VERSION 1.1

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EXTERNAL MOTOR CONTROLLER

PRODUCT MANUAL

BY PEGASUS ASTRO

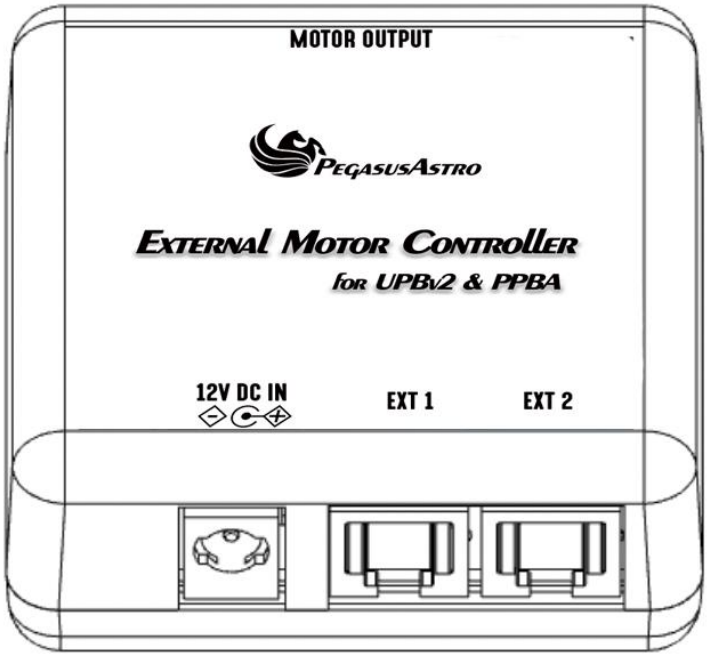
INTRO

Thank you for purchasing our Pegasus Astro - **eXternal Motor Controller (XMC).** This product is designed to expand the focus capabilities of the "Ultimate Powerbox v2" (supports a 2nd focus controller) and to add focus functionality to "Pocket Powerbox Advance". The device does not require a USB cable and can be attached directly to the EXT port of both powerboxes. It can drive a large bipolar or unipolar stepper motor (up to 2Amps per coil) with high precision.

CONTROLLER CARE

- Controller electronics are protected from moisture but they are not waterproof and they should be kept clean and dry.
- Excessive moisture for long periods of time can damage electronics and connectors
- Do not allow solvents or chemicals to come into contact with the device
- Store controller indoor in a dry room when not in use for long time
- Do not touch the internal components as they may get hot when in use

DESIGN OVERVIEW



***FRONT**: From left to right:*

- Power DC IN (12V preferred) * Based on the motor type (please check below 'stepper motors' table)
- EXT 1 (RJ12 Socket)
- EXT 2 (RJ12 Socket)
- Motor Output (RJ45 Socket)

<table>
<tr><td rowspan="2">What is inside the box</td><td>
1 x External Motor Controller</td><td>
1 x RJ12 to RJ12 straight cable (1 meter / 3 feet)</td></tr>
<tr><td>
1 x RJ45 straight cable / (1 meter / 3 feet)</td><td>
1 x DC Power Cable (1 meter / 3 feet)</td></tr>
</table>

SUPPORTED POWERBOXES

Please note that External Motor Controller is not a standalone device. It requires the purchase of:

- Ultimate Powerbox v2 **(UPB v1 is not supported)**
- Pocket Powerbox Advance

OPERATING INSTRUCTIONS

1. Plug your stepper motor to the RJ45 port named “MOTOR OUTPUT”. Use compatible cable type for your motor.
2. Plug UPBv2 environmental sensor to the EXT2 port in order to get readings about temperature and humidity.
3. Use the RJ12 cable and plug one side into Powerbox **EXT** port and the other side to **EXT1 or EXT2** port of controller.
4. Use the 2.1mm DC cable and provide DC power (12V DC preferred) to the device.
5. LED will turn solid red indicating that device is up and fully operational.

Connectivity Diagram



POWER INPUT

Controller can accept voltage ranges from DC 8.2V – 24V *

>> Preferred voltage is 8.2 - 12V. Please note that each motor type requires its own voltage level so we strongly recommend to supply the device from ***Powerbox adjustable output or from a Powerbox 12V DC output****.*

>> Please check [stepper motors] table for appropriate voltage levels and motor settings.

Unit has been designed with reverse polarity protection. If you accidentally reverse the power source polarity, the unit will cut the power.

EXT1 & EXT2 PORTS

You do not have to occupy a USB port as the controller does not require USB connectivity.
>> Please use the supplied RJ12 to RJ12 cable.

Plug one cable side into the EXT port and the controller and the other side into Powerbox EXT port.

Both "EXT" ports can accept the RJ12 cable. The purpose of the 2nd EXT port is to daisy chain future expansion devices or connect the stock temperature/humidity sensor that comes with the Powerbox.

STEPPING MODE

Controller support micro-stepping which can be configured through "Powerbox" software. This provides additional precision and a smooth rotation from the stepper motor.

>> Micro-stepping mode is inversely proportional to the configured "Max Speed".

