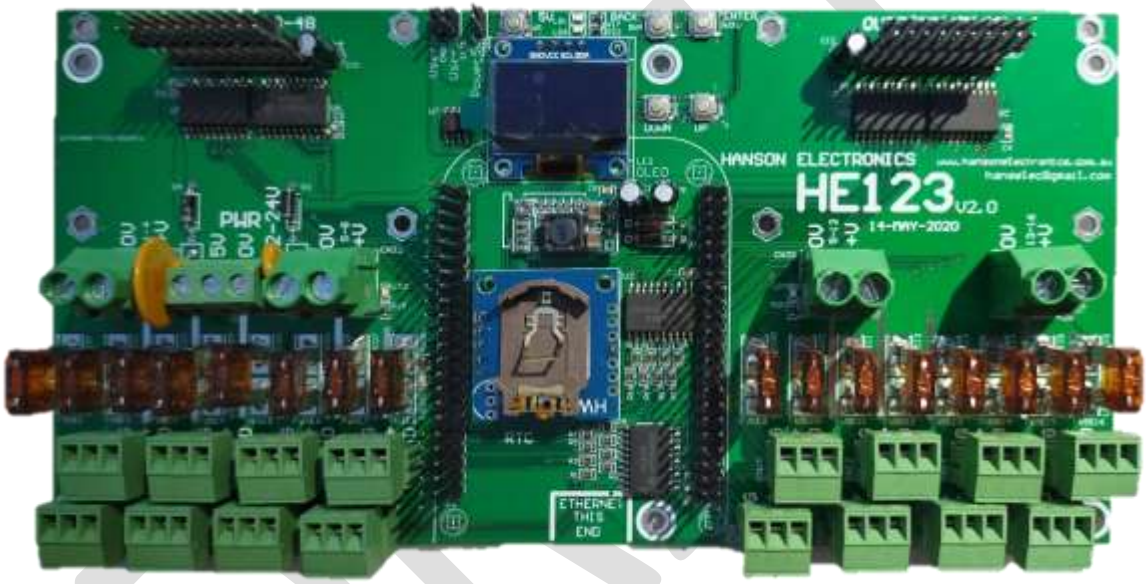
HANSON ELECTRONICS

HE123 BeagleboneBlack 48 output pixel controller User Manual



The HE123 is a pixel controller board operated via a BeagleBone Black (BBB) or Beaglebone Green (BBG) single board computer. It uses design elements of the RGB123 48 output pixel board and is controlled with Falcon Player (FPP). The HE123 is the motherboard that the BBB plugs onto. Up to 2 optional daughter boards (of 3 types) can plug onto it as well. The 48 outputs are for 2811 and compatible pixels.

Dimensions and user manuals are available on website where applicable.
This manual covers the HE123, HE123 Mk2 and HE123D. Differences will be noted.

Screenshots and configurations shown and described in this manual suit Falcon Player version 7. Older and newer version may and will differ in some of the configuration.

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http://www.hansonelectronics.com.au
https://www.facebook.com/HansonElectronicsAustralia

The HE123 is a motherboard designed to be run off a Beaglebone Black (BBB) or Beaglebone Green (BBG) single board computer and is compatible with the RGB123 48 output cape that the original design was based on. Throughout this manual HE123 is used to cover the HE123, HE123Mk2 and HE123D with differences in specifications or features pointed out where necessary.

The HE123 and HE123Mk2 have 16 fused pixel outputs and 2 expansion headers to allow for the addition of an additional 32 outputs. The additional outputs can be facilitated by the HE123-RJ, HE123-TX , HE123-TXI, HE123-PX2, HE123-PX2I or HE123-PX. The HE123-PX has been replaced by the HE123-PX2 which has the same function but uses mini fuses rather than ATO. The HE123D is a 48 output differential output (also called "long range") version of the HE123 and most of the setup in Falcon Player and Xlights is the same for both.

The HE123 can be run off either Falcon Player (FPP http://falconchristmas.com/forum/index.php?board=8.0) or the Ledscape library (https://github.com/Yona-Appletree/LEDscape). As Falcon Player is the most common control method and uses parts of the LEDscape library it will be the only method discussed. The non pixel features of the HE123 aren't supported with LEDscape. Falcon Player (formerly Falcon Pi Player) is developed and maintained on the Falcon Christmas forum. First line support is via the forum with further support via the Falcon Player Facebook page and the Falcon Player github repository.

The HE123 can use either a Beaglebone Black (BBB) or a Beaglebone Green (BBG) as the "brains" that runs the board. As far as the operation of the HE123 goes there is no difference between the 2. Most of the 2 single board computers is identical with the main difference is that the BBB has a video output and the BBG has some connectors for IO interfaces. In both cases these generally will not be used. A Beaglebone Green Wireless can run the HE123 but a number of outputs get lost due to them being used for the wifi.
On P8, pins 11, 12, 14, 15, 16, 17, 18, and 26.
On P9, pins 12, 28, 29, 30, 31.

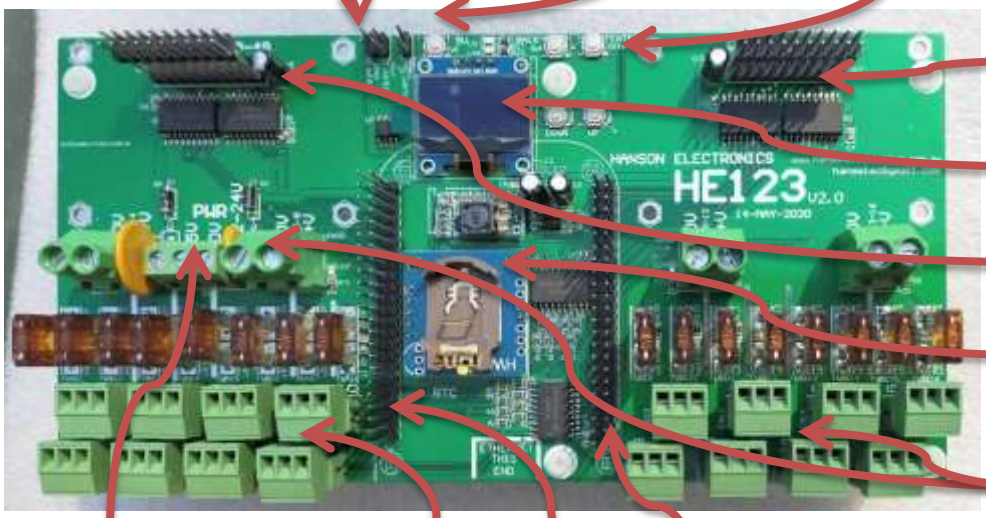
The HE123 is supplied with 7.5A output fuses and without a Beaglebone Black/Green (unless ordered with 1). It can be powered from either 5V or 12V. The 5V supply should be stable and vary no more than +/- 0.1V. The 12V supply can actually be anywhere in the range of 8-24V but 12V is the nominal voltage. Reversing the power or connecting up to both the 5V and 12V inputs at the same time may damage components on the board or the BBB. The BBB is powered from the same power source as the HE123.

There is a real time clock (RTC) that can be used for scheduling a show. It uses a CR2032 battery which isn't supplied. The RTC only needs to be used if the HE123 is used in Player (standalone) or Player (master) AND the HE123 doesn't have a connection through a network to the internet and thus have access to a time server. The battery only needs to be installed if using the RTC.

Care should be taken when plugging the BBB on top of the HE123 to ensure that no pins are bent and that there is no mis-alignment of the header pins. The Ethernet connector comes out the same end as the pixel connectors (see picture).

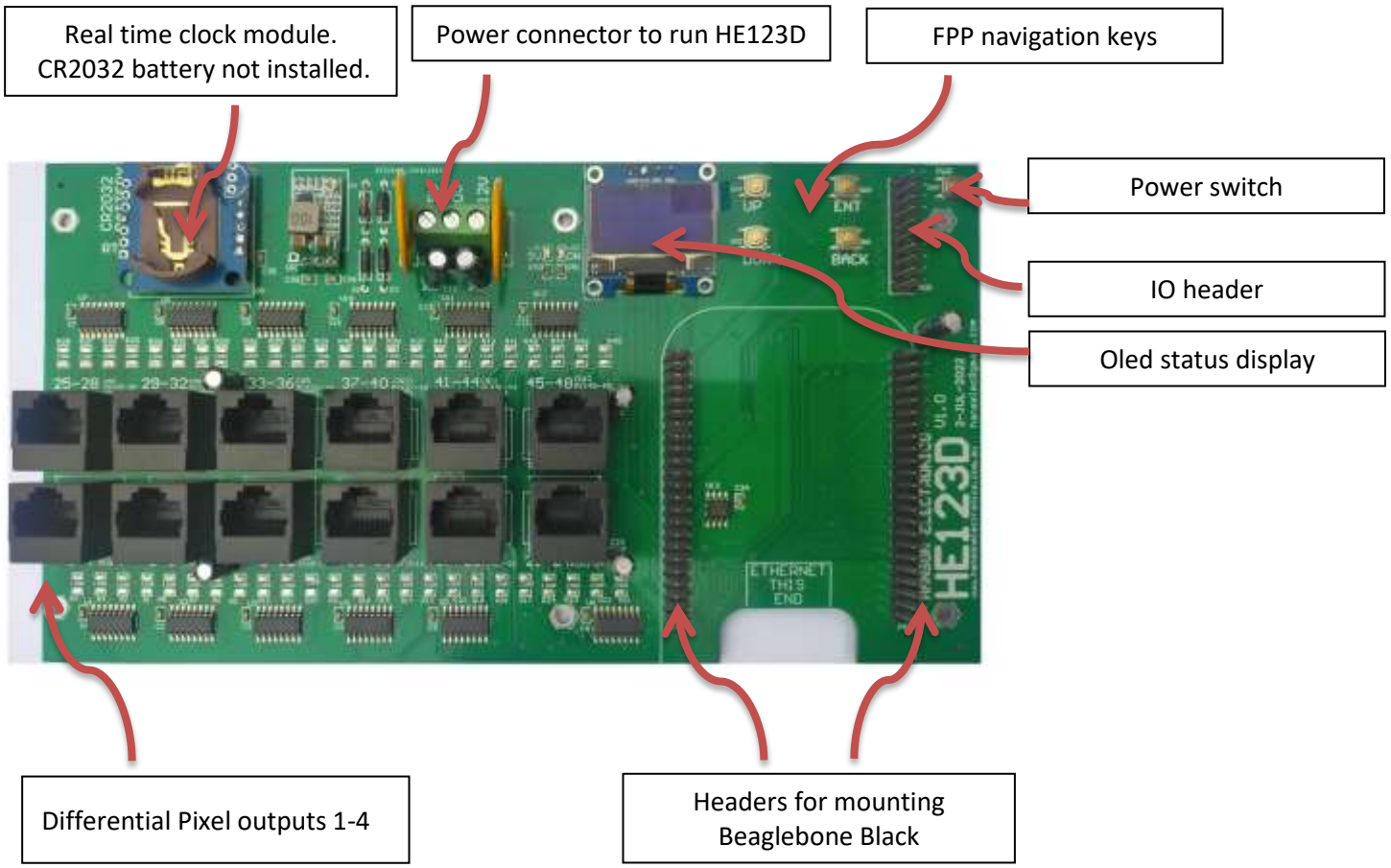
HE123 motherboard

- 16 fused pixel outputs with 4 outputs per power input
- 2 expansion headers of 16 pixel outputs each
- inbuilt real time clock
- connects to HE123RJ, HE123TX, HE123PX, HE123PX, HE123TXI,HE123PXI
- header to take the Beaglebone Black power switch to the outside of an enclosure. A normally open switch can be connected to this header for powering off the BBB.
- can be powered by 5V or 12-24V



Features marked with ** are on HE123Mk2 but not original HE123.
The position of some components/features may be moved on different revisions of HE123.

