VERSION 2.3

MAY 1, 2022

ULTIMATE POWERBOX V2

PRODUCT MANUAL

BY PEGASUS ASTRO

INTRODUCTION

Thank you for purchasing our Pegasus Astro - Ultimate Powerbox v2. Ultimate Powerbox v2 (UPBv2 in short) is the successor of our renowned Ultimate Powerbox. If you are tired of carrying multiple power packs and dealing with a mess of power and data cables, our Ultimate Powerbox v2, a sophisticated power control unit, is the absolute solution. Our idea is one enclosure that makes available a sufficient number of amperes. No cables disturb the movements of the mount and the instrument, only the main power cord and one USB data cord comes to the Ultimate Powerbox v2 from which branch off the other cables powering all devices.

CONTROLLER CARE

- Controller is protected from moisture but it is not waterproof and it 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.

FRONT: From left to right:

- 4 Channel x 12V DC Outputs (6 Amps each)
- 3 Channel x 12V DC PWM Duty Cycle Outputs – For dew heaters / flatfield box / fans (6 Amps each)
- Focus Output for Unipolar / Bipolar Stepper Motor
- Input Power 12V-13.8 DC XT60 (Left Pin is positive, Right Pin is negative)
- Led (red) indicator

BACK: From left to right:

- Input USB3.1 type B connector / PC
- 4 (2 x Dual Stacked) Ports USB3.1 - Industrial Grade USB Hub
- 2 (1 x Dual Stacked) Ports USB2 - Industrial Grade USB Hub
- Adjustable Output (3-12V) / 3Amps Max
- Ext Port & Environmental Sensor (Relative Humidity /Temperature)
- Always ON / 12V Output
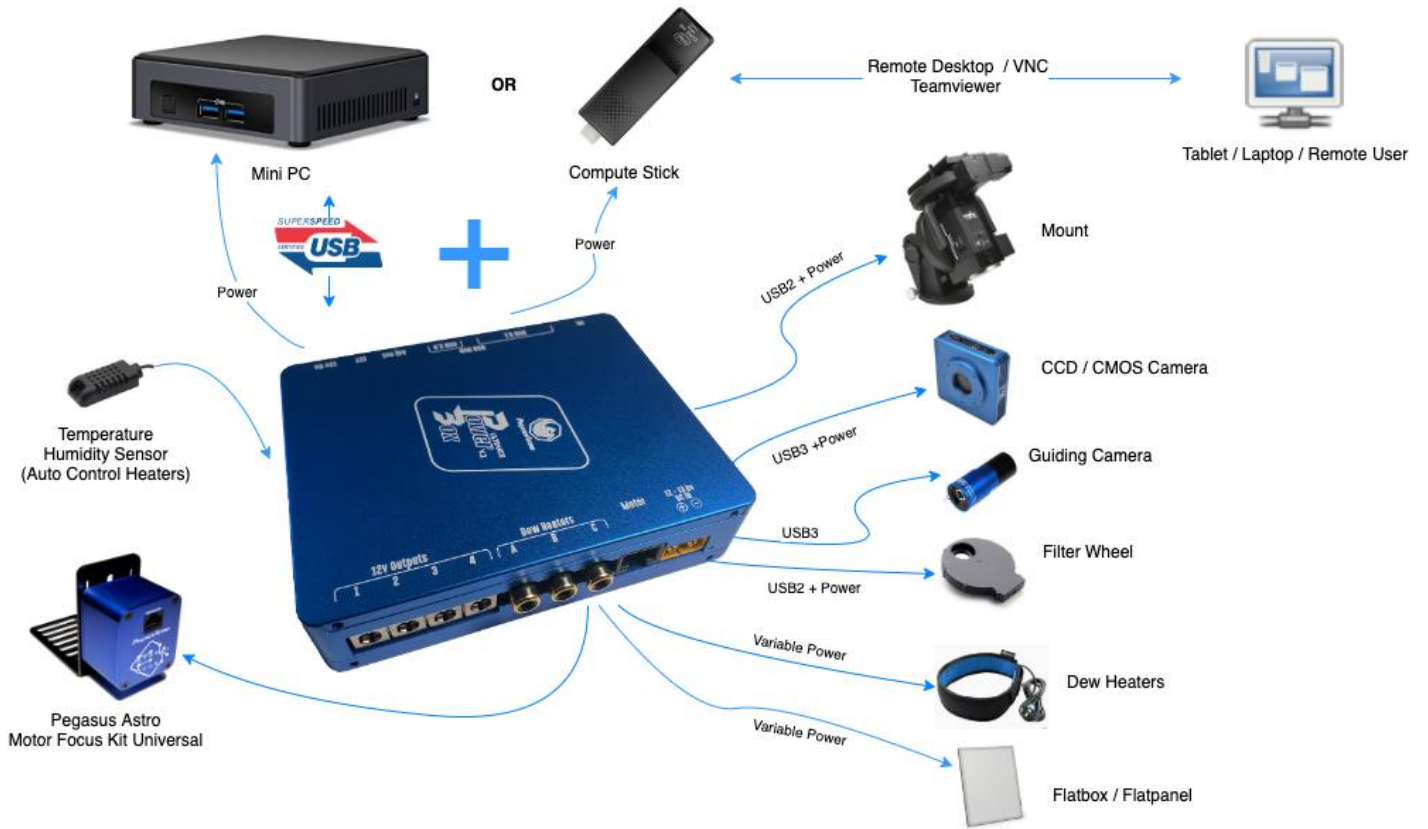
Ultimate Powerbox handles all power (12V DC) and data (USB2 /USB3) cables. Mini PC is piggiback on the Ultimate Powerbox. Only one cable (Main Power) exits the setup

