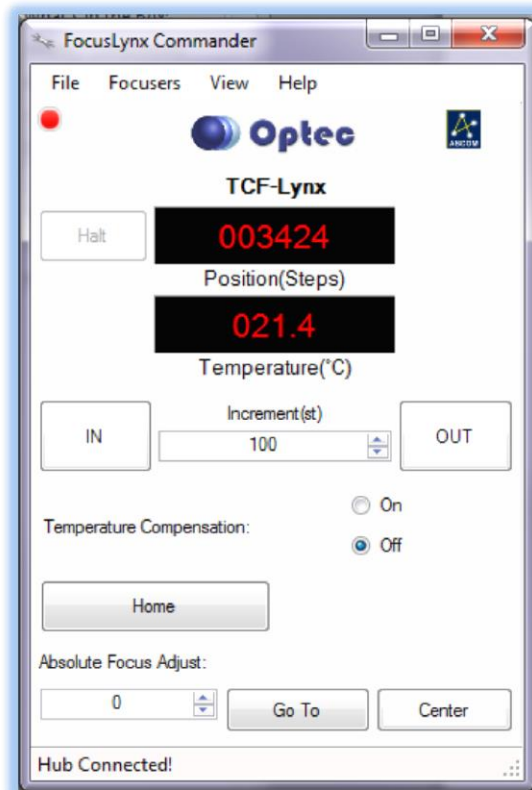
### Step Range

The TCF-Lynx has a fixed number of total steps. Full IN is at step position 0 while full OUT is at step position 7,000. Upon initial power up the focuser will move to position 0 and then outward to the last position before last power down. We recommend you begin the session by moving to the center position (click the Center button) of 3,500. 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-Lynx drawtube which is about 15.2mm.

### Homing Procedure

Upon power up, the FocusLynx controller will automatically home the focuser by moving all the way in to position 0. The controller will force the motor to move over 7,000 while a mechanical limit will stop the drawtube travel at position 0. It is normal for the large gear to spin against the mechanical stop before moving outward.

At any time you may wish to re-home the focuser and move to Center for coarse focus adjustment. Simply click the Home button the main FocusLynx screen. If you do not have enough travel, you will need to add or remove spacers between the focuser and camera package.



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## TCF-Lynx Focuser with FocusLynx

### Temperature Compensation

TCF-Lynx 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.

### Temp Comp at Start

After completing the Temp Comp Wizard and calculating an accurate TC, you may enable the **Temp Comp at Start** checkbox to direct the TCF-Lynx to calculate the best focus after a power cycle. The TCF-Lynx will measure the current temperature and, based upon the slope and intercept of the linear equation defined by the Temp Comp Wizard, will calculate the best focus. FocusLynx will then drive the focuser to this best focus position and temperature Compensation will remain enabled.

### WiFi and Wired Network Connections

The FocusLynx hub has a built-in wired Ethernet socket and an optional 802.11b/g WiFi card with antenna for wireless operations. Refer to the FocusLynx Help file for additional details to configure either of these network connections to attach to your local network.

### 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](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.



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## TCF-Lynx Focuser with FocusLynx



### FocusLock Software

Optec has partnered with Innovations Foresight to develop a new and unique method of quickly obtaining and maintaining best focus. Rather than using a model for calculating and determining best telescope focus, FocusLock takes real-time feedback from a guide camera image for continuous closed-loop focusing.



FocusLock requires an On-Axis Guider (ONAG) from Innovations Foresight or an off-axis guider with our Lacerta device attached to the guide camera. Lacerta, like the ONAG, introduces a slight amount of



astigmatism to the guide image. While this does not degrade the guiding performance of the images, it does provide position information with regards to focus. On-axis astigmatism yields a cross-shaped star that appears elongated in one direction inside of

focus and the opposite direction outside of focus. Using the real-time guide image allows FocusLock to quickly lock onto the best focus and maintain that focus while the guide camera is in use.

Full details for FocusLock and the Lacerta device can be found on the Optec website:

<http://www.optecinc.com/astronomy/catalog/focuslock/index.htm>

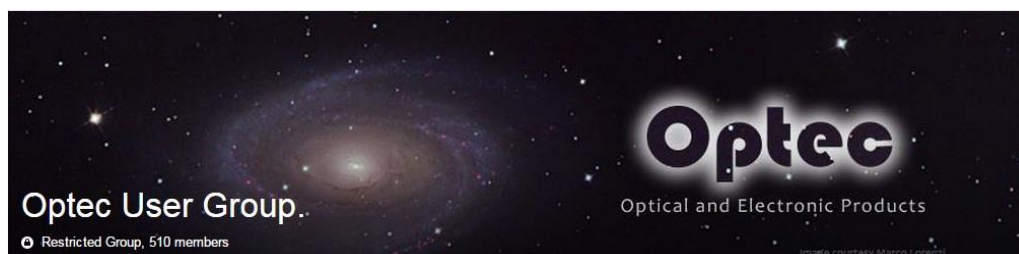
<http://optecinc.com/astronomy/catalog/focuslock/19860.htm>

Innovations Foresight describes the patented ONAG On-Axis Guider device:

<https://www.innovationsforesight.com/product-category/on-axis-guider/>

### Optec User Group

The Optec User Group on Yahoo! can also provide answers to specific configuration questions and provides a forum to communicate with other users. Click the banner below to subscribe.



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