HE123D



BeagleBone Black (BBB) is used for running Falcon Player and operating the He123 pixel controller. It can also be used for other lighting control gear.
The BBB is the brains that controls the HE123 and provides storage for sequences and has the Ethernet access. The BBB is not supplied with the HE123.
http://www.hansonelectronics.com.au/product/beaglebone-black/

A Beaglebone green is virtually identical to the BBB with the exception that 2 grove connectors replace the HDMI ouput.
http://www.hansonelectronics.com.au/product/beaglebone-green/

Throughout this manual the Beaglebone Black(BBB) is used/shown. The BBG can as easily be used.
If a Beaglebone Green Wireless is used (not recommended) then the following outputs cannot be used.
Output---
Output---

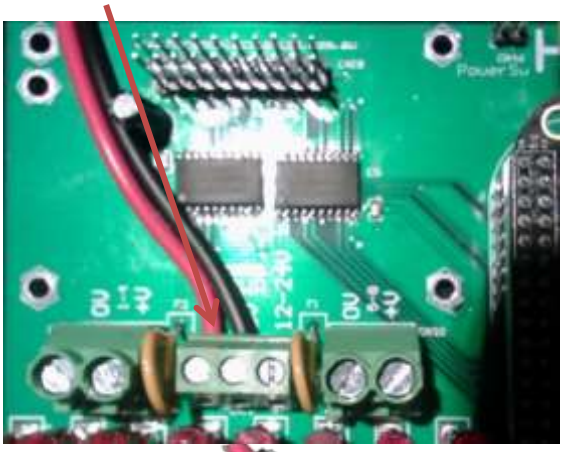
Connection Examples

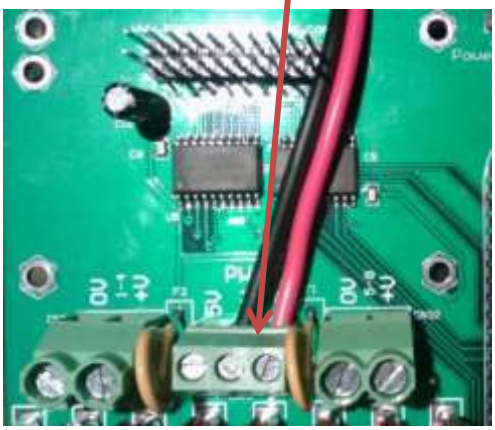
HE123 Power

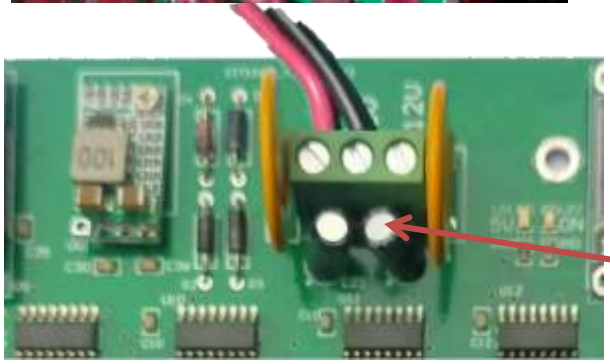
HE123 powered from 5V

HE123 power connector (between pixel power connectors for outputs 1-4 and 5-8)

HE123 powered from 12V





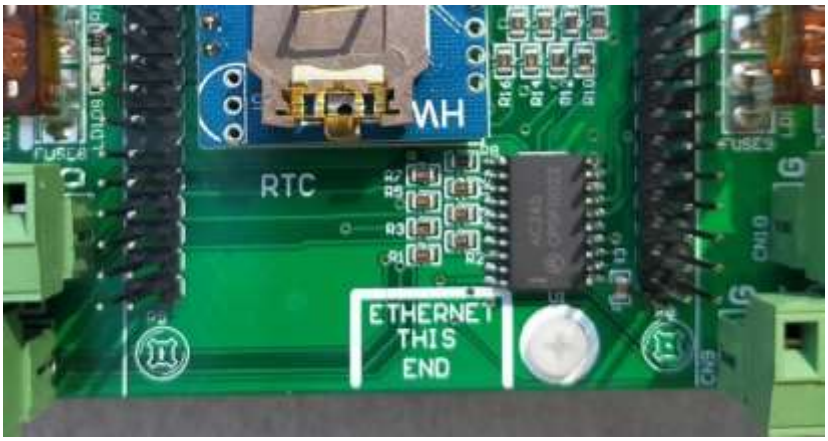


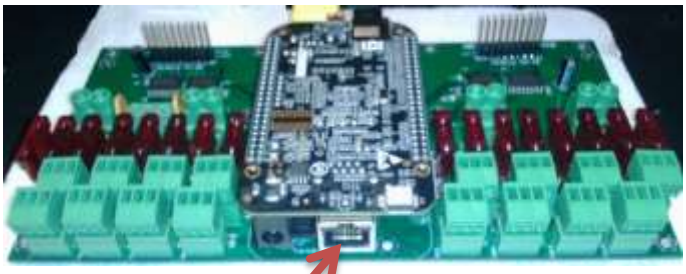
HE123D powered from 5V

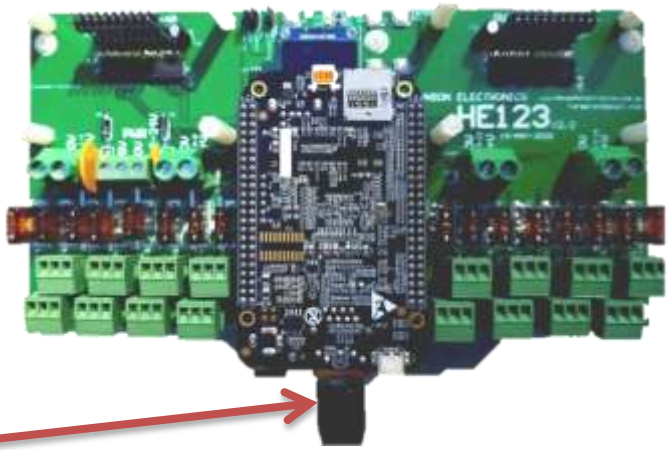
The Beaglebone Black (BBB) is powered from the HE123. The board and BBB are powered via the 3 way terminal located between the power connectors for pixel outputs 1-4 and 5-8. Depending on the voltage that the board is to be powered from it would be connected to either the 0V and 5V terminals or 0V and 12-24V terminals.
Connecting higher than 5.1V to the 5V input of the HE123 will likely damage the BBB immediately and may damage components on the HE123 and daughterboards if they are connected.
There is a 5V power led to the right of the BBB socket (below where the pixel outputs 33-48 daughterboard mounts)
There is a header terminal for a power switch mounted to the top left of the BBB location. This switch works in parallel with the power switch on the BBB.

Ethernet

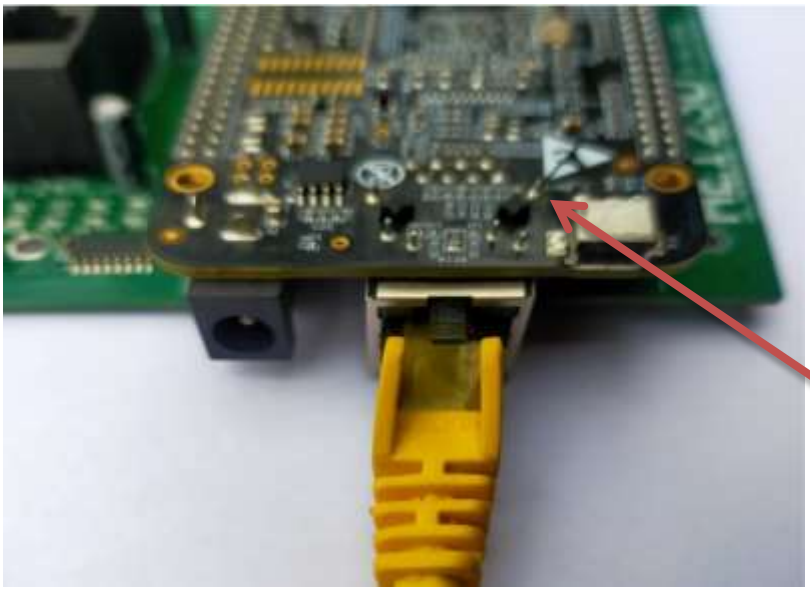
The Beaglebone Black has an Ethernet connector on it which should be located at the same end as what the pixel output connectors are on the HE123. (see below photo).







Ethernet connection to router/switch, PC, Raspberry Pi or another Beaglebone Black



BBB mounted to HE123D and Ethernet cable connected

Falcon Player (FPP) Configuration

The Falcon Player user manual is always an ongoing project and it can be found at http://falconchristmas.com/forum/index.php/topic,7103.0.html

The below screenshots show some of the configurations accessible via the FPP web interface required when setting up and using the HE123. The appearance and potentially placement of some configurations may change with different versions of Falcon Player.

In the setup description only the Beaglebone Black (BBB) is described for brevity. The exact same setup process is used for the Beaglebone Green (BBG).

The first step to setting up the HE123 is to install and configure Falcon Player.

See http://falconchristmas.com/forum/index.php?board=8.0 for information and support for Falcon Player.

The Falcon Player image needs to be downloaded from https://github.com/FalconChristmas/fpp/releases . The image will have a name like FPP-v4.1-BBB.img.zip with the version number being whatever is current (or the older 1 that you choose to use) and BBB indicating that it suits the Beaglebone Black (and Green). Download and save the image. The image will then need to be "burnt" onto a micro SD card using a program like Balena Etcher (https://www.balena.io/etcher/). The SD card should be 8GB or larger and Speed Class 10 (V10) or faster. Run Etcher, select the FPP-v*.*-BBB.img.zip image that you previously downloaded, Etcher should select the SD card and select "Flash". You may have to give to okay to Windows User Account control to allow Etcher the permission to run the burning/etching/flashing process.

A brief (bad) setup video for burning FPP is at https://www.youtube.com/watch?v=9M1EhyadXNA

It is recommended that the initial setup of Falcon Player on the BBB/BBG is done via the USB cable that is supplied with the BBB and with the BBB not plugged onto the HE123.

Install the previously burnt micro SD card into the BBB. Plug the supplied USB lead into the BBB and your computer. You will potentially be prompted to install a virtual com port. After the com port is installed you can then access Falcon Player on the BBB via a web browser and the IP of 192.168.7.2 (for Mac and Linux the IP is 192.168.6.2)

When you login via the browser you will be taken to the status page. The screenshot below shows the status page that has that previously been setup. When you first login the FPP Mode will be in Player (Standalone) and there will be no schedule or playlist listed.

With many/most of the settings changes you will need to click on save and many require a start of the Falcon Player daemon (FPPD) which is the background program that actually is the main Falcon Player program.

In order to be able to access the BBB once you disconnect from the USB cable and connect to an Ethernet network I would suggest immediately setting up the network and making the connection a Static connection rather than DHCP. Being static means that every time that you power up the BBB it will be accessible on the same IP whereas DHCP relies on a computer or router that has DHCP server capability to assign an IP address at each power up.

The network setup page is under the Status/Control tab at the top left of the FPP web page.

This screenshot shows the network setup page with a static IP set to 10.0.0.160 which is a suitable IP for my computer network. 10.0.0.x and 192.168.0.x are the 2 most common ranges. The netmask of 255.255.0.0 allows connection between 10.0.0.1 and 10.0.255.255 for a 10.0.0.x network or 192.168.0.0 and 192.168.255.255 on a 192.168.0.x network. The gateway IP is the IP of the router that it is connected to.

The Host name is an individual name that allows access to that instance of Falcon Player via a "name" rather than an IP. By default the Host Name is "FPP" which means in your browser you can access the webpage via http://FPP rather than 10.0.0.160 for instance. If you have multiple Falcon player installations then having different names for each makes sense. They could be named FPP1, FPP2 etc or FPP_House, FPP_Yard etc.

