FOCUSCUBE V3

PRODUCT MANUAL

Version *1.0*
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VERSION HISTORY

Version #	Implemented By	Revision Date	Reason
1.0	*Evans Souglakos*	*01/12/2023*	*Initial Document*

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INTRODUCTION

Thank you for purchasing the Pegasus Astro FocusCube v3!

1.1 PURPOSE

The FocusCube v3 is our cutting-edge solution for achieving fast, reliable, and precise focusing of your telescope in the ever-evolving field of astrophotography. In an era where fast optics and advanced camera devices are essential, maintaining accurate focus is paramount.

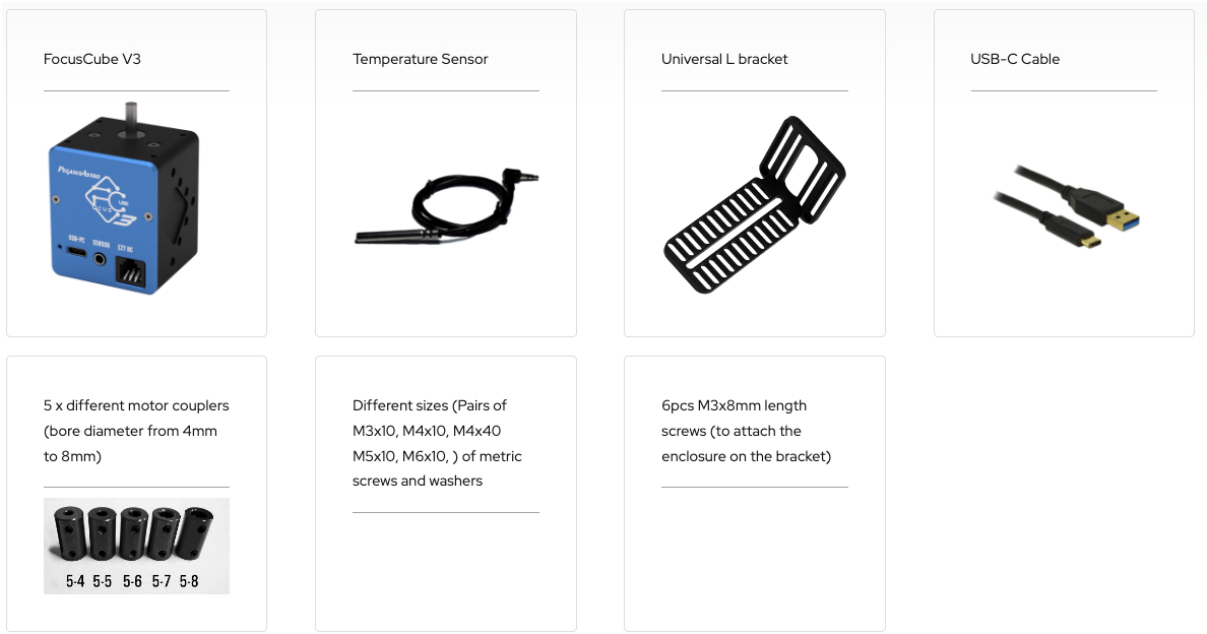
Equipped with a high-resolution stepper motor coupled with a robust gearbox, it delivers an exceptional level of torque that can effortlessly lift and support telescope equipment weighing up to 6 kg, even when pointing at the zenith. What sets this motor system apart is its meticulous attention to precision, as the backlash has been meticulously minimized to achieve very low values.

The FocusCube 3 offers streamlined convenience with a single USB-C cable for both power and data, reducing complexity in your telescope setup. Additionally, it's Wi-Fi enabled, allowing you to control and monitor focus remotely from your mobile phone.

Notably, you can operate it simultaneously with USB or Wi-Fi, providing flexibility and ease of use for astronomers, all from the convenience of your smartphone.

1.2 IN THE BOX

The box contains the following items:



- FocusCube v3
- Temperature Sensor
- Universal L Bracket
- USB-C cable
- 5 different motor couplers (bore diameter from 4mm to 8mm)
- Different sizes of metric screws and washers
- 6pcs M3x8mm length screws (to assemble the bracket and attach the enclosure to it)

1.3 DEVICE CARE

The device electronics are housed inside an aluminium blue and black anodized enclosure. The enclosure is made from aircraft aluminum alloy type 6061 which provides very good corrosion resistance.

- While the controller is safeguarded against moisture, it is essential to emphasize that it is not waterproof and should always be maintained in a clean and dry environment.
- Prolonged exposure to excessive moisture can pose a significant risk to the electronics and connectors, potentially causing damage. It is imperative to exercise caution in this regard.
- Avoid any contact between solvents or chemicals and the device, as these substances can have adverse effects on its functionality.
- When the controller is not in use for extended periods, it is advisable to store it indoors within a dry room to prevent any potential moisture-related issues.
- Take precautionary measures and refrain from touching the internal components during operation, as they may become hot. Ensuring safety and optimal performance is paramount.

DEVICE DESCRIPTION

1.4 DESIGN OVERVIEW

From left to right

- Red LED operation indication (as dim as possible)
- USB-PC connector (accepts a USB type C cable)
- Temperature Sensor socket (3.5mm mini stereo connector)
- EZY-HC Hand Controller Socket (RJ12)

L-Shape Bracket with the four M3 x 6mm screws and the motor coupler.

1.5 FEATURE LIST

- **Fast and Precise Focusing**: Swift and accurate focusing for modern telescopes and cameras.
- **Automated Focusing with Temperature Compensation**: Maintains optimal focus by automatically adjusting for temperature changes.
- **High Torque Motor**: Can lift up to 6 kg even when pointing at zenith.
- **Low Backlash**: Minimized play for precise focus v-curve points.
- **Universal Bracket**: Fits various focusers (4mm to 8mm couplers included).
- **Digital Temperature Sensor**: Monitors ambient temperature changes.
- **USB-C Connectivity**: Single cable for power and data.
- **Wi-Fi Enabled**: Hotspot and wireless 2.4GHz client support.
- **Web Browser Access**: Control via web browser on any device, making it OS-independent.
- **ASCOM Alpaca Support**: Seamless integration with popular software.
- **Firmware Upgradability**: Future-proof with software updates.
- **Optional External Hand Controller**: Ideal for visual observers who prefer manual control.

