# HELIOS®

## LED Processing Platform

## User Guide

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**Contact**

**+1 818 884 5488**

[http://megapixelvr.com](http://megapixelvr.com)

**Warranty Information**

Megapixel warrants the HELIOS® LED Processing Platform, hardware products, against defects in materials and workmanship under normal use for a period of one (1) year from the date of retail purchase by the original end-user purchaser.

Megapixel does not warrant that the operation of the product will be uninterrupted or error free. Megapixel is not responsible for damage arising from failure to follow product or installation instructions.

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## Safety Information

The symbols below are used throughout this manual to identify important safety information. Heed all warnings and safety information.

| Symbol | Meaning |
|--------|---------|
| ⚠️ | Warning, Danger, or Caution<br>Risk of injury to yourself or the product. |
| ⚡ | Risk of Electrical Shock<br>Risk of severe electrical shock. |

⚡ This device contains Electrostatic Sensitive Devices. Wear anti-electrostatic gloves or bracelet when handling the device.

⚠️ This device passed test under the condition of being used with professional devices only. It may cause frequency interference when used in a domestic environment.

⚠️ Signal may become disconnected when electrostatic is induced externally.

## Installation Environment

The HELIOS Processor is designed to be rack mounted in a central control room for fixed installations or flight cased for rental / temporary applications.

The unit has been qualified to operate in a dry environment within a temperature range of 10°C to 40°C (50°F to 104°F).

⚠️ **NOTE:** Never obstruct the airflow to the side ventilation slots. The front filters need to be regularly checked and cleaned.

**WARNING:** Below is a set of environmental conditions that must be met prior to installing Megapixel products. The installation and/or use of products in these environments not meeting these conditions may void all warranties.

- Installation locations must be free of moisture.

- Installation locations must be dust free.

- All heavy and dirty site work must be complete. This includes re-working or modifications to walls, ceiling and floor.

- All construction materials and debris must be removed, area swept, vacuum cleaned, and the floor wet-mopped.

- Building structure, roof, and walls are sealed and weather proofed. Roof successfully tested for leaks.

- Outside drainage system and floor drains checked and tested to protect the equipment from flooding.

- Floors sealed and cleaned.

- All doors and windows installed and operational with weather seals.

- All final wall preparation complete including all taping, joint compound and fire sealant. Walls to be primed and finish painted.

- Overhead fire sprinkler or suppression system installed and pressure tested.

- HVAC ducts blown free of debris. HVAC shall be operational/balanced and running 72 hours prior to equipment installation.

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## EMI Statement

### FCC

This equipment has been tested and found to comply with the limits for a class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy. If the equipment is not installed and used as directed in the instruction manual, it may cause harmful interference to radio communications. It is the responsibility of the user to correct any interference.

### CQC

警告：在居住环境中，运行此设备可能会造成无线电干扰

Warning: Operation of this equipment in a residential environment may cause radio interference.

## Carrying and Handling the Equipment

Before you handle the HELIOS LED Processing Platform equipment, disconnect all cables and cords. Do not operate the HELIOS LED Processing Platform equipment in areas with significant amounts of airborne dust or smoke, or near a humidifier. Tiny airborne particles can damage the equipment.

## Power

Unplug the power cord (by disconnecting from the power source) and disconnect all other cables if any of the following conditions exist:

- The power cord or plug becomes frayed or otherwise damaged.

- Liquid has spilled onto the equipment.

- The equipment is exposed to rain or excess moisture or humidity.

- The equipment has been dropped, and has been damaged.

- You suspect that the equipment needs service or repair.

- You want to clean the case (use only the recommended procedure, described later in this document).

⚠️ **IMPORTANT:** The only way to completely turn off power is to unplug the power cord.

⚡ **WARNING:** The AC cord has a three-wire grounding connector. This connector fits only a grounded AC outlet. If you are unable to insert the connector into an outlet because the outlet isn't grounded, contact a licensed electrician to replace the outlet with a properly grounded one. Do not defeat the purpose of the grounding pin.

## Liquid Exposure

Keep the HELIOS LED Processing Platform equipment away from all sources of liquid. Protect equipment from dampness, humidity, or wet weather, such as rain, snow, and fog.

## Repairing

The HELIOS LED Processing Platform equipment does not have any user-serviceable parts. Do not attempt to replace or repair any components inside the equipment. If the equipment needs service, contact the company that provided or installed the equipment. If you open the equipment or install items, you risk damaging the equipment. Such damage isn't covered by the limited warranty on the equipment.

## Medical Device Interference

HELIOS LED Processing Platform equipment contains components that emit electromagnetic fields, which may interfere with pacemakers, defibrillators, or other medical devices. Maintain a safe distance of separation between your medical device and equipment. Consult your physician and medical device manufacturer for information specific to your medical device. If you suspect equipment is interfering with your pacemaker or any other medical device, stop using the equipment.

## Medical Conditions

If you have a medical condition that could be affected by using HELIOS Processing equipment (e.g., seizures, blackouts), consult with your physician prior to using HELIOS LED Processing Platform equipment.

## High-Consequence Activities

HELIOS LED Processing Platform equipment is not intended to be used where failure could lead to death, injury, or severe environmental damage.

## Explosive Atmospheres

Using HELIOS LED Processing Platform equipment in any area with a potentially explosive atmosphere (e.g. where the air contains high levels of flammable chemicals, vapors, or particles (such as grain, dust, or metal powders), may be hazardous. Obey all signs and instructions.

## Using Connectors and Ports

Never force a connector into a port. When connecting a device, make sure the port is free of debris, that the connector matches the port, and that you have oriented the connector correctly in relation to the port.

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## Storing the Equipment

If you are going to store the HELIOS LED Processing Platform equipment for an extended period of time, keep it in a cool and dry location (ideally, 71° F or 22° C).

## Cleaning the Equipment

When cleaning the outside of the HELIOS LED Processing Platform equipment and its components, first shut down the equipment, then unplug all cords and cables. Use canned air such as 'Turbo Blast' by ACL Staticide Inc. or a clean, soft, lint-free cloth to wipe the equipment exterior. Avoid getting moisture in any openings. Do not spray liquid on the equipment. Do not use sprays, solvents, abrasives, or cleaners.

## Changes

Megapixel provides this manual 'as is' without warranty of any kind, either expressed or implied, including but not limited to the implied warranties or merchantability and fitness for a particular purpose. Megapixel may make improvements and/or changes to the product(s) and/or the program(s) described in this publication at any time without notice.

This publication could contain technical inaccuracies or typographical errors. Changes are periodically made to the information in this publication; these changes are incorporated in new editions of this publication.

## Certifications

# System Components

## Overview

The HELIOS LED Processing Platform was designed to support high density display products for use in studios, live events, and fixed installs. The HELIOS Processor is compatible with video sources that have up to 8K resolution (i.