The DNS server mode I would recommend setting to manual and using the Google public DNS servers of 8.8.8.8 and 8.8.8.4. If you are experienced in computer networking you may choose other DNS servers like your own ISP providers DNS servers. The DNS server needs to be configured so that Falcon Player can access Github for any potential updates.

What needs to be configured within FPP depends on what mode you will be running in. Below is a brief description of what the modes do and what needs to be configured for each mode.

FPP global settings

-time and date.

-If the HE123 will be used to no connection to the internet then CR2032 battery needs to be installed and RTC time set

-If connected to the internet then enable NTP and select time zone.

-Oled display. The HE123 Mk2 has an oled display for viewing the status and accessing settings.

-Channels. The channels that are to be used must be matched up with your sequencer

-Outputs. The 16-48 channels of the HE123 must be matched up with channels assigned to the desired outputs

-If the HE123 is used in 1 of the modes that requires audio playback then the usb audio device must be selected

FPP Modes

Player (standalone). This mode is as it sounds. The HE123 and BBB running FPP run entirely without user input and plays back sequences configured in a playlist to a schedule. All data for all channels and all media is stored locally. This is usually on the same micro SD card as Falcon Player.

-time and date. (see global settings above)

-Sequences and media (if needed)
-Playlist/s of sequences and the matching media
-Schedule of playlist/s

Player (master). The mode is the same as the standalone mode except that it will send sync packets to remote instances of Falcon player to control them. The master may have only the channels in the sequences and media required for the HE123 on the micro SD card or it may have all the data for the remotes as well. Depending on how the sequences are installed onto the SD card it can be either part or all.

All the configurations used for standalone player must be configured the same way

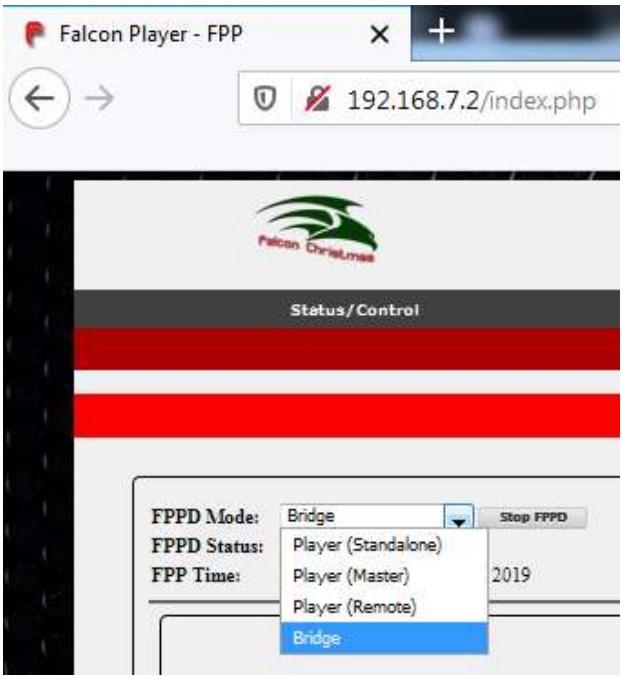
-IP's for instances of Falcon Player running in Player(remote) mode

Player (remote). This is an instance of Falcon Player that will use sync packets from a FPP master (or it can also be done from Xscheduler). Falcon Player will use sequences stored on its local micro SD card and will play them according to the sync packets from the master. This mode allows for very limited Ethernet traffic as it's just the timing being sent by the master and all the sequence data is local.

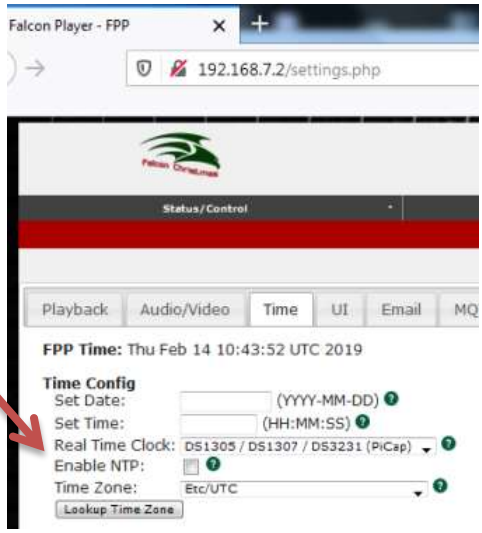
- Sequences and media (if needed). Depending on how the sequences are uploaded to Falcon Player the sequence may have all the channels or only those required for this instance of FPP.

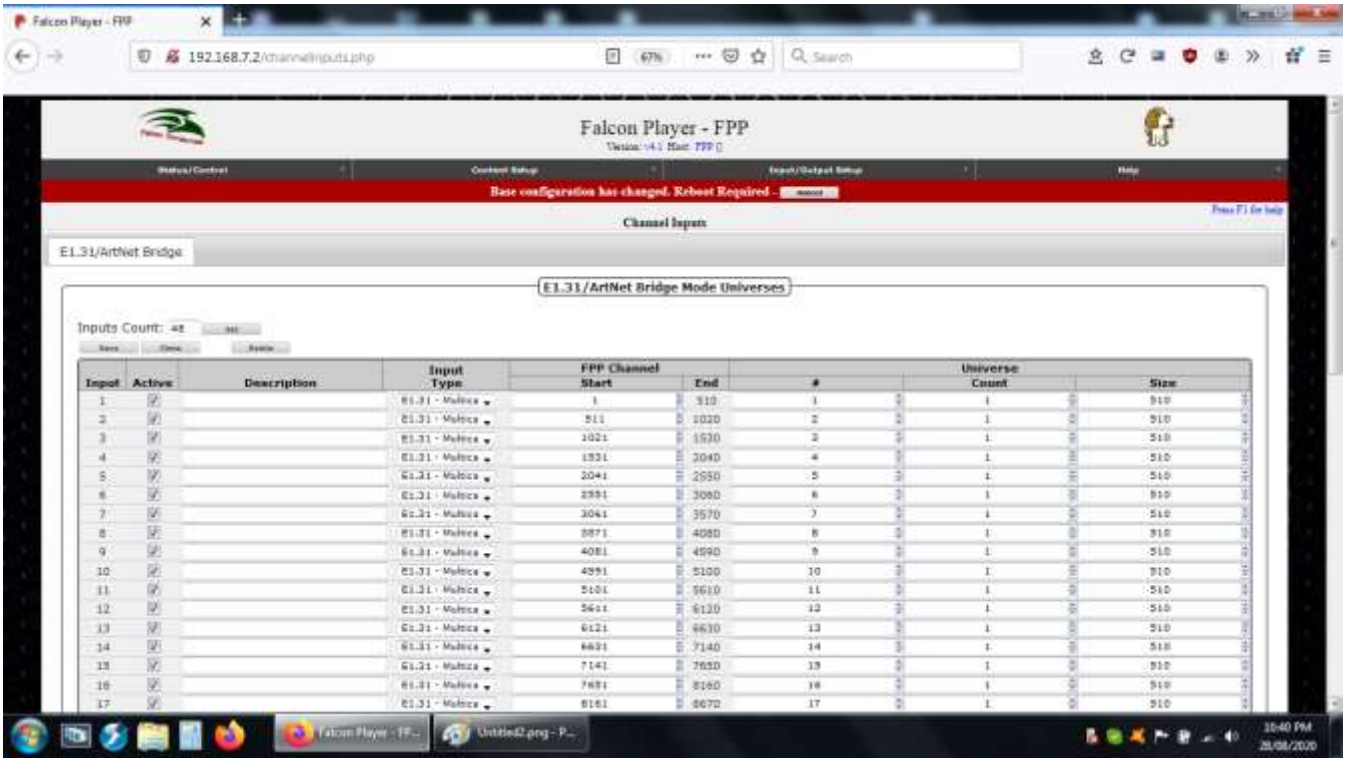
Bridge . This mode allows the instance of Falcon player on the HE123 to act as if it is a standard E1.31 pixel controller. All sequence data is sent via Ethernet from another source like Xlights on a PC, Falcon Player in Player(standalone) mode or similar.

The Falcon Player mode is selected on the status page as shown.



If the Real Time Clock (RTC) is needed due to the HE123 being configured as a Player and having no internet connection to use to get access to a time server then a CR2032 battery will need to be installed in the RTC module. The RTC type needs to be configured as a DS1307 type on the Time tab.

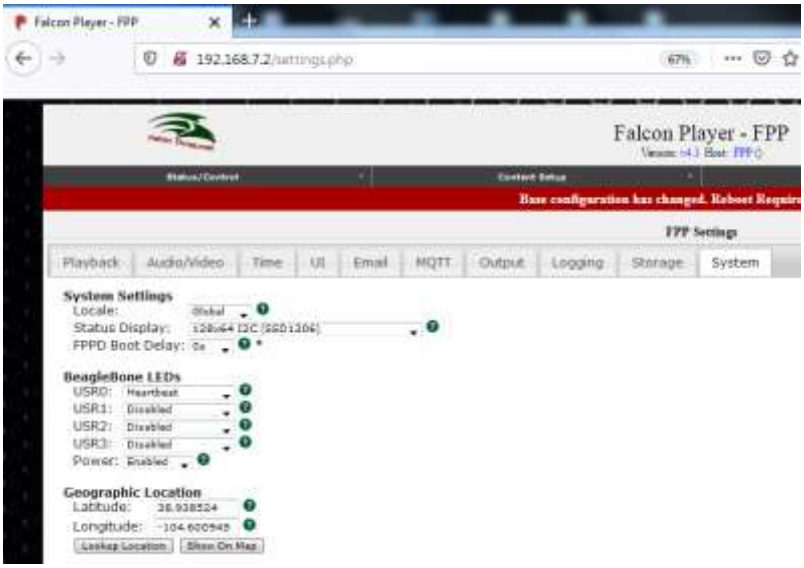




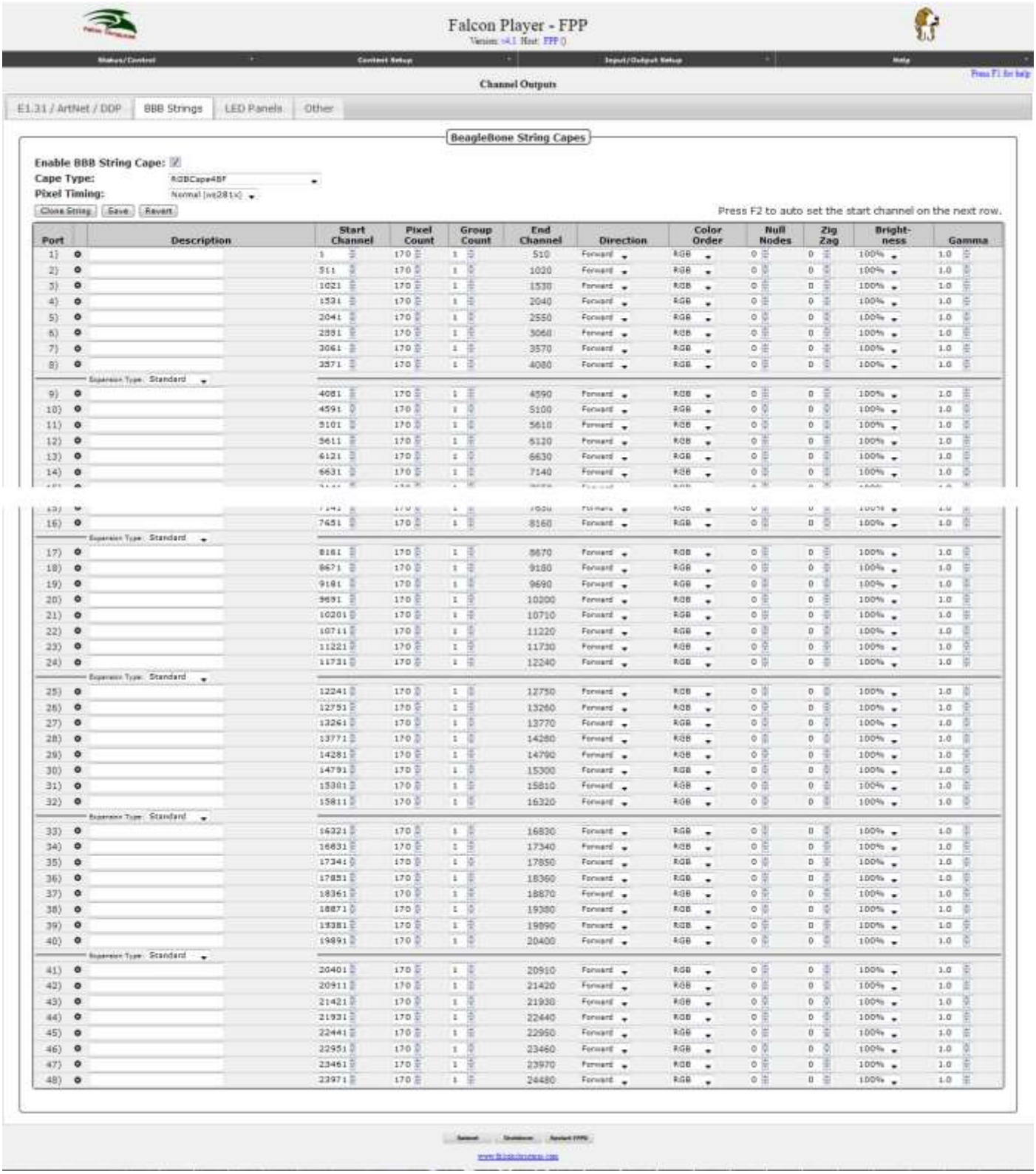
If using the HE123 in bridge mode in which it will act like a standard E1.31 pixel controller the universes and FPP channels will need to be reconciled on the Input/Output Setup> Input >E1.131/ArtNet Bridge page. On this page the universes that are in use in your sequencer will need to be matched. Care should be taken to not mistakenly set the size to 512 channels as in most cases the universe size will be set to 510 or a smaller multiple of 3.