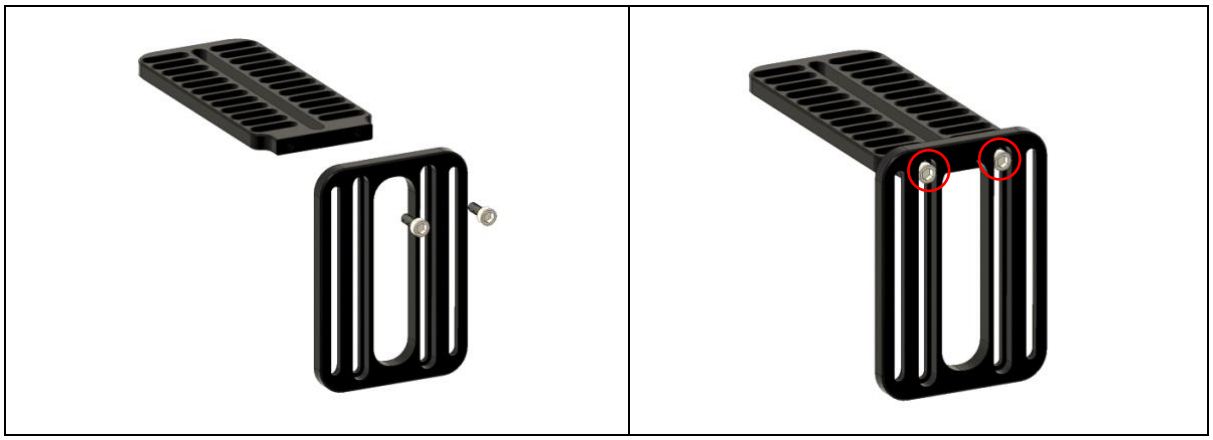
INSTALLATION

FocusCube v3 is supplied with a unique L-shaped bracket for connection to a wide variety of focusers:

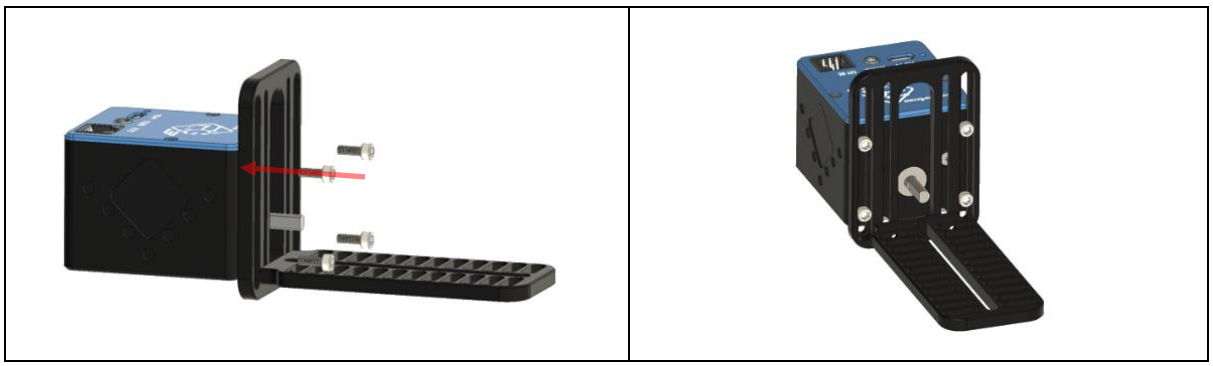
- ✓ Baader Diamond Steeltrack
- ✓ Baader Steeltrack
- ✓ Explore Scientific Focuser
- ✓ Askar Telescopes Focusers
- ✓ ZWO (Askar Made) Telescopes
- ✓ MoonLite Focusers
- ✓ Skywatcher Esprit Series Focuser
- ✓ StarField Optics Focusers
- ✓ Starlight Feathertouch Series
- ✓ Stellarvue Focusers
- ✓ Takahashi FS-60, TSA-120, Epsilon Focusers
- ✓ Takahashi FSQ & TOA Focuser
- ✓ Vixen ED81S
- ✓ William Optics GT71
- ✓ William Optics RedCat

Alternative focusers may also be compatible with the installation of the FocusCube v3. We advise consulting the connection plate rails to ensure compatibility with your specific focuser before initiating the installation process.

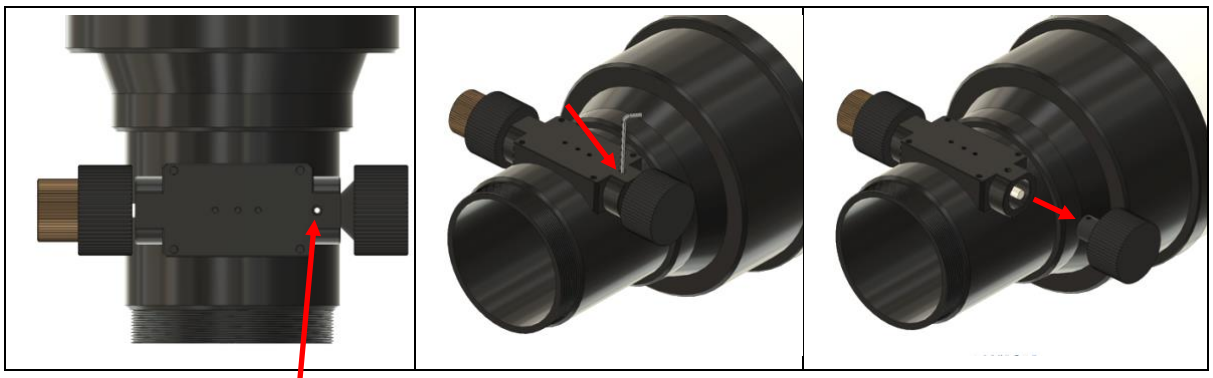
- Assemble the L bracket by using the supplied 2 pcs of M3x8mm screws.