What is inside the box	Ultimate Powerbox v2	1 x Environmental Sensor
Pack of 4 Power Cables (1 meter / 3 feet)	1 x USB3 Cable Type B (1.8m / 5.9 feet)	

POWER INPUT

Controller accepts voltage ranges from DC 12V – 14V. We strongly recommend to use a branded linear or low ripple power supply unit of **12V-13.8V DC**. A 13.8V lead (or calcium/lead) battery is also recommended. Please use a power supply that can provide at least 6 Amps of current. For your observatory needs you might need 10-15Amps of current.

> *Under no circumstance exceed DC input voltage of 16V as you will cause severe damage to the electronics of the controller*

- Unit has been designed with reverse polarity protection. If you accidentally reverse the power source polarity, the unit will cut the power.
- The controller is fitted with a XT60 DC power connection which powers on the unit.

Please note that Cig. Lighter Adapter to DC Power is an optional cable that can be purchased separately.
*(CIGLIGHT-ADAPTERXT60)*

Insert the XT60 plug into the DC power input. Controller will initialize and the status LED will turn red (or blue in older board revision) after 4 seconds. *(The 4 seconds wait time duration is on purpose for a new firmware upload process)*

> *Above 14.5V the Ultimate Powerbox v2 will shut down all output ports to protect your precious equipment from overvoltage.*

USB 3.1 HUB

USB3.1 Hub implementation is an Industrial / Automotive Grade - Temperature Rated (-40°C to +80°C) USB 3.1 Super-Speed 7-Port Hub Controller. Its features are:

- 4 x USB 3.1 Super Speed and 2 x USB 2.0 High Speed Ports are available at the back of the controller. The 7th port is used for the internal controller communication.
- Each USB port can provide up to 2.5 Amps of current.
- Multiple Transaction Translators (MTT). One per USB port
- Each port has a current limit / protection and it will automatically decrease current to 2.5Amps if a short-circuit detected or a connected device will draw more current than 2.5Amps.
- Each USB port can be switched (VBUS & Data) ON / OFF via the supplied software.
- All USB3 ports and backward compatible with USB2 devices.
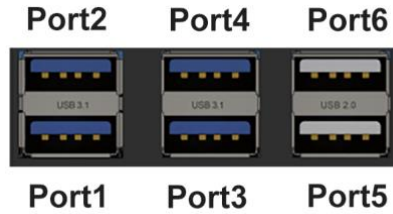
USB Hub port numbering (Port 1 – 4 are USB3 ports, Port5 - 6 are USB2 ports)

DATA CONNECTIVITY

A USB3 Type B port at the back of the unit accepts the USB3 cable for PC connection.