Channels that will be used for the pixel outputs need to be configured under Input/Output Setup -> Channel Outputs -> E1.31. If not using as Master then there is no need to tick the Enable E1.31 output but all of the required FPP channels, universes and universe sizes need to be configured. Once configured and saved, change to the BBB tab, select RGBCape48F as the cape type, configure whichever of the 48 outputs are used. The RGB Cape48C setting doesn't control all the outputs and changes the output order.
The 1st 16 outputs are on the HE123 motherboard and the other 2 groups of 16 are from the two optional daughterboards. Save after configuring. The FPPD will need restarting after changes.

The BBB the screenshots are of is configured with a static IP of 10.0.0.160 and was configured with the default hostname of FPP. The above screenshot is the Status display in Bridge mode. The IP of 10.0.0.160 isn't shown (Host FPP (10.0.0.0.160)) as the screenshot was taken whilst connecting to the BBB via the virtual USB Ethernet IP of 192.168.7.2 .



The HE123 Mk2 has an oled display. If it hasn't been detected and working then on the Status/Control> FPP Settings page on the System tab the oled Status Display type needs to be set to 128x64 I2C (SSD1306).



On the Input/Output>Outputs>BBB Strings tab the “Enable BBB Strings” should be ticked and the cape type selected as RGBCape48F. Choosing 48C will give incorrect results with the order of outputs not matching the HE123 and some outputs not working.

The Ports (1-48) match the outputs of the HE123. For each of the Ports/Outputs in use the start channel and the number of pixels will need to be set. The prop name or another name can be assigned in the description if desired.

For more information on configuring the “virtual strings” which is enabled by clicking on the plus beside the Port number and for the other settings like RGB order and Gamma refer to the Falcon Player manual as linked at the start of this manual.

The Start Channel to End Channel range for each port/output should not overlap with other ports. Ie. In the example shown above port 1 uses 1-510 and port 2 uses 511-1020 etc.

FPP Navigation and status via Oled

The HE123 Mk2 has 4 switches for navigating Falcon Player through the Oled display. If these are automatically detected and running then they need to be setup as per the following on Input/Output Setup>GPIO Input Triggers. All 4 inputs need to be configured with “Pull Up”, the enable (En.) ticked and the Falling Edge Command set to OLED Navigation.

The IO’s are set as per the following.

P9-17 Back

P9-18 Enter

P9-21 Up

P9-22 Down

The Oled display on the HE123Mk2 will generally be supplied with the protective cover installed still as shown by the tab on the display above.

The display will show the status of Falcon Player by default but with the use of the navigation keys and the menu system a number of options can be accessed.

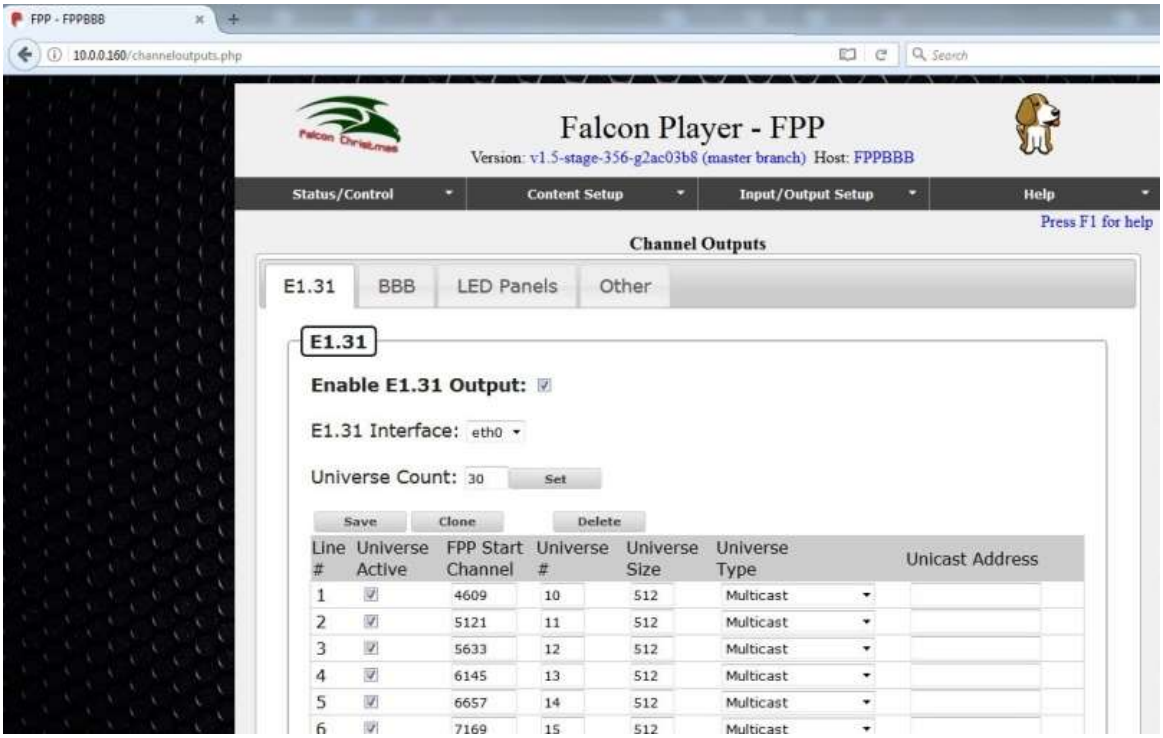
User Inputs

There are 2 user inputs on the HE123 Mk2. These are configured on the same page as the FPP navigation switch setup above. If these are to be used then they would also need to be configured with “Pull Up”, enable ticked and a command selected for each. It is likely that the “Falling Edge” would be used as a closing of contact on the inputs results in a falling edge trigger.

User 1 P8-27

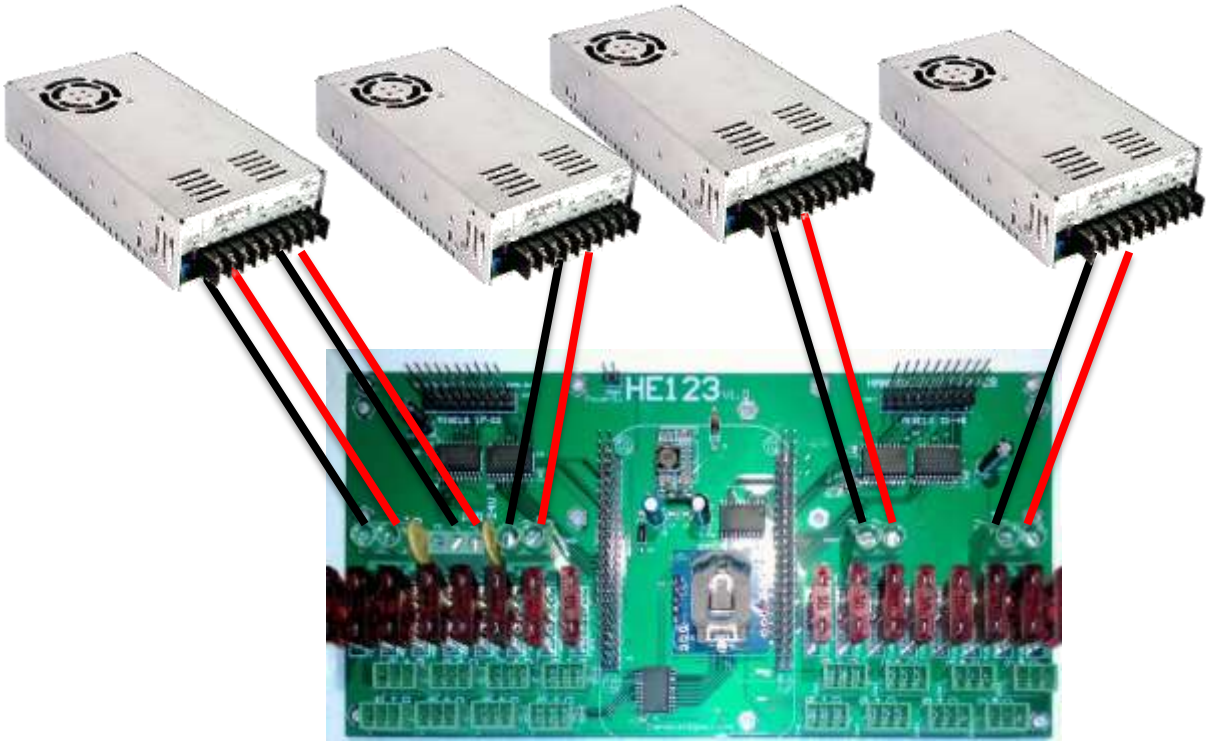
User 2 P9-26

Falcon player status screen when in Bridge Mode will show the incoming data on the configured universes. By default the "Live Update Stats" is unticked as this slows the performance of Falcon Player slightly. If you are troubleshooting then turning this on will allow you to confirm that you are getting regular data updates and that there is a low error rate.



Power and fusing

The HE123 motherboard has 4 power connectors for the 16 direct pixel outputs. These 4 connectors share a common ground but the +ve inputs are isolated. Each of the 4 inputs powers 4 pixel outputs. The maximum current that the power connector can carry is 30A and the 4 output connectors are rated to a maximum of 10A each but are supplied with 7.5A fuses (4 x 7.5A=30A).



The HE123 can be powered from 1 to 4 power supplies depending on the available and desired voltages and currents. The motherboard itself can be powered from any 1 of the power supplies and it will need to connect to the correct terminals depending on the power supply voltage. Power supplies as shown above have a maximum current per output connector of 30A which is the same as the power input terminals of the HE123.

The HE123 can be used with 5V, 12V and 24V pixels and they can be mixed across the 4 power inputs if needed.

The HE123 is supplied with 7.5A fuses fitted. Up to 10A fuses can be used but the total of the 4 fuses used across the 4 outputs supplied per power input needs to be 30A or less.