- Bond the L bracket with the FocusCube v3 device. Use the 4 pcs of M3x8mm screws to connect the enclosure on the bracket. Do not overtight them as you need to adjust the final position of the motor.

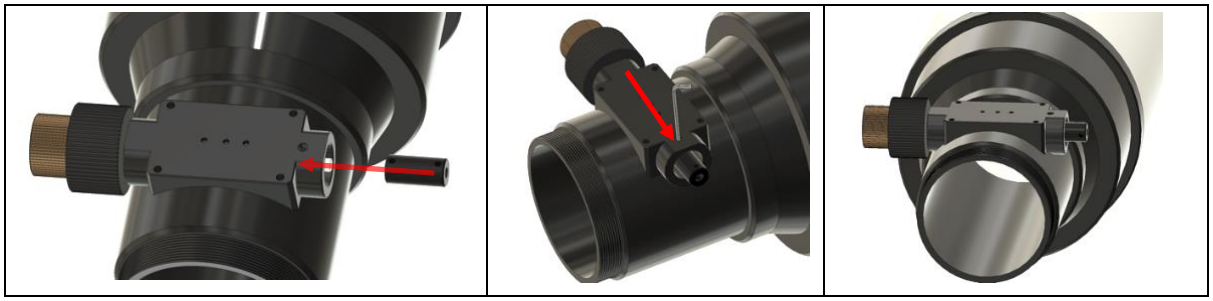


- Remove the coarse knob from your focuser by untightening the grub screw(s). Keep the knob somewhere safe as you will not need it now. * Hex key tool is not included

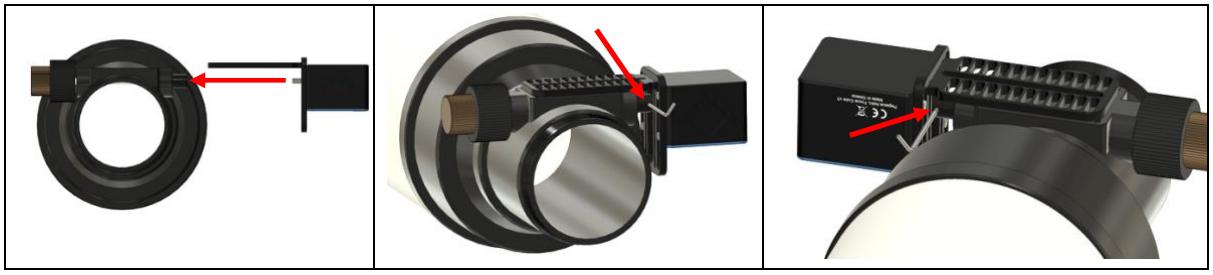


  - Some focusers do not have a grab screw on the knob. If this is your case, it is located underneath the set screw near the coarse knob. Remove it and locate the knob's hidden grab screws. Usually, there are two of them so turn the knob to access & untie them.

- Choose the appropriate motor coupler (from a range of 4mm to 8mm) that firmly fits into the shaft of your focuser. The motor shaft is 5mm.
- Insert the coupler into the shaft and **fully tighten** both grab screws with a hex key tool. Make sure to have the flat surface of the focuser shaft facing the thread.

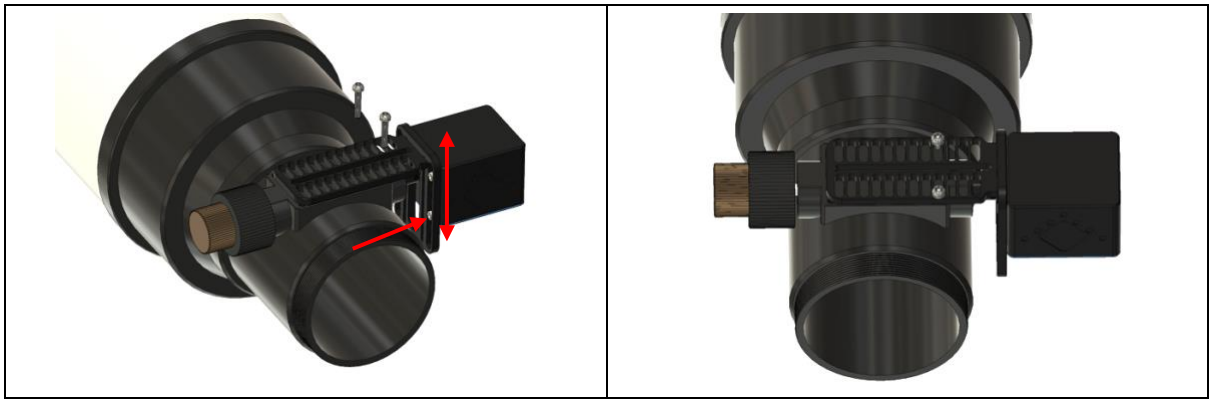


- Connect the focuser body to the motor coupler and firmly secure it by tightening the lock screw with a hex key tool. Tighten the **two** grub screws (one on each side) of the coupler to firmly lock the motor shaft in the coupler. To do that you need to rotate the motor axis. A quick way is to connect to FocusCube v3 hotspot and with your mobile phone to access the web dashboard where you can control the motor.