A 1.8m USB3 type B cable is supplied in the package.

By the time you plug the USB3 Type B cable the UPBv2 spawns 2 x USB Hub devices.

1. A USB3.1 Hub which is recognized with the name "USB5807 Hub"
2. A USB2.0 Hub which is recognized with the name "USB2807 Hub"

Controller is recognized as a USB 2.0 device with the name "UPBv2 rev[x]". This device allows the communication of the main controller with the PC. Communication is achieved through a Virtual to Serial interface (VCP/FTDI) with speed settings: 9600 / 8N1.

POWER OUTPUTS

Device includes:

- Four (4) x 12V DC unregulated output. Each output is driven by a Smart MOSFET, capable to deliver up to 6 Amps of current. These MOSFETs incorporates a broad range of smart features like diagnose and protection.
- Each of these 4 ports can be switched ON / OFF via the supplied software.

Each 12V power output has the following specifications:

Voltage type	Port
12V-13.8V DC unregulated	5.5 x 2.1mm DC Power Jack / 6 Amps each (center pin positive)

One Adjustable Output (ADJ OUT)

Voltage type	Port
3-12V Regulated (per 1Volt step) **Voltage level setting is stored and automatically retrieved from EEPROM during UPBv2 boot.**	5.5 x 2.1mm DC Power Jack / 3 Amps peak (center pin positive)

One 12V DC unregulated output – Always ON

Voltage type	Port
12V-13.8V DC unregulated	5.5 x 2.1mm DC Power Jack / rated up to 8Amps (center pin positive)

DEW HEATER OUTPUTS

Device has 3 x Dew heater channels / outputs. Like power outputs, each dew heater output includes the same Smart Mosfet types, capable to deliver up to 6 Amps of current.

A smart function (auto-dew) exists in the controller's firmware: The controller consults the environmental readings of the dew point and automatically adjust power of the Dew Heaters. This functionality can be switched on / off from the software.

Please notice: Dew heater outputs are also suitable to light a flat panel or drive your telescope's fans.

Voltage type	Port
12-13.8V DC – PWM - Duty Cycle %	Blue RCA Female Jack / 6 Amps peak

AUTO-DEW CALCULATION

Auto-Dew functionality takes over the control of the power of all Dew heater channels. User can select which Dew channel is eligible for the auto-dew control.

Algorithm calculates:

- the Dew Point, consulting relative humidity and ambient temperature levels
- the max drawn current (in Amperes) of each heater

based on these two factors, the device tunes the power intensity of the heaters every 10 seconds.

User is able to control the aggressiveness of the auto-dew functionality via the supplied software. (firmware >= 2.2)

Aggressiveness accepts a value from 1 to 10. The higher the value, the more power to the Dew Heaters.

BUILT IN POWER SENSORS

Each output (4 x 12V + 3 x Dew Heaters) has an individual current meter. Smart Mosfets are capable to diagnose the power consumption of each port and provide protection against overload, over temperature and short circuit.

- A DC voltmeter is installed after controller's power input. (Measures 5 – 15 Volts)
- A current meter is installed after controller's power input. (Measures 0 – 30 Amps)

EXT PORT

An RJ12 expansion port is available for future devices. Expansion Port allows the connectivity of current and future Pegasus Astro Products. Plugged devices can be controlled from UPB software (ASCOM /INDI / Standalone).

- Expansion port can accept wide range of future devices, simultaneously.
- Stock Temperature/Humidity Sensor is also connected into this port

STEPPER MOTOR CONTROLLER

Stepper motors offer excellent speed control, precise positioning, and repeatability of movement. UPBv2 includes an embedded stepper motor controller that precisely control your focus motor.

Controller can drive unipolar & bipolar stepper motors and it supports motor that consume up to 2.4 Amps of current (1.2 Amp per phase).