The HE123 uses ATO automotive fuses and fuseholders. The HE123Mk2 uses mini automotive fuses and fuseholders.

The HE123 Mk2 has power leds adjacent to each of the 4 power input terminals and it has fuse failed leds adjacent to each of the 16 fuses.

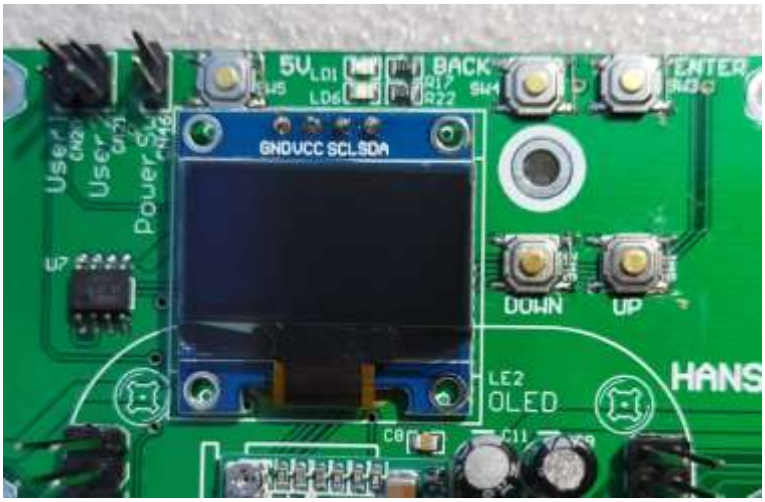
The HE123 uses a separate power terminal for running the HE123 and the attached Beaglebone Black (or Green). This is a 3 pin terminal located between the power input terminals for outputs 1-4 and 5-8. The 3 terminals on the “PWR” connector are labelled 5V, 0V and 12-24V. When powering the HE123 you can use either 5V power which would require connecting to the 0V and 5V terminals or if using 12 to 24V then you would use the 0V and 12-24V terminals.

Connecting higher than 5V to the 5V PWR input terminal may damage the HE123 and attached Beaglebone Black.

Powering down Falcon Player

Falcon Player on the Beaglebone Black (or Green) runs off a micro SD card although it can also be ran from the eMMC onboard memory. To prevent corruption of the data on the SD card Falcon Player should be closed down prior to removing the power from the HE123. The shutdown can be done via logging into Falcon Player and using the "Shutdown" link at the bottom of the page or alternately there is a jumper on the HE123 labelled "Power Sw" which will trigger a shutdown process. The HE123 Mk2 also has a power switch adjacent to the jumper. The jumper or power switch can also be used to power the Beaglebone Black back up after it has been shut down.

There are also scripts that allow FPP to be shutdown remotely.

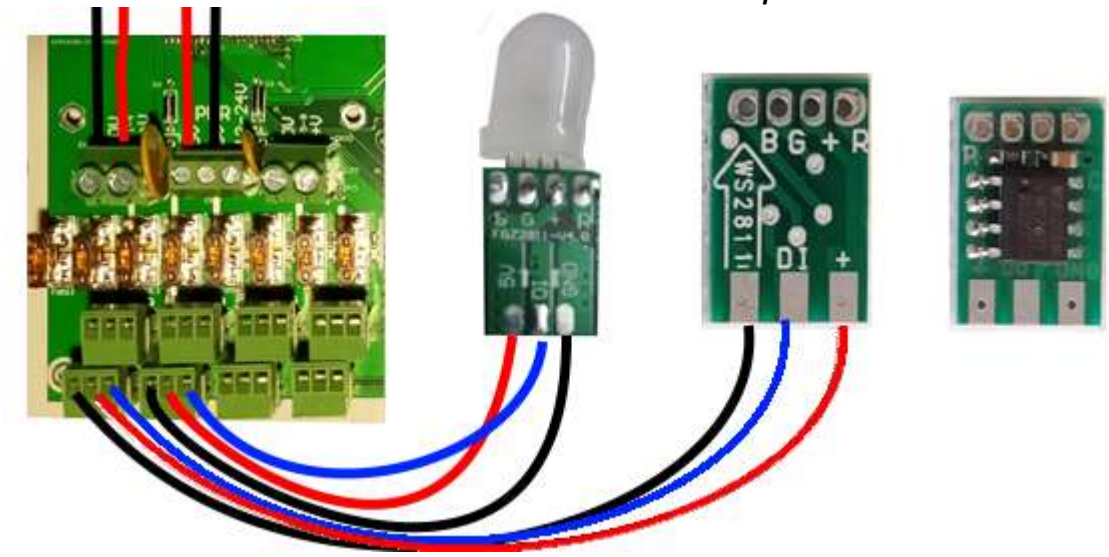


Pixel connectors

Pixel connection labels
G, +, D

All of the pixel connectors on all HE123 series boards use 3 pin 3.5mm spacing pluggable terminals rated to a maximum of 10A. Each connector has its connections labelled with a G, + and D. These represent Ground (-V, V- or 0V), +V (or V+) power which can be 5V, 12V or 24V and Data.

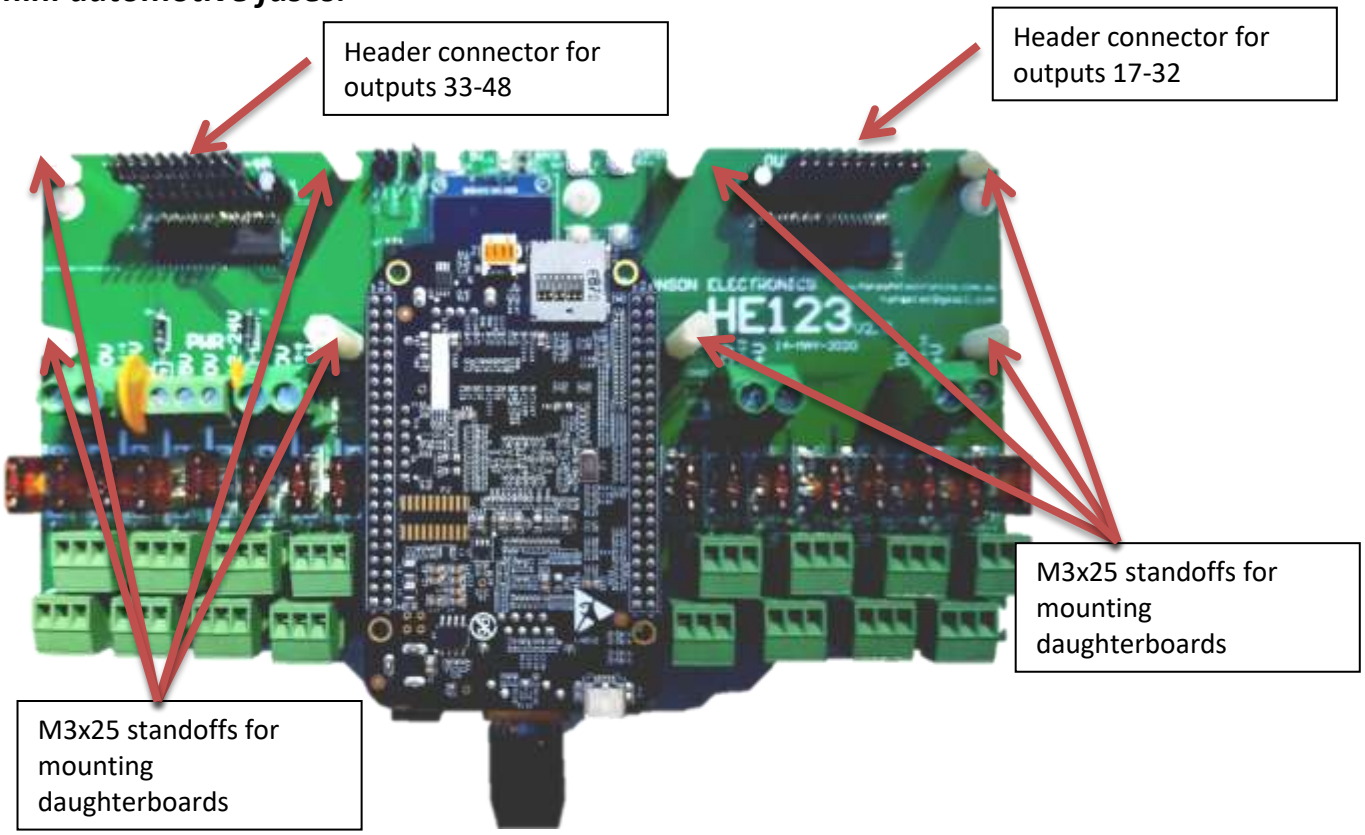
Take note of the position of connections as what is used on HE123 series may vary compared to other pixel controllers.



Example showing 2 pixels wired to outputs 1 and 3. Pixels will/should have similar markings as above. The power to them will be marked similar to 0V,-, -V or Gnd for the negative connection. The positive will be marked with a 5V, 12V, + or V+. This will depend on manufacturer and voltage of the pixels. The correct pixel voltage must be connected. Ie 5V power to 5V pixels, 12V power to 12V pixels. The HE123 can have different voltages supplied to each of the banks of 4 outputs. The data output of the HE123 needs to connect to the data input terminal of the connected pixels. This terminal is generally marked with a DI (data in). There is often an arrow on the pixel pcb to indicate the data direction. Data in comes from the base of the arrow. Data to subsequent pixels goes from the DO (data out) of pixel 1 to DI of pixel 2. DO of pixel 2 to DI of pixel 3 etc.

Daughterboards

A number of the HE123 daughterboards have been upgraded to a Mk2. The only significant difference in them is that they have changed from using ATO automotive fuses to mini automotive fuses.



HE123-PX2 powered pixel expansion daughterboard

- 16 outputs. 4 power inputs. 4 fuses per output
- maximum of 30A per power input and 10A per pixel output
- plugs on top of HE123 to give an additional 16 fused 2811 outputs

The HE123-PX2 uses mini fuses and has a different terminal arrangement.
http://www.hansonelectronics.com.au/product/he123-px2/

HE123-RJ pixel breakout daughterboard

- 16 outputs. no electronics. pixel outputs match standard RJ45 pairs
- plugs on top of HE123 to give an additional 16 unfused 2811 outputs on 4 RJ45 connectors
- mates with 4 HE123-EX2
- up to several metres between HE123-RJ and HE123-EX2

http://www.hansonelectronics.com.au/product/he123-rj/

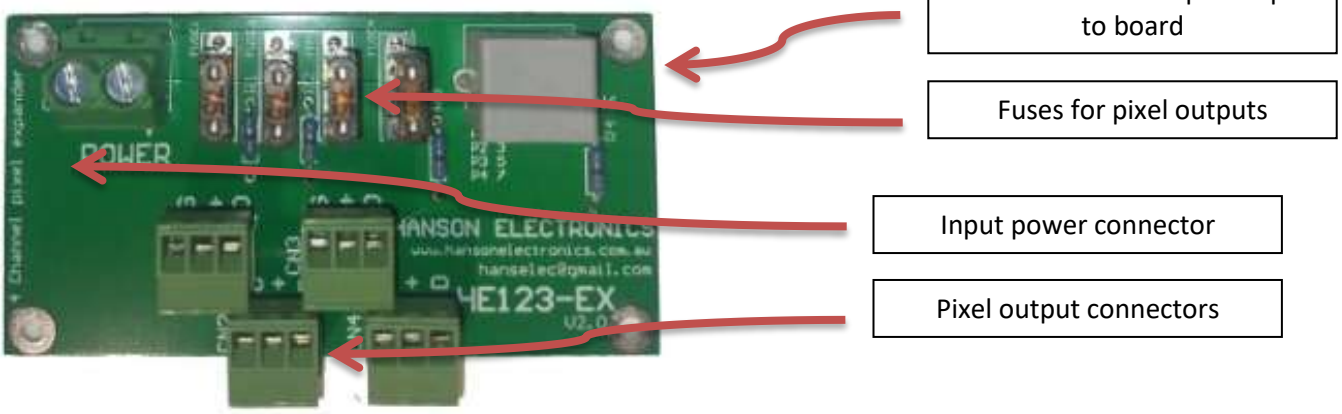
HE123-TX pixel differential expansion daughterboard