- Carefully examine the options you have to attach the bracket to one or more thread holes underneath your focuser. Use compatible screws and spacers (included) or use your locking thumbscrew to attach the motor to your focuser. Try not to mess with friction screws as you may have slippage on the drawtube of your focuser.

- Adjust the motor up or down to align it with the focuser's shaft and then tight well the set screws on the motor side



- Ensure the secure attachment of all mounting brackets. With this, the hardware installation of the FocusCube v3 is completed.

OPERATION

I. Initial Connection:

1. **USB Cable**: Carefully insert the USB type C cable into the designated port on the FocusCube v3 and connect the other end to your computer.

II. Device Boot-up:

3. Upon connecting the USB-C cable, the device will commence its boot sequence. Observe the LED indicator, which will perform three rapid blinks before transitioning to a steady, solid red illumination. This confirms the successful loading of firmware and signifies that the device is now in full operational mode.

III. Software Installation:

5. To establish communication with the device, please visit our official website at pegasusastro.com. Download the Unity software package from https://pegasusastro.com/download/, which **includes the requisite ASCOM driver**, to facilitate connectivity with the FocusCube v3. You can also connect the device with ASCOM Alpaca. Check ASCOM Alpaca section in this manual.

MOTOR TYPE

The FocusCube v3 is equipped with a high-resolution geared stepper motor featuring a Step Angle of 7.5 degrees and a Gearbox Reduction Rate of 120 (resulting in an impressive 0.06255 degrees per step). This gearbox ensures minimal backlash and delivers exceptional torque, making it perfectly suited for achieving micron-scale precision in focusing applications.

FocusCube v3 controller drives the stepper motor at **full step.**

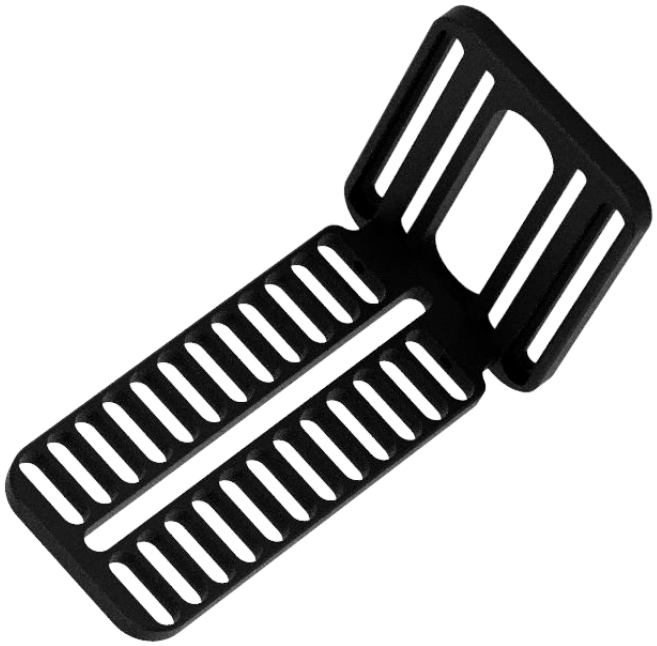
- **WARNING**: DO NOT ATTEMPT MANUAL MOVEMENT OF THE MOTOR WITHOUT POWER.
  The motor functions as a brake, and attempting rotation without power may result in damage of the internal gearbox.

UNIVERSAL BRACKET

Our versatile Universal bracket features custom-made holes and rails, designed to ensure seamless integration with any telescope system.

Whether you have a refractor, reflector, or any other telescope type, the FocusCube 3's bracket can be effortlessly adjusted to meet your exact needs.

Use the provided screws and washers to attach the bracket on your telescope focuser.



USB CONNECTIVITY

The unit requires USB2 signaling and features a USB Type-C port, designed to seamlessly accommodate the included 1.5-meter USB-C cable, ensuring a hassle-free setup right out of the box.

Additionally, the same USB cable serves a dual purpose by not only connecting the FocusCube v3 but also supplying power to the device. It delivers a robust current of up to 900mA to the stepper motor, ensuring efficient and reliable operation.

It is strongly recommended to limit the **maximum USB2 cable length to 5 meters**. Adhering to this guideline ensures optimal data transmission rates and minimizes the potential for signal degradation over longer distances, thereby promoting stable and reliable USB2 connectivity for your device.

While USB extenders may function on a case-by-case basis, it is important to note that we cannot provide a guarantee of compatibility or performance with third-party devices. The efficacy of such extenders can vary depending on numerous factors, and users should exercise caution and conduct their own testing when integrating third-party USB extenders with our products.

TEMPERATURE SENSOR

The external probe serves as a temperature measurement device seamlessly integrated with the controller. It is equipped with a 0.6m cable featuring a 3.5mm / mini stereo jack. Capable of measuring temperatures ranging from -55°C to +125°C, the probe exhibits an accuracy of ±0.5°C within the temperature range of -10°C to +85°C.

The FocusCube v3 promptly identifies the presence of the probe and initiates temperature readings at 10-second intervals. In scenarios involving multiple controllers and probes, slight variations in reported temperatures may occur due to minimal differences in individual sensor readouts. Importantly, these discrepancies do not impact the units' functionality, as they are designed to respond to measured temperature changes rather than absolute temperature values.

- Feel free to connect the sensor at any time. The device will autonomously detect the sensor shortly after connection and promptly provide temperature readings.

EZY HC CONNECTOR

The device is equipped with an RJ12 (6P6C) Female Jack designed exclusively for auxiliary use. It is important to note that this socket is compatible **only** with the optional **EZY Focus Hand Controller**; other connections are not supported.

Plug the **EZY Focus Hand Controller** anytime with the provided straight 6-pin cable. FocusCube v3 will identify the hand controller and provide all required information to the display. You can unplug and plug the hand controller at your request.

- WARNING: DO NOT CONNECT ANY OTHER DEVICE TO THE EZY-HC PORT. THIS ACTION MAY RESULT IN SEVERE DAMAGE TO THE FOCUSCUBE V3.