A wide range of motors are compatible with the stepper controller as displayed in the table below. Each motor requires a special cable as the pinout is different for each type.

| Supported Stepper Motors	(Required cable SKU)
Pegasus Motor Focus Kit	Requires RJ45 to RJ45 common straight network cable
Robofocus	PEG-CMOT-RJ45DB9
Moonlite	PEG-CMOT-RJ45DB9

Lakeside	PEG-CMOT-RJ45DB9
Starlight HSM 20,30,35	PEG-CMOT-HSM
Starlight MSM 20,30,35	PEG-CMOT-MSM
Rigel nStep	PEG-CMOT-MSM
Starlight POSI Drive Motor	PEG-CMOT-HSM

The performance of the stepper motor is greatly affected by the driving method. UPBv2 uses **a Half Step** drive. Compared with the full step drive, the motor's step angle resolution is doubled, and the motor runs more smoothly and quietly.

When starting a stepper motor, acceleration and deceleration should happen through pulses to the motor that start slowly and gradually quicken in a process called ramping. Most stepper motors require gradual ramping to full speed.

For this specific reason an acceleration and deceleration profile is applied to the motor movement. (Please check image below of how this works). This profile ensures that motor will ramp up power consumption and will not jump when it starts under focuser load or overshoot steps when it is time to stop.

Acceleration/Deceleration profile can be disabled from supplied software so the motor will instantly start at full speed and instantly stop when position is reached.
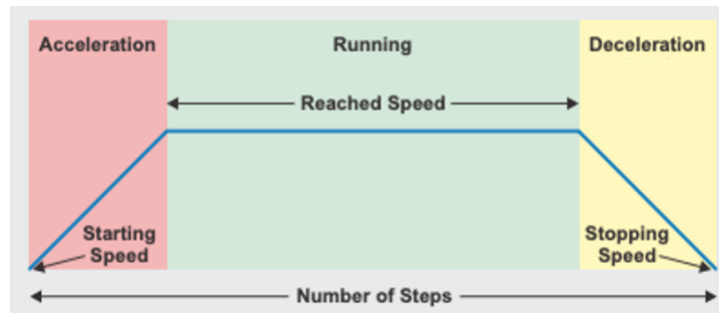
Backlash compensation is implemented in the firmware and can be enabled, tuned or disabled from the supplied software.

An ASCOM6 focuser driver is available for the stepper controller.

RJ45 connector is located at the front of the Ultimate Powerbox v2. Pinout can be seen at the following table:

UNIPOLAR STEPPER MOTOR (RJ45 – 8PIN) 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

Position of the motor is automatically stored to EEPROM memory 10 seconds after last motor movement.

ENVIRONMENTAL SENSOR

The stock probe is an external temperature / humidity sensor which is attached to the controller. It comes with length of 60cm cable. Probe measures:

- 0 to 100% humidity readings with 2-5% accuracy
- -40 to 80°C temperature readings ±0.5°C accuracy

The unit automatically detects the presence of the probe and gets temperature readings every 15 seconds.

A RJ12 socket (**EXT**) connects the temperature/humidity sensor with the Ultimate Powerbox v2 controller

Important: Please ensure that the sensor is plugged into the EXT port ONLY. Do not plug the sensor to the motor output! Severe damage to the sensor might happen if you accidentally plug the sensor to motor output.

- Place the sensor away of a direct moisture hit (water droplets)
- Place the sensor away of direct sunlight hit
- Dust and high humidity over the time can create "mud particles" and interfere with the sensor internal circuit leading to higher humidity levels.
- In order to prevent all the above it is **highly recommended** to place the sensor between telescope and dovetail.

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 (or blue in older revisions) LED is fitted on the right front side of the unit. The light pattern displayed by the led indicated the status of the device. The led can be turned on / off from the software at your demand.

| Permanently Light | Device is up and running |

Flashing Light (4 times every 4 sec in loop)	Device entered to firmware upload
Permanently Off	Controller not operational

MOUNTING

PAIR OF DOVETAIL BRACKETS FOR UPBV2

We strongly advise to securely mount the UPB on a lightweight Losmandy 3'' or Vixen dovetail.
Optionally, we provide a pair of brackets in order to achieve that. Grip the plate on the telescope or under your mount's saddle.
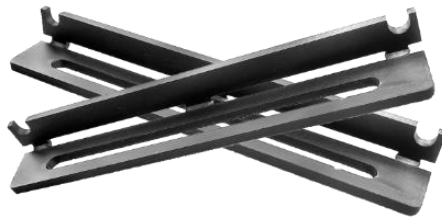
SMALL FACTOR PC BASE PLATE FOR UPBV2

An anodized aluminum base plate to securely mount your small factor PC (e.g Intel NUC) on the UPBv2.