- 16 RS422 balanced pair outputs for long range tx
- 16 outputs. pixel outputs on standard RJ45 pairs
- mates with 4 HE123-RX
- up to several hundred metres between HE123-TX and HE123-RX

http://www.hansonelectronics.com.au/product/he123-tx/

Receivers

HE123-EX2 4 channel pixel power breakout

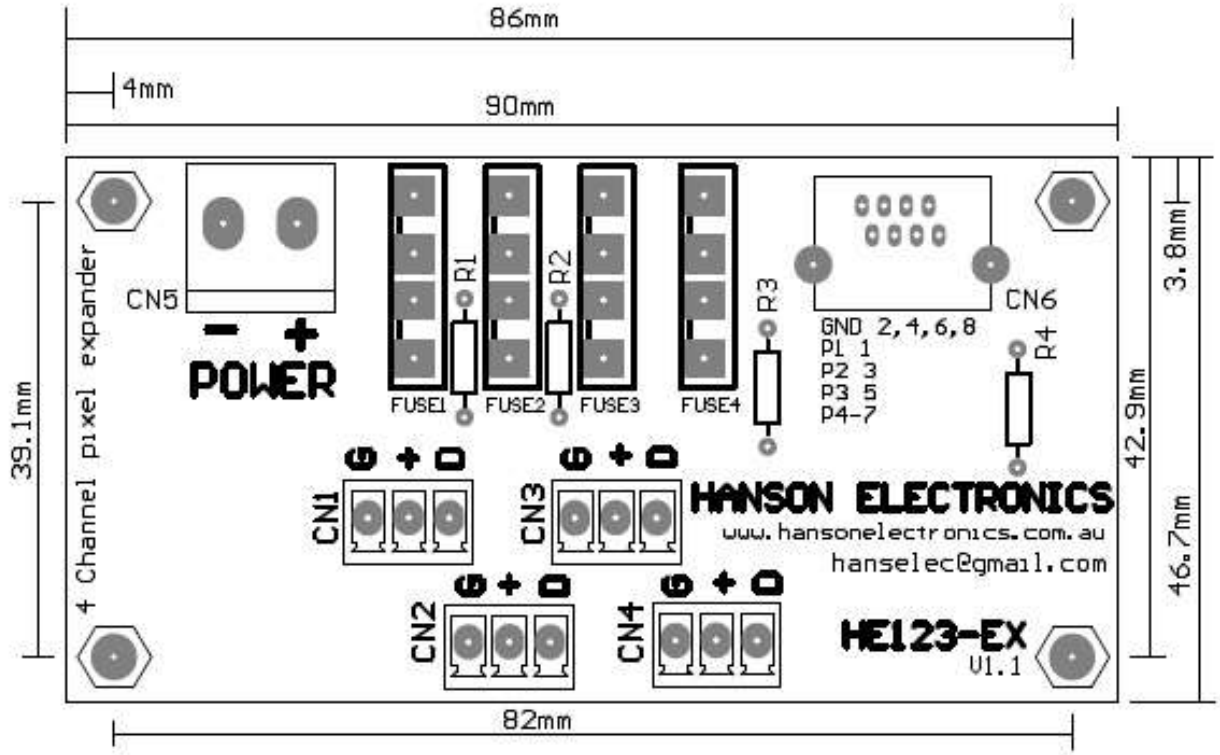


- RJ45 connector to 4 channels fused pixel outputs
- mates with HE123RJ via RJ45 connector. Can be connected to other pixel boards to provide output fusing.
- can be used as a breakout to power unfused pixel outputs on other controllers
- maximum of 30A input to pcb via power connector
- maximum of 10A fuse to any pixel output. ATO fuses are used. Supplied with 4 7.5A fuses.
- up to several metres between pixel controller and HE123-EX2. The distance depends on cable, the actual pixel controller and also distance between HE123-EX2 and pixels.

The connections used on the RJ45 connector for the 4 pixel connections are marked on the pcb.

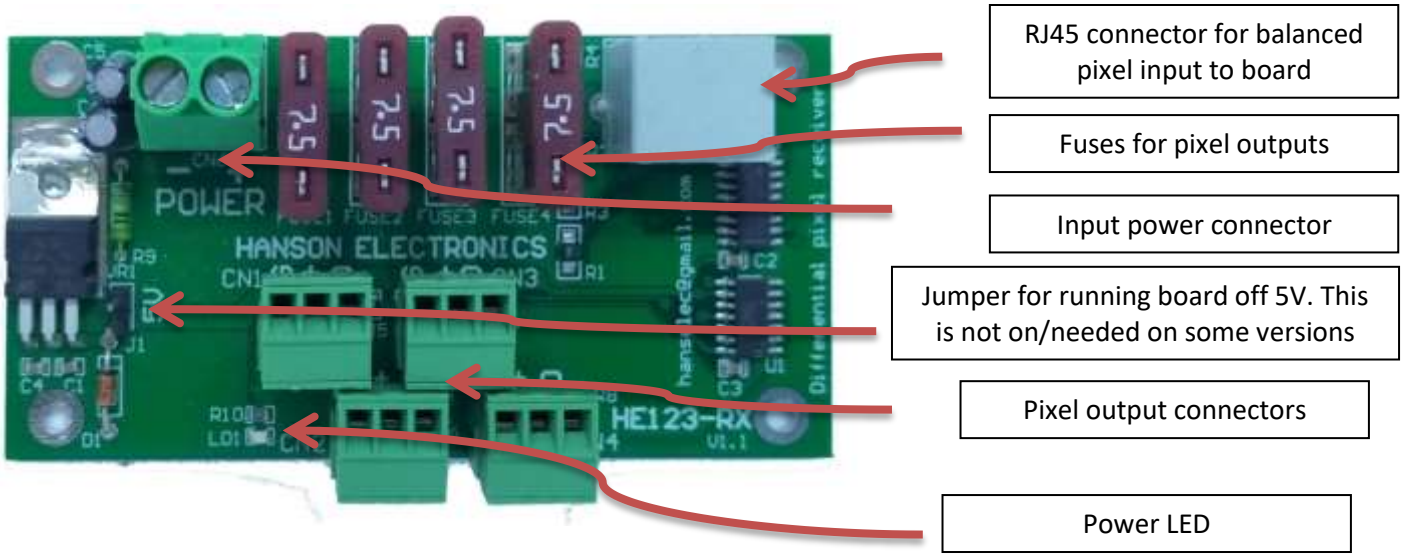
GND	-Pins 2,4,6,8
Pixel 1 data	-Pin 1
Pixel 2 data	-Pin 3
Pixel 3 data	-Pin 5
Pixel 4 data	-Pin 6

http://www.hansonelectronics.com.au/product/he123-ex2/



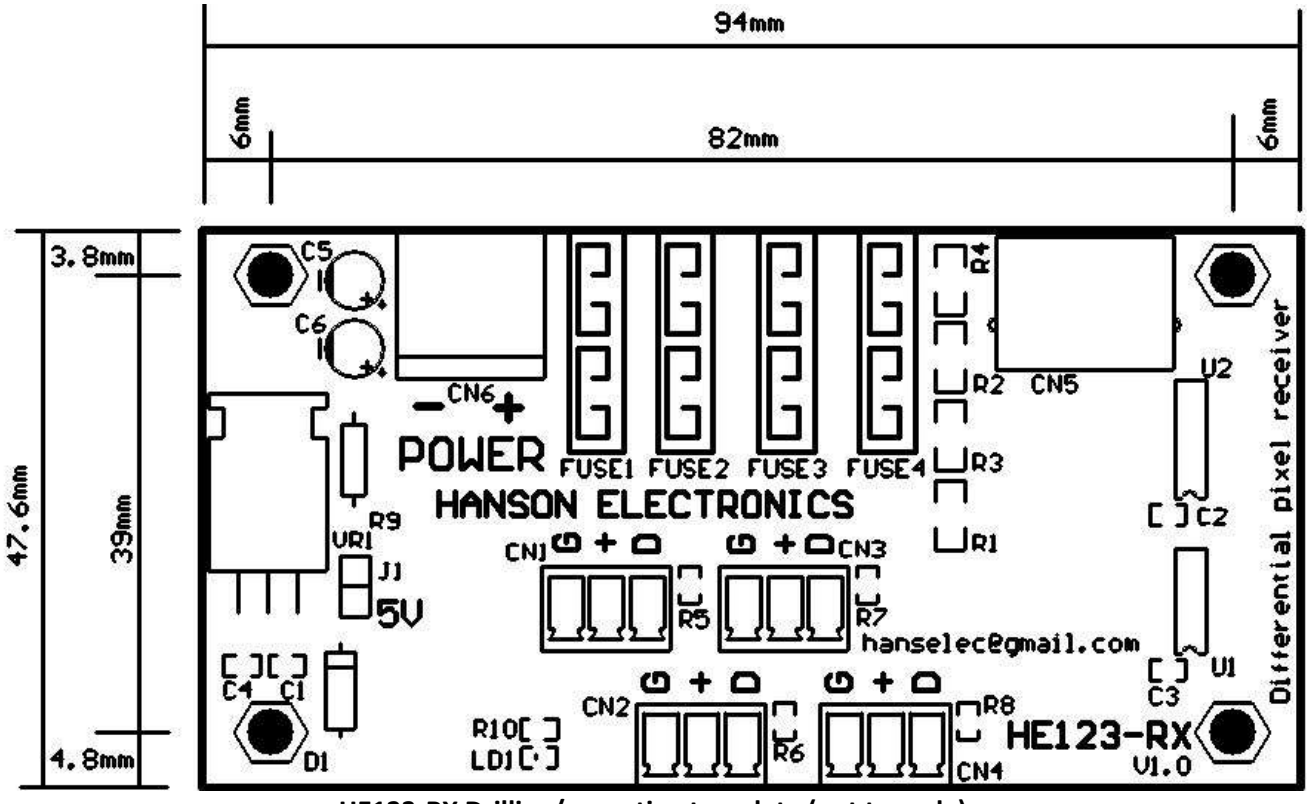
HE123-EX Drilling/mounting template (not to scale)

HE123-RX2 4 channel
Balanced long range pixel receiver



- RJ45 connector to 4 channels powered, buffered pixel outputs
- mates with HE123-TX, HE123-4T or HE123D. Can also be used as a dumb remote on Falcon F48.
- can be powered from 5V or 12-24V (whichever the pixel voltage is)
- jumper to select 5V input power. Powering the board with more than 5.1V while the 5V jumper is installed will damage the board. On latter versions there is no jumper for when running on 5V. Any voltage in the 5-24V DC range can be used.
- maximum of 30A input to pcb
- maximum of 10A fuse to any pixel output. Supplied with 4 7.5A fuses.
- up to several hundred metres between HE123-TX (or HE123-4T) and HE123-RX

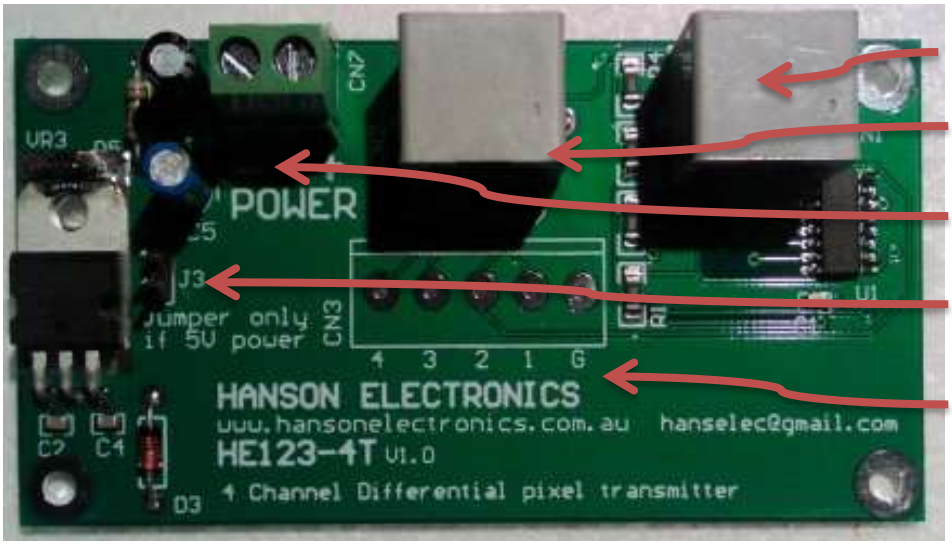
http://www.hansonelectronics.com.au/product/he123-rx2/