LED INDICATION

Located on the back side of the unit, a prominent red LED serves as a visual indicator, conveying the operational status of the device through distinct light patterns. This LED's functionality can be conveniently controlled via the software interface, granting you the flexibility to activate or deactivate it as needed to suit your preferences and operational requirements.

Permanently Light	Device is up and running.
Blinking Light	Motor is moving.
Light Off	Device not operational.

RESET WATCHDOG

In the realm of operational integrity, an invaluable safeguard is in place: a hardware watchdog mechanism that diligently resets the device should the controller fail to respond within a mere three (3) seconds. This feature, though seldom required, provides a notable reassurance, especially in the context of remote observatory management, where absolute operational reliability is imperative. In this rare occurrence of a microcontroller freeze, it guarantees that your remote observatory functions seamlessly, assuring the highest level of operational assurance.

BACKLASH COMPENSATION

The gearbox of the stepper motor has a very low backlash. However, it is important to compensate the backlash to produce an ideal v-curve autofocus graph. The measured backlash is close to 30 steps.

Within the Unity Platform and Web Dashboard, you have the option to configure the motor backlash. However, we strongly recommend that you exclusively adjust the motor backlash settings from your imaging software, such as NINA or SGPro.

- Ensure that there is no backlash compensation set in the device firmware, and be cautious not to inadvertently configure double backlash compensation within your imaging software. Failure to adhere to this precautionary measure may fail any focus V-curve. Maintaining a singular and accurate setting for backlash compensation across both firmware and imaging software is crucial for the optimal performance of your focusing process

WIFI CLIENT

FocusCube v3 seamlessly operates as a client, connecting to a 2.4GHz WiFi network. Notably, it stands out by functioning concurrently **as both a WiFi hotspot and a WiFi client.**

To link up with a WiFi network, navigate to the Unity platform, access the WiFi tab, and initiate a scan to discover networks in your area. Simply select the desired network, input the WiFi password and your preferences are stored.

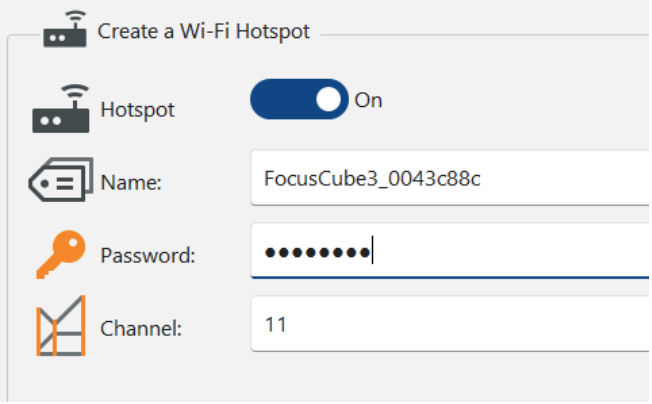
With each reboot, the device effortlessly connects to the configured wireless network. The device retrieves your selection on every boot and automatically connects to the configured wireless network.

WIFI HOTSPOT

FocusCube v3 has a Wi-Fi Access point (hotspot) at 2.4 GHz. The hotspot is enabled by default. The SSID name is compiled from the prefix `FocusCube3_` and the unique device ID e.g. `0043c88c`.

You can easily control the hotspot settings from the Unity Platform.

- Open Unity Platform, click on the discovered FocusCube v3, and locate the Wi-Fi settings tab.
- There you will see the below screen which allows you to control the WiFi hotspot.
- You can easily change the SSID name, enable, or disable the Wi-Fi hotspot, or switch to another channel number.



- You will have to change the hotspot channel if your area is fully crowded with Wi-Fi networks. **Channels 1, 6, and 11 [default] are the best channels for 2.4 GHz Wi-Fi.** These are the only channels in the 2.4 GHz frequency band that don't overlap with each other. You'll only want to consider using a different channel if each of these channels is overcrowded in your coverage area.

1.6 CONSIDERATIONS ABOUT WI-FI CHANNELS TO IMPROVE NETWORK CONNECTION

- Wi-Fi is a line-of-sight radio technology, which means that it operates not by surrounding your device with a wireless signal, but by connecting directly to it, through whatever walls, subflooring, or other electronic devices are in its way. Each solid object between the antenna of your wireless access point (router/modem) and your computer will diminish the signal. Repositioning things by inches can make a world of difference.
- Sources of interference are not always obvious. Many times, you may be receiving interference from hidden wireless networks or even some electronics. Interference from electronics is more prevalent with the 2.4 GHz radio spectrum. If you are using a low channel width on a free channel and are still seeing wireless disconnects (even while near your wireless access point), then the issue could be something else occupying that spectrum. Try experimenting with other channels.
- In a crowded wireless landscape, wireless performance will often degrade and improve on its own, as other people use their Wi-Fi networks. Experimenting with channel settings can help here as well, since some of your competition may rarely use their Wi-Fi, while others are continually transferring data from many devices. If you live in an apartment complex, for example, and your neighbor has their router against a shared wall, sharing a wireless channel will not become a noticeable problem until they get home, connect with their smartphones, and start streaming to their television. However, at that point, your Wi-Fi may become completely unusable until you change the wireless channel.

WEB DASHBOARD

Upon connecting to the FocusCube hotspot or any Wi-Fi network, you can conveniently access it from any web browser by simply typing "**`focuscube3.local`**" in the address bar. The device announces itself as *focuscube3.local* in your local network.