In short, lower micro stepping mode allows higher max speed.

Supported Stepping Mode
Full step (2-phase excitation) with 71% current
Half - 1/2 step (1-2 phase excitation)
1/4 step (W1-2 phase excitation)
8 microsteps/step

STEPPER MOTORS (SUPPORTED)

STEPPER MOTOR	CABLE TYPE / SKU	RECOMMENDED MICROSTEPPING MODE	ALLOWED MAX SPEED	RECOMMENDED VOLTAGE
Pegasus Motor Focus (v1 & v2)	Straight RJ45 Network Cable	Full or Half 1/2	200 or 400	12V
Starlight HSM 25/30/35	PEG-CMOT-HSM	1/4	1000	9V
Starlight MSM 25/30/35	PEG-CMOT-MSM	1/4	1000	9V
Starizona Micro-Touch	PEG-CMOT-MSM	1/4	1000	9V
Rigel nStep Motors	PEG-CMOT-MSM	Full or Half 1/2	200 or 400	12V
Moonlite Stepper Motor	PEG-CMOT-RJ45DB9	Full or Half 1/2	200 or 400	12V
Robofocus Stepper Motor	PEG-CMOT-RJ45DB9	Full or Half 1/2	200 or 400	12V
Lakeside Stepper Motor	PEG-CMOT-RJ45DB9	Full or Half 1/2	200 or 400	12V
Lacerta Motor	PEG-CMOT-LCRT	1/4	1000	9V

Important Note: Motors like HSM, MSM, Starizona and Lacerta are 5V motors. Providing higher voltage will make the motor hotter and it will vibrate more than usual. Setting the motor to 8V and performing microstepping we compensate this issue.

>> Note: 8.2 Volts is the lowest voltage controller can accept. Below this voltage the controller does not work.

MOTOR OUTPUT

Device drives **unipolar & bipolar stepper motors**. It is capable of driving up to 2A of current from each output. (motor coil). 4 Amps in total.

RJ45 (8P8C) connector is located at the side of the controller named “Motor Output”.

Note: Simple DC motors are not compatible with this controller.

Pinout of this connector can be found at below table:

STEPPER MOTOR (RJ45 – 8P8C) FEMALE CONNECTOR	
PIN 1	N/C
PIN 2	N/C
PIN 3	**COIL 1+**
PIN 4	**COIL 1-**
PIN 5	**COIL 2+**
PIN 6	**COIL 2-**
PIN 7	N/C
PIN 8	N/C

N/C = Not connected

ABSOLUTE POSITION

Calculation of the absolute position is taken care by the external stepper controller firmware.

Controller can accept and display absolute position values from 0 to 999999. Negative values are NOT supported by the controller or ASCOM driver.

Above concept is that position zero (0) point to a fully retracted focuser (fully in). As you gradually move the focuser tube out, you increase steps.

>> Absolute position of the motor is automatically stored to EEPROM memory 10 seconds after last motor movement. When you turn ON the controller the last position is retrieved from its memory.

BACKLASH COMPENSATION

Controller allows backlash compensation which can be enabled and configured (actual backlash steps) from "Powerbox" software. XMC applies **INWARDS** only backlash compensation.

>> If you use software backlash compensation from your imaging software (e.g SGPro / MaximDL) you will have to disable the hardware backlash compensation. Both enabled will definitely lead to wrong backlash compensation calculation.

SLEEP MODE / POWER SAVE

Controller sets the motor to sleep after 10 seconds of inactivity. This ensures that the motor will not overheat as energized coils produce heat. Moreover, this ensures that your battery will not be drained by the power that motor coils consume.

RESET WATCHDOG

A watchdog resets the device if, for any reason, there is no response from the controller after two (2) seconds. A neat feature in the unlikely event of a microcontroller freeze – when have a remote observatory and you need to be sure that everything works as expected.

STATUS LED

A red colored LED is fitted close to the left side of the DC 2.1mm socket.