HE123-RX Drilling/mounting template (not to scale)

Standalone transmitter

HE123-4T 4 channel pixel to 4 balanced long range pixel transmitter



RJ45 connector for balanced pixel output from board

RJ45 connector for pixel input to board

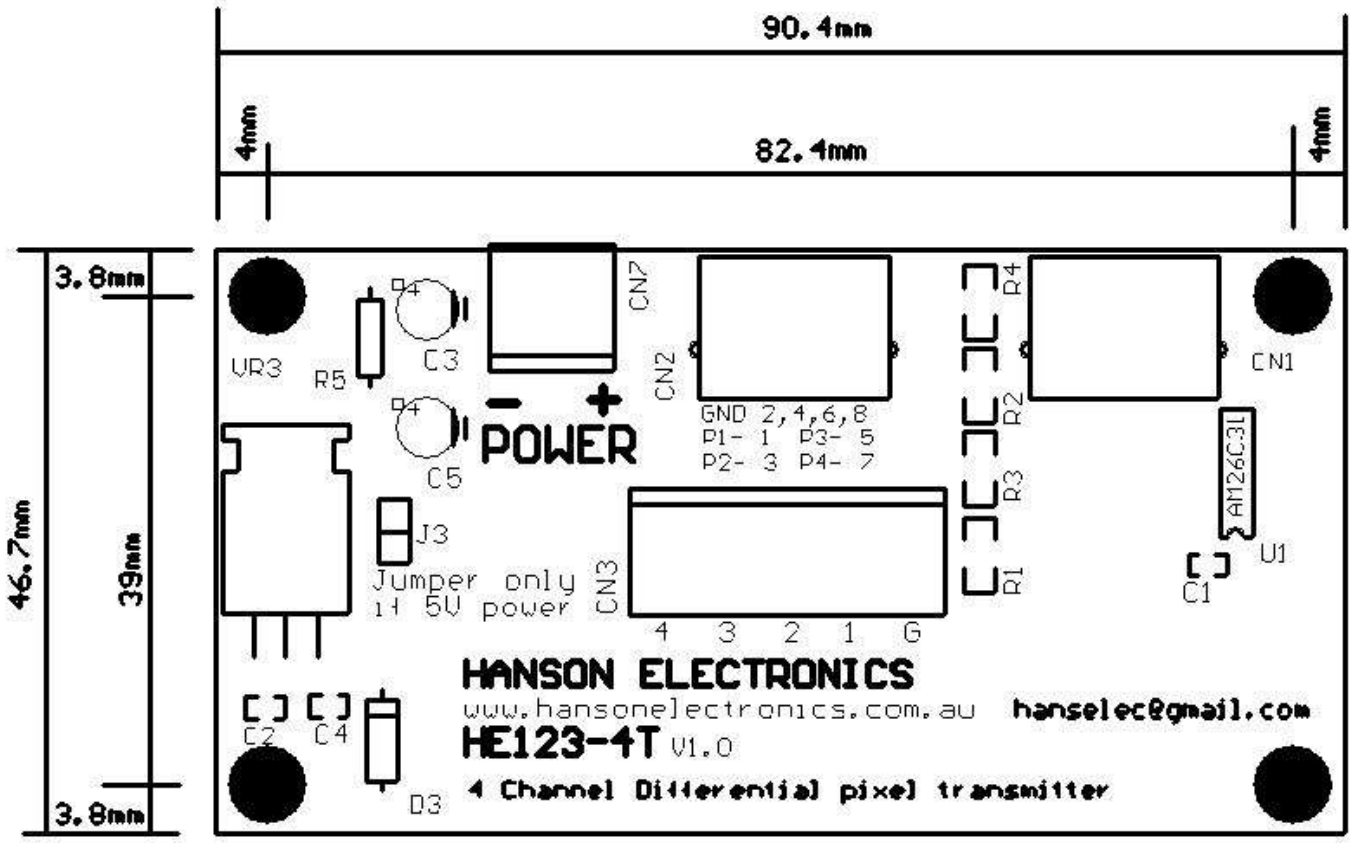
Input power connector

Jumper for running board from 5V

Mounting holes for 5mm terminal as alternative pixel input to board

- balanced pair outputs for long range transmission
- connects to any 281x pixel board to allow long range transmission
- mates with 1 HE123-RX2
- connects via RJ45 cable to HE123-RJ or other pixel board. Pads are supplied to allow fitting of a 5 way 5mm terminal block. This can be used to connect standard pixel outputs from the base HE123 or other non differential outputs on pixel controllers and allowing them to be used with the HE123-RX.
- powered from 5V or 12-24V. If there is no header for a jumper then the board doesn't require the jumper for the full 5-24V voltage range.

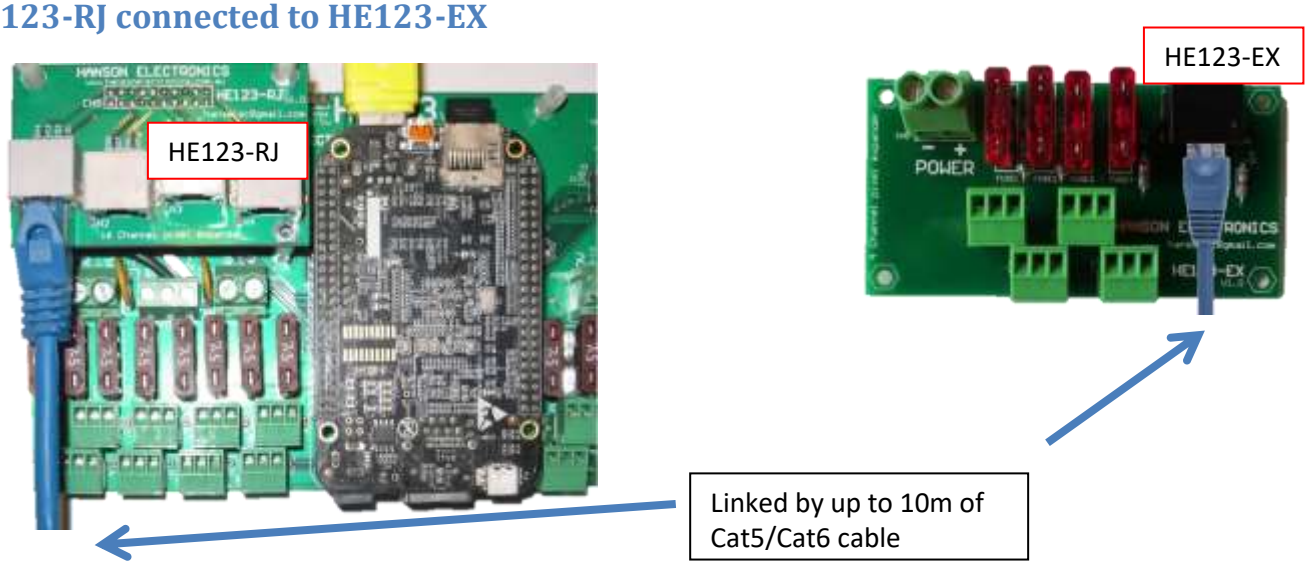
http://www.hansonelectronics.com.au/product/he123-4t/



HE123-4T Mounting/drilling template (not to scale)

Daughterboard Connections

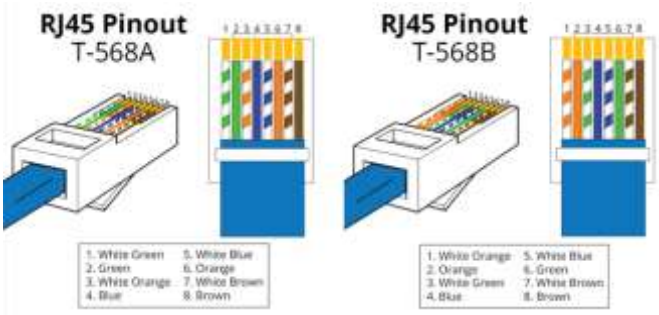
HE123-RJ connected to HE123-EX



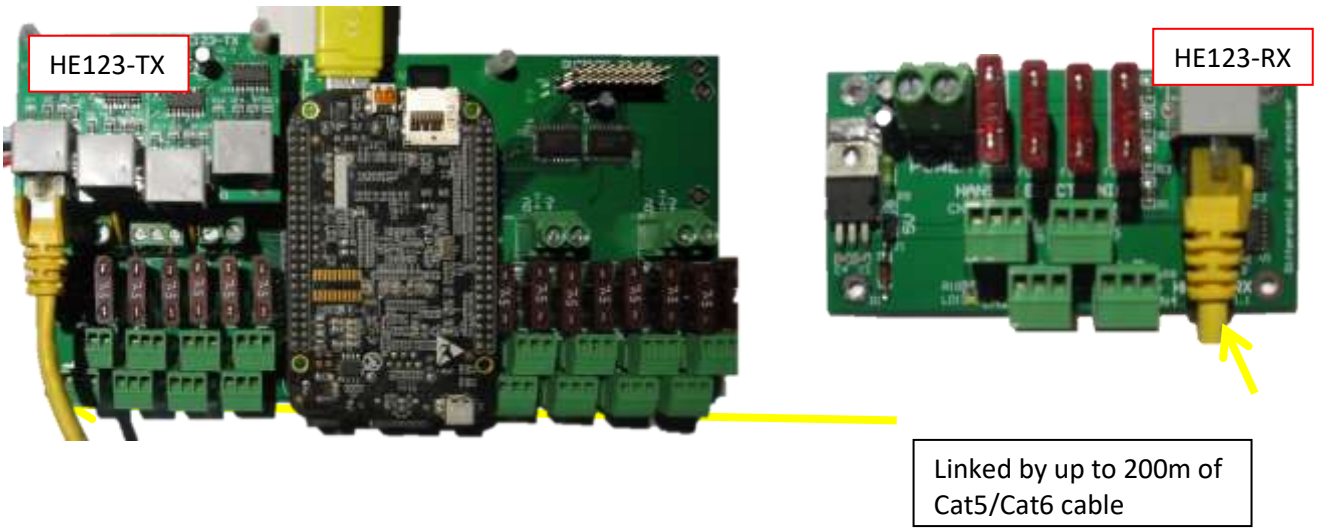
The HE123RJ provides 4 RJ45 outputs each with 4 281x pixel outputs on a "pair" of connections. The board allows the fusing and distribution of outputs to occur up to several metres away from the HE123. The total distance from the HE123-RJ to HE123-EX and to the 1st pixel should typically be under 10m total. It "may" be possible to go further depending on the choice of cable and environmental noise.
Only 1 of the 4 outputs of HE123-RJ is shown connected
Power to HE123-EX not shown
The HE123-EX is purely a power distribution board and there is no electronics on the board.
The HE123-EX can be used with any pixel voltage.
The 4 outputs of the HE123-EX are powered from the 1 30A rated power input and each output is rated to a maximum of 10A.