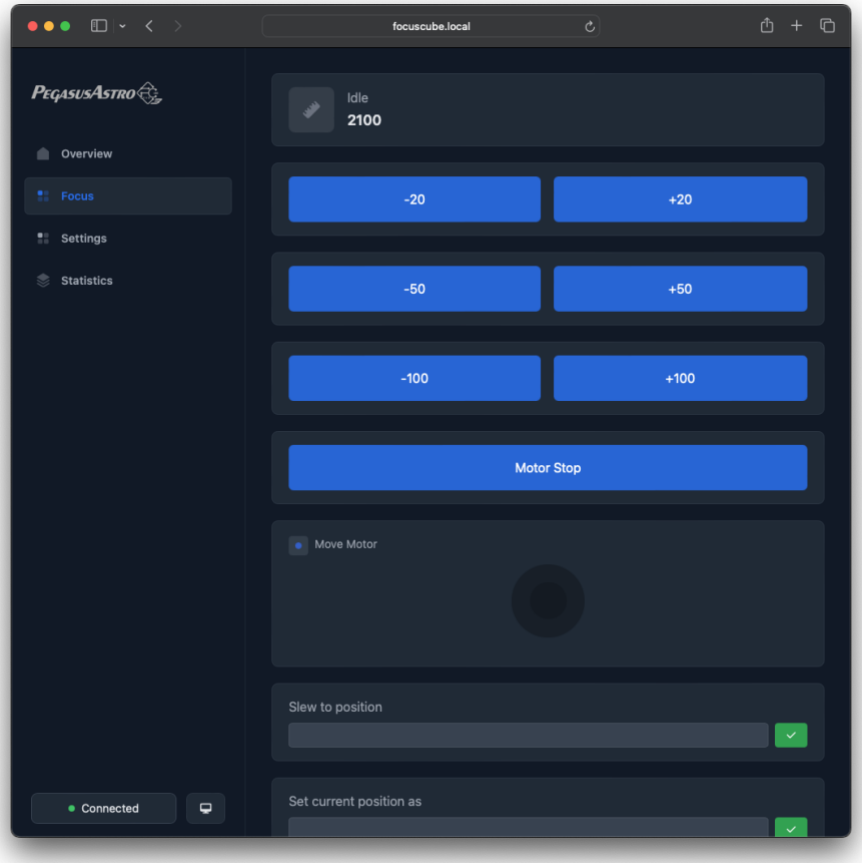
For security reasons, the web dashboard has a simple authentication process and requires a username and aa password upon login. The dashboard password is always the Wi-Fi hotspot password.

Default credentials are:

Username	`admin`
Password (always same as hotspot password)	`12345678`

This feature is operating system-independent and functions seamlessly alongside USB control.

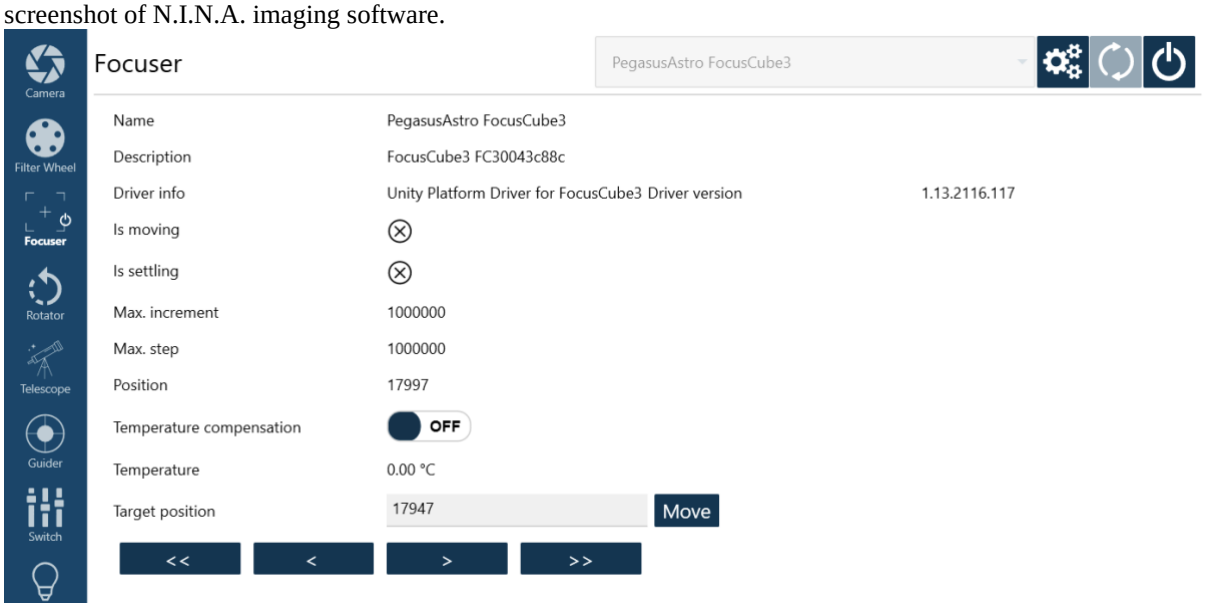
The web dashboard offers full control of the device, configuration of backlash, and motor position along with statistics and information about FocusCube v3.



ASCOM 6

Classic ASCOM 6 (32 and 64-bit compatible) drivers are bundled along with the Unity Platform.

The driver is named as "`PegasusAstro FocusCube 3`" and an example can be found in the below screenshot of N.I.N.A. imaging software.



ASCOM ALPACA

ASCOM Alpaca outshines classic ASCOM drivers with its platform independence, modern web standards, streamlined installation, remote control capabilities, extensibility, and open-source options. This ensures superior compatibility and user-friendly performance, making it the preferred choice for advanced astronomy applications.

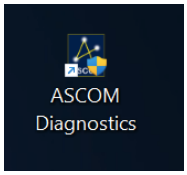
FocusCube 3 comes equipped with an integrated web server that seamlessly communicates with Alpaca clients natively. This integration enhances the user experience by providing easy access to telescope focus control through ASCOM Alpaca but also monitoring from any device with a web browser such as a smartphone.