- We advise to buddle the Ultimate Powerbox v2 with **a Compute PC Stick** or a **small factor PC.** These tiny computers have (nowadays) sufficient power for your astrophotography requirements.
- It is wise to select and use good quality and short length USB cables.
- Do the same for power cables. Long and thin power cables will have an effect of voltage drops. This can cause issues to your camera/ccd image quality or mount tracking.
- Make sure you use a good quality DC input socket with a thick power cable (1.5mm each pole). Verify there are no gaps that can cause power disconnect.
- Pay extra attention of you are using a "step up voltage converter" in the DC input. You need at least 6 Amps to power all of your devices. (We don't recommend step up converters – buy a good battery or a decent linear PSU).

DIMENSIONS

Size (Width, Depth, Height)	135mm x 107mm x 30mm
Weight	400 grams

FREQUENTLY ASKED QUESTIONS

Question	Answer
What kind of power supply do I need?	We strongly suggest using our certified 12V/10A PSU which is sufficient for a single astro-setup, in most cases. If your power requirements are higher than 120Watts, please select a branded linear 12V / 10-20A power supply. Cheap units will lead to voltage drops on high load and ripple effect. This will cause issues and artifacts to your precious CCD / CMOS Camera.
What type of cable do I need to use for input?	If you are going to make a custom input cable notice that you need at least an AWG 17 cable. Make also sure that you do not exceed 2 meters (6 feet) to reduce voltage drops.
I would like to use the Ultimate Powerbox to my remote observatory. What if the device freezes for some reason?	Device has a hardware watchdog and resets itself 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. Moreover, USB2 Hub Chip is an industrial model which fully complies with this temperature range.
What if I accidentally short-circuit an output?	Ultimate Powerbox v2 has an internal protection for all outputs. In less that 5 milliseconds it will cut off the power of this output and a warning message will be appeared on the software screen.
What if I accidentally reverse polarity?	Ultimate Powerbox has a reverse polarity protection input. Device will not power on and of course will not allow any voltage to pass through outputs.
What if I short-circuit a USB Hub port?	Device has a USB short-circuit / overcurrent protection per port. It will instantly isolate/disable

|	the selected USB port. Just remove the USB device and plug another one to bring it to life.
I have a USB device which requires more power than a normal USB port	Each USB port can deliver up to 2.5Amps of current
Can I upgrade the firmware?	Of course, device has been designed to support firmware upgrade for future features or bug fixes.
Why don't you place a mini PC inside the Ultimate Powerbox?	We really don't support this idea. Why to buy something and pay noticeable amount of money for a mini PC that will be obsolete (in its specification) after 6-12 months? What we suggest is to just buy a compute stick, plug it in a USB hub port to supply it with enough power juice and you have your tiny PC up and running! If you don't like it after some time, buy another one with higher specifications.

Optional Accessories

Battery Coupler for DSLR /Mirrorless Cameras (Different types for Canon, Sony, Fuji, Nikon)	Pair of Dovetail Brackets for UPBv2	Stepper Motor Cable (Robofocus / Lakeside / Moonlite Pinout) RJ45 to DB9
Power cable for Skywatcher EQ8 or Power cable for Skywatcher EQ6R / EQ6-AZ	Power Supply Unit 12v/10A XT60 Plug	Pegasus Stepper Motor Kit (Universal L shaped bracket or SCT Bracket)
Small Factor PC Base Plate for UPBv2	Stepper Motor Cable for Starlight HSM 20/30/35 Motors (RJ45 to RJ45)	Cig, Lighter Adapter to DC Power CIGLIGHT-ADAPTERXT60