The HE123-EX can be used to provide fused output power to virtually any other WS281x compatible source. If doing this then use a standard Cat5 patch cable with 1 end stripped.
The input RJ45 connector uses the following

Pin	Pin Use	T568A colour	T568B colour
1	Pixel 1 data	White/Green	White/Orange
2	Ground (pixel 1)	Green	Orange
3	Pixel 2 data	White/Orange	White/Green
4	Ground (pixel 4)	Blue	Blue
5	Pixel 3 data	White/Blue	White/Blue
6	Ground (pixel 2)	Orange	Green
7	Pixel 4 data	White/Brown	White/Brown
8	Ground (pixel 4)	Brown	Brown

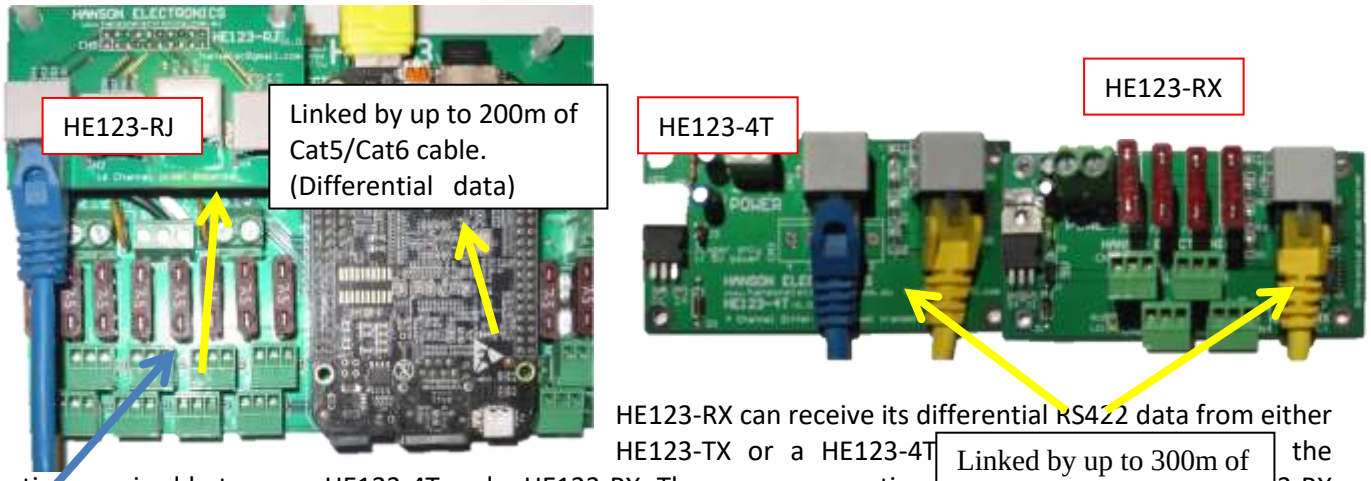


HE123-TX connected to HE123-RX



The power connection to the HE123-RX is not shown.
If the HE123-RX is to be ran off 5V the "5V" jumper should be installed. It should ONLY be installed if running off 5V
Only 1 of the 4 possible outputs of the HE123-TX is shown.
The maximum current capacity of the HE123-RX power input terminal is 30A. The maximum current on any of the 4 pixel output terminals is 10A. The HE123-RX is supplied with 4 7.5A fuses.

HE123-RJ connected to HE123-4T and then to HE123-RX



ata)

The HE123-RX can receive its differential RS422 data from either a HE123-TX or a HE123-4T the connection required between a HE123-4T and a HE123-RX. The power connections 3-RX are not shown. The distance between the HE123-RJ and HE123-4T can typically be up to 10m. The environmental noise can reduce that distance. 1 of 4 possible connections from the HE123-RJ is shown. Any 1 of the 4 outputs (each with 4 pixel outputs) can be used.

If using the HE123-4T with an alternate pixel controller like 1 of the direct outputs of HE123, an F16, a Pixlite 16 or virtually any other WS281x compatible source then it's possible to use a standard Cat5 patch cable with 1 end stripped.
It is also possible to solder a 5 (actually a 2+3) way 5.0mm terminal block to the HE123-4T to allow screw connections for the incoming pixel data. These terminals are not supplied. If using this method the use of the 5 terminals is marked on the pcb.

HE123-PX2

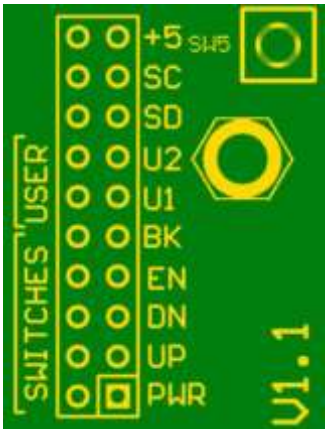
The HE123-PX2 (which supersedes the HE123-PX) is a 16 output pixel daughterboard that has 16 fused outputs and 4 power inputs. The HE123-PX can be used in either the Outputs 17-32 or 33-48 positions or 2 can be used with 1 in each.The 4 power inputs power 4 outputs each. The voltage for the 4 inputs can be mixed to suit requirements. Each power input is limited to 30A max. Each pixel output is supplied with a 7.5A fuse. The maximum current per output is 10A which must be factored into the 30A maximum across for outputs.

IDC cable connected expansion boards

The HE123-TXI and HE123-PXI are identical in function to the HE123-TX and HE123-PX but instead of mounting directly on the HE123 they connect via a 20 way IDC cable of up to about 0.5m. This allows a less cluttered collection of cables above the pixel output connectors.

HE123D specific information

The HE123D has a header over at the top right corner that has a 10 x 2 male header that has 5 the onboard switches mirrored to it, 2 user inputs, 5V and the SC and SD I2C serial data connections. These connections have 0V/Gnd on the left hand pins and the labelled pins on the right. (The prototope HE123D had the left/right swapped). Shorting between the left and right terminals will operate the input (excluding SD, SD and 5V). Normally closed switches can be placed across any of the 5 switch inputs or the 2 user inputs if they want to be taken out to the outside world. The 5V, SD and SC connections are there in case someone wants to interface to the board with further I2C interfaces or external control of the inputs is desired via relays or opto-isolators etc. No more than a 100mA load should be attempted from the +5V connection.



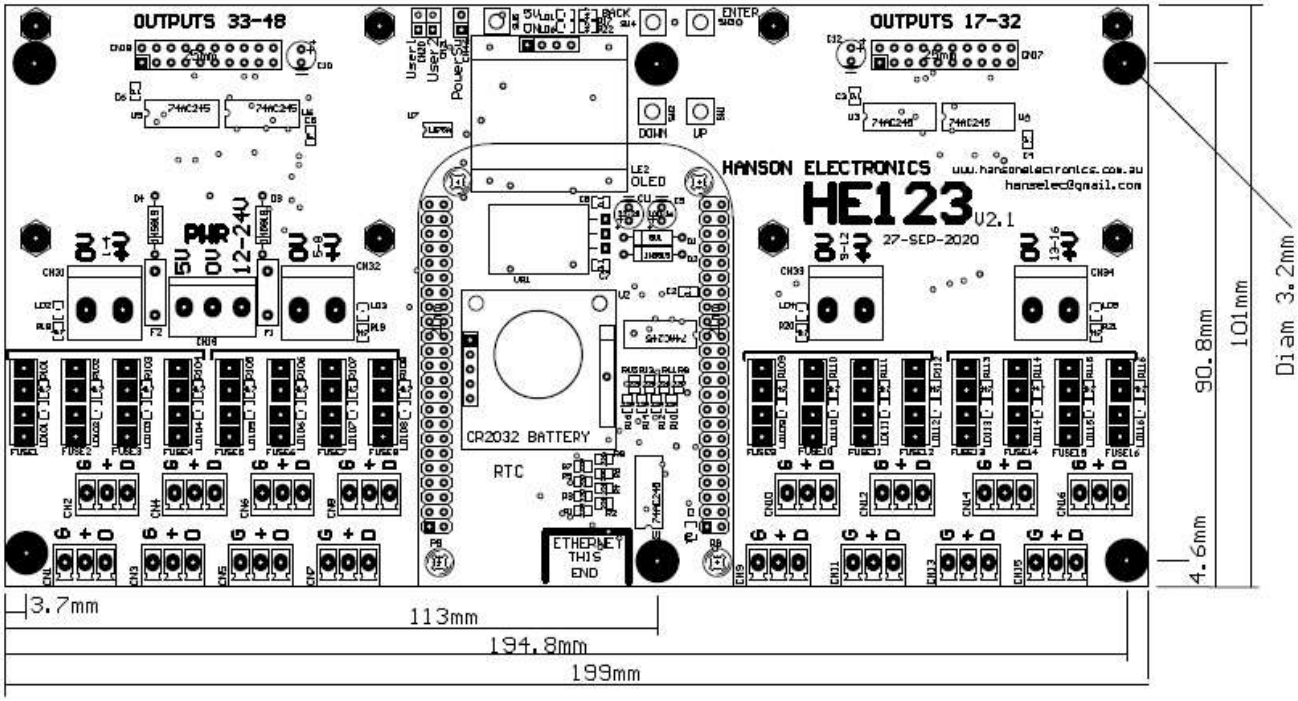
Additional features on the HE123Mk2 and HE123D where applicable versus the HE123

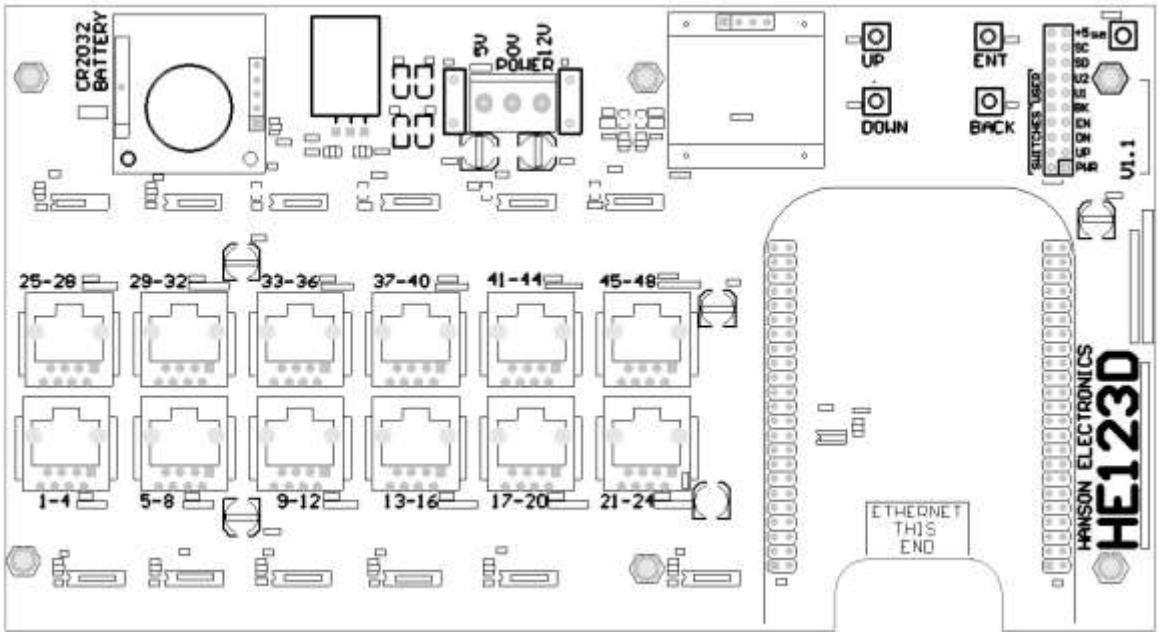
Temperature sensor on HE123Mk2 and HE123D
Markings to delineate the 4 outputs per power input
Oled display
Switches for navigating FPP

Show power supply on receiver and standalone transmitter boards.

Dimensions

The main HE123 motherboard dimensions and the mounting hole positions. The 6 mounting holes have a circular border. The 2 pairs of 4 daughterboard mounting holes are bordered by a hexagon.





The HE123 uses the same mounting pattern as the HE123 but the mounting holes aren't surrounded by a round border.

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