To use ASCOM Alpaca make sure that the FocusCube v3 is connected to your WiFi network or you use its hotspot feature and you are connected to it.

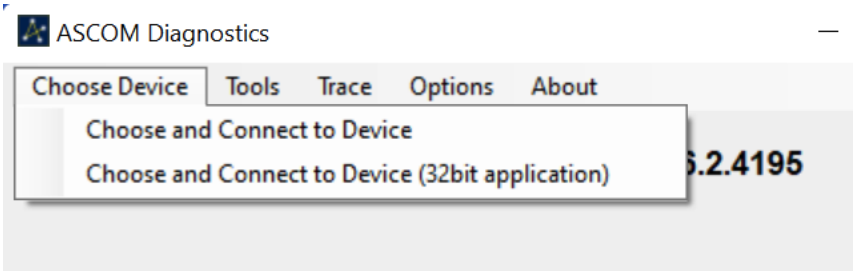
This is a one-off action and it is required to discover FocusCube v3 and automatically create the appropriate ASCOM Alpaca driver.

To do that:

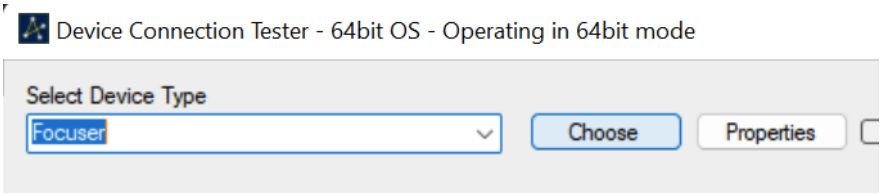
Open ASCOM Diagnostics (you should have this software once you install ASCOM)



Choose: Device -> Choose and Connect to Device

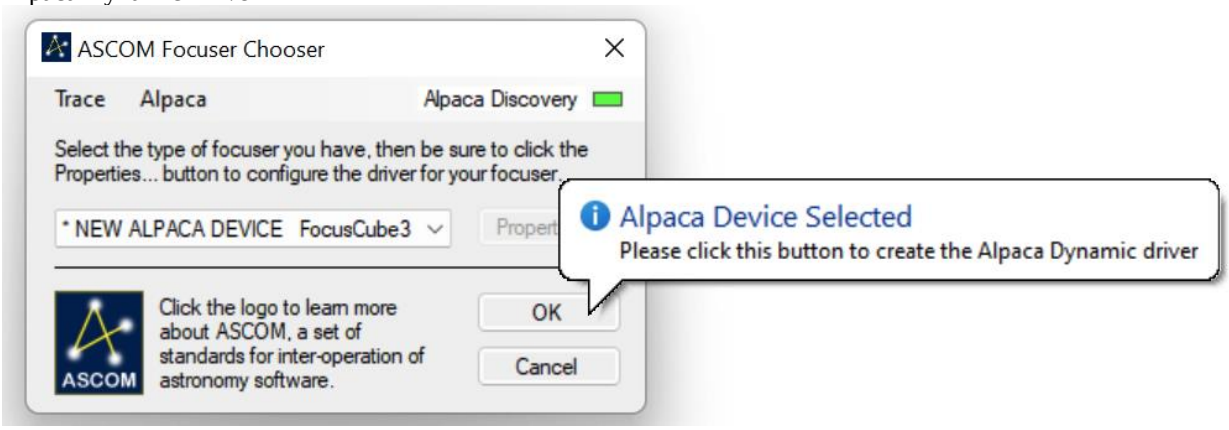


Select Focuser in the drop-down line of device types and press Choose button.

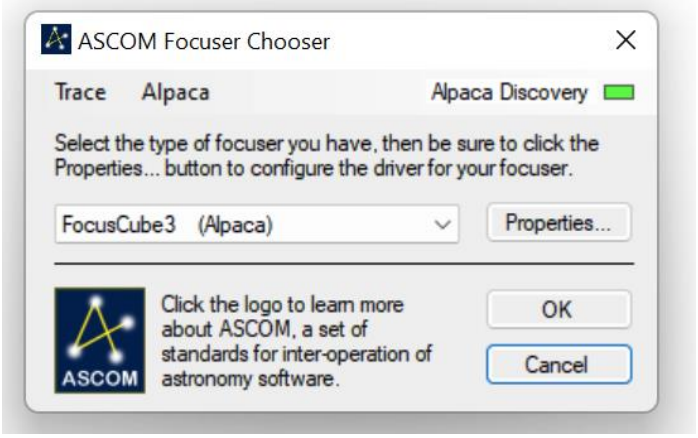


ASCOM Alpaca Discovery will flash on the top right and will be converted to a green rectangular meaning that a new alpaca device has been discovered.