Device is covered by two (2) years warranty
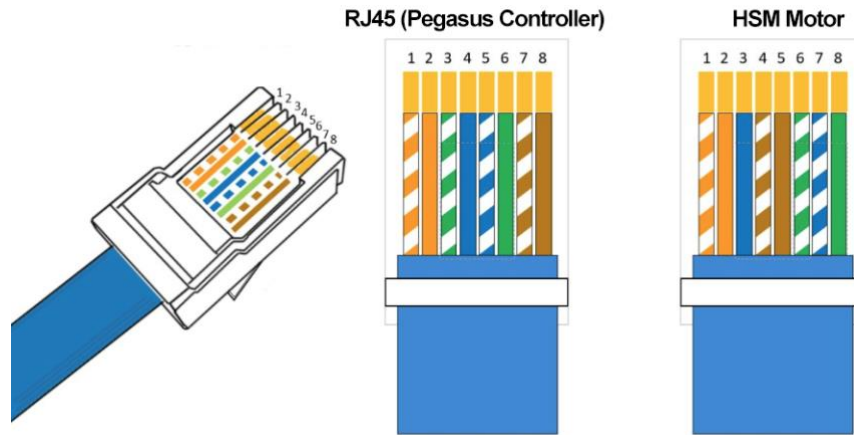
Designed and Assembled in Greece

APPENDIX

Robofocus / Moonlite / Lakeside - DB9 Cable Pinout

RJ45 (Pegasus Controller)
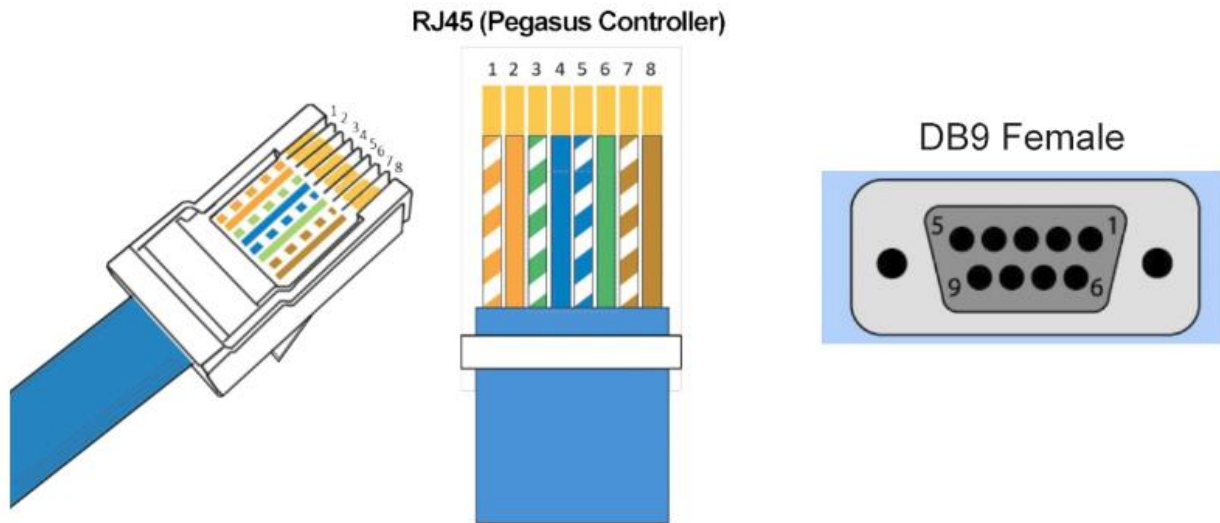
DB9 Female

Pin Number	RJ45 (Pegasus Controller)	DB9 Female
1	White-Orange	-
2	Orange	-
3	White-Green **Coil A+**	1
4	Blue **Coil A-**	2
5	White-Blue **Coil B+**	3
6	Green **Coil B-**	4
7	White-Brown	-
8	Brown	-