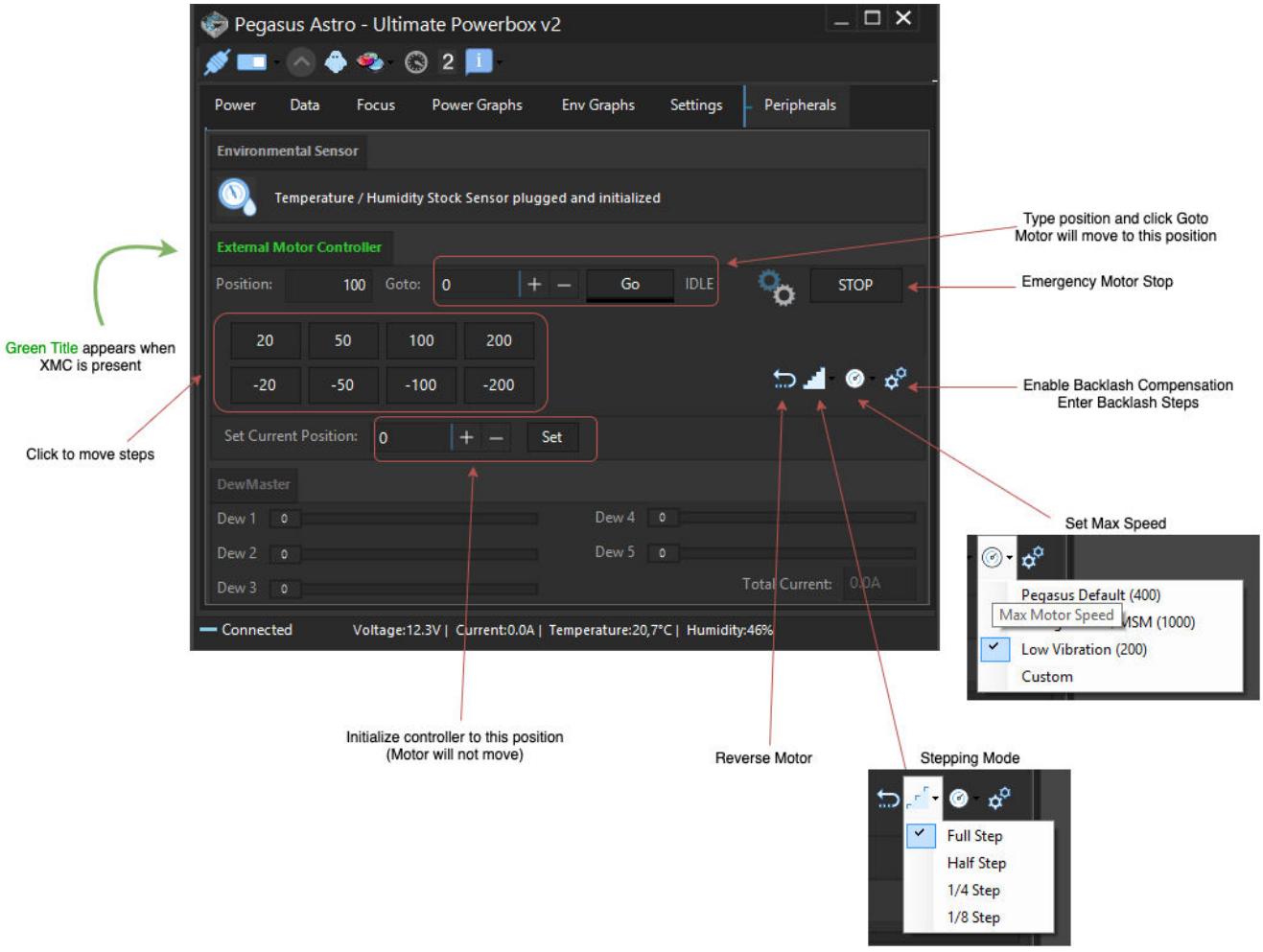
Permanently Light	Device is up and running, Motor > 8Volt detected
Permanently Off	Motor DC power (>8V) is not detected or EXT cable is not present

PROTECTIONS

The controller is fully protected against undervoltage, overcurrent, and overtemperature events.

SOFTWARE OPERATION VIA UPBV2

- Device is controlled through standalone software (please make sure you have the latest version). Please check "**Peripherals**" tab of UPBv2 standalone software. When the controller is present the "External Motor Controller" title will turn to Green and all tab controls are going to be available.
- Device is also controlled through an ASCOM driver. Please download the appropriate ASCOM driver from our support page. You only have to keep open the standalone software as it works like a "command helper/translator" between ASCOM and eXternal Motor Controller.



RECOMMENDATION

- Please use only our certified motor cables. Based on your motor type you can order the required SKU from one of our dealers. **Most of recorded controller failures had to do with custom made cables that had a wrong pinout.**
- Provide power to the controller only from a powerbox output. (ADJ OUT, 12V OUT or Always ON Out)

DIMENSIONS

Size (Width, Depth, Height)	66mm x 66mm x 28mm
Weight	150 grams

WARANTY

Device (controller only) is covered by two (2) years warranty

Cables are not covered by warranty

Designed and Assembled in Greece

FREQUENTLY ASKED QUESTIONS

Question	**Answer**
What kind of power supply do I need?	We strongly suggest to use: • the Adjustable Output of the Powerbox • the Always ON Output of Powerbox • Any 12V Output of Powerbox.
What type of cable do I need to use for input?	Please us our stock 2.1mm to 2.1mm cable. Its thickness ensures that motor will receive proper power
I would like to use the XMC to my remote observatory. What if the device freezes for some reason?	Device has a hardware watchdog which triggers a reset if the microcontroller is not responsive after 2 seconds
My observatory is in a very cold place. Is there any issue with the electronics of the device?	All electronic components were selected to support temperature ranges from -40 to +80 °C.
What if I accidentally short-circuit a motor output?	Device has an internal short-circuit protection.
What if I accidentally reverse polarity?	Device has a reverse polarity protection input.
Can I upgrade the firmware?	No, this controller does not support upgrade of firmware. The only way to upgrade firmware is to ship the controller back to us.