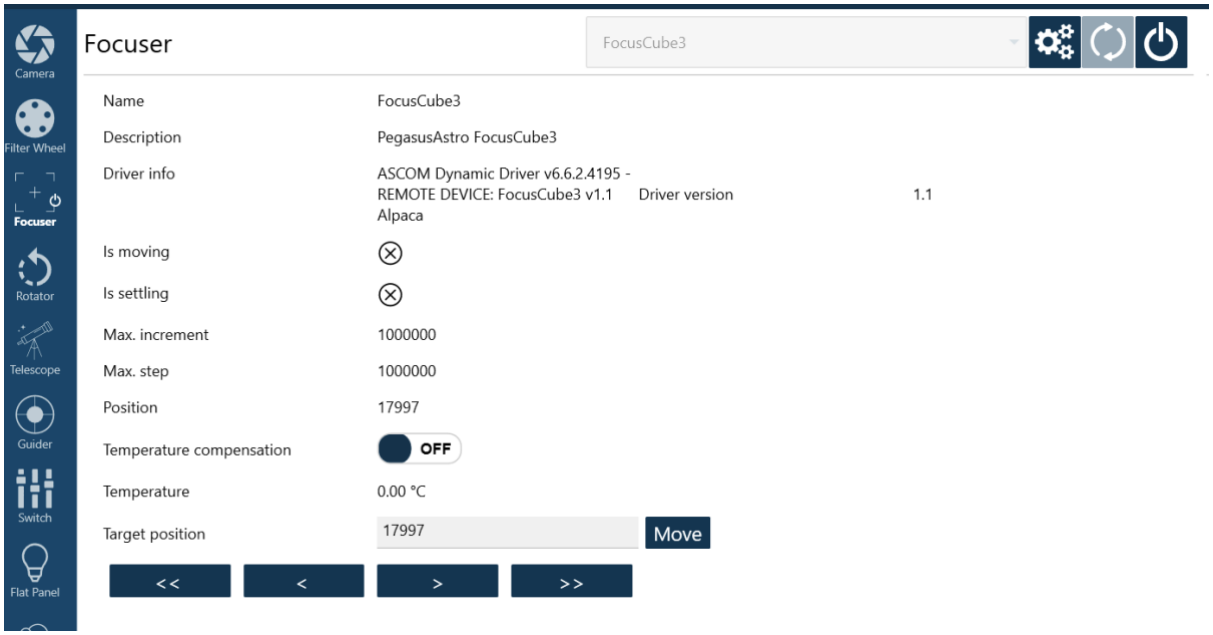
Select from the drop-down list the "`NEW ALPACA DEVICE FocusCube 3`" and press OK to create the Alpaca Dynamic Driver



After that, the generated driver will be automatically renamed to `FocusCube3 (Alpaca)`.



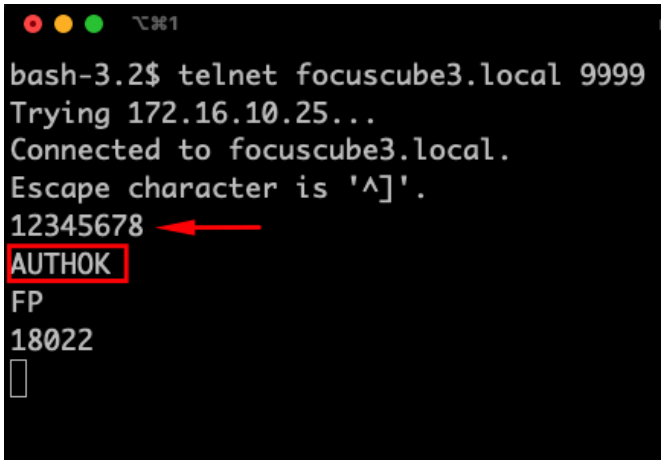
You are ready to go. You can use the FocusCube3 driver on your selected imaging software.
The below screenshot is an example from NINA using the Alpaca FocusCube3 driver.



COMMAND SOCKET VIA TCP PORT

FocusCube v3 spawns TCP port number 9999 and accepts the same command set like USB serial port.
The only difference is that you need to provide the access point password before any interaction with the device.

In the below example, we send the default password "`12345678`" and receive an `AUTHOK` reply.
After that, we can communicate and control the device. In case the password is wrong the FocusCube v3 will close the connection.



For the complete command set please check the FocusCube v3 product page at the PegasusAstro website.

STANDALONE OPERATION

The FocusCube v3 is engineered for convenient standalone operation right out of the box. With a simple USB-C cable connection setup and the Wi-Fi hotspot functionality already enabled by default, your preferred settings are ready for immediate use each time you power up the device.

UPGRADABLE FIRMWARE

The device offers firmware upgradeability, a valuable feature that not only ensures the flexibility to accommodate future enhancements but also allows for the seamless rectification of any potential bugs or issues.

DIMENSIONS

59 mm x 50 mm x 44 mm

RECOMMENDATIONS

- Make sure that you have tightened all four grab screws on the motor coupler. We have seen cases where the grab screws are loose over time and this gives the impression that the motor shaft does not turn correctly, or you have a very high motor backlash!
- We highly recommend the selection and use of high-quality, shorter-length USB cables to ensure optimal power, connectivity, and data transfer reliability.
- Avoid the practice of looping USB or power cables, as this can introduce communication issues and disrupt the seamless operation of your equipment.

TECHNICAL SPECIFICATION

Type	**Value**
Supply Voltage	From USB socket (5V)
Current	Slewing: 900mA @ 5V Idle: 80-120mA @ 5V (depends on Wi-Fi transceiver)
Motor Output	None, The stepper motor is built-in
USB Connectivity	USB-C socket (USB2)
Thermal Sensor Resolution	9-bit Celsius temperature measurements
Power Input Connector	Same USB-C Socket
Motor	High resolution geared stepper motor (Step Angle (Deg) 7.5 / 120 Gearbox Motor is driven at full step (0.0625 deg per step)
Dimension	59 mm x 50 mm x 44 mm
Weight	260g (enclosure with electronics)
Operating Tempetature	-30 °C to +80 °C

ENVIRONMENT

The device's electronic components and materials have undergone a meticulous selection process to ensure its robust performance across a wide range of environmental conditions. With an operational capability spanning from -30°C to +80°C, coupled with the ability to withstand humidity levels of up to 99%, this device has been engineered to excel even in the most challenging of climates.

WARRANTY

The device is covered by a comprehensive 2-year warranty. Within the warranty period, we offer free repair services to address any issues that may arise. Following the expiration of the warranty period, we continue to provide repair support and service, which will be subject to a fee. It is important to note that this warranty does not extend to damage resulting from abuse, misuse, accidental falls, or other incidents occurring after the purchase of the product. The customer is responsible for shipping the product to our designated return address for either repair or replacement. For more information please read: https://pegasusastro.com/returns

SUPPORT

For any issues, questions or feedback and recommendations please contact us via email: support@pegasusastro.com