Starlight HSM20/30/35 - RJ45 Motor Cable Pinout

for **UPBv2 & DMFC**

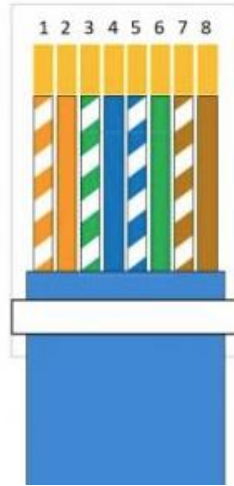| Pin Number	RJ45 (Pegasus Controller)	RJ45 (HSM Motor)
1	White-Orange	White-Orange
2	Orange	Orange
3	White-Green **Coil A+**	Blue **CoilA-**
4	Blue **Coil A-**	White-Brown
5	White-Blue **Coil B+**	Brown
6	Green **Coil B-**	White-Green **CoilA+**
7	White-Brown	White-Blue **Coil B+**
8	Brown	Green **Coil B-**

Starlight MSM20/30/35 & Rigel nStep

Motor Cable Pinout

for **UPBv2 & DMFC**

RJ45 Pegasus Controller   **RJ12 Rigel Motor**

Pin Number	RJ45 Pegasus Controller)	RJ45 (HSM Motor)
1	White Orange	White Orange
2	Orange	Orange
3	White Green **Coil A+**	White Green **Coil A+**
4	Blue **Coil A-**	Blue **Coil A-**
5	White Blue **Coil B+**	White Blue **Coil B+**
6	Green **Coil B-**	Green **Coil B-**
7	White Brown	-
8	Brown	-

Lacerta Motorfocus Stepper
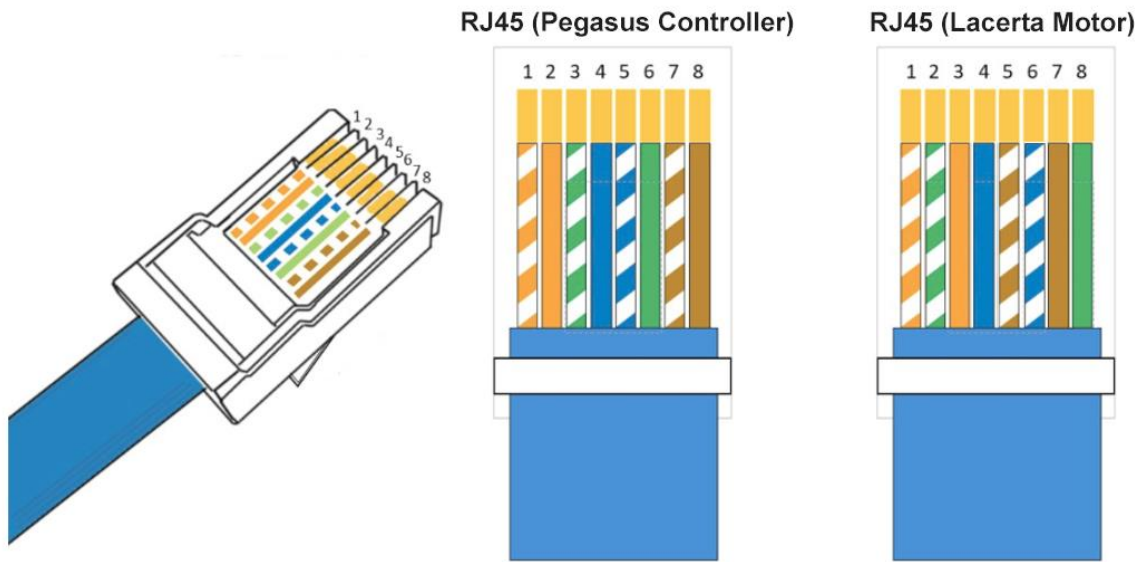
Pin Number	RJ45 (Pegasus Controller)	RJ45 (Lacerta Stepper Motor)
1	White-Orange	White-Orange
2	Orange	White-Green **CoilA+**
3	White-Green **Coil A+**	Orange
4	Blue **Coil A-**	Blue **Coil A-**
5	White-Blue **Coil B+**	White-Brown
6	Green **Coil B-**	White-Blue **Coil B+**
7	White-Brown	Brown
8	Brown	Green **Coil B-**

Pegasus Motor Focus Kit (v1/v2)

Pegasus Motor Focus Kit requires a common straight RJ45 to RJ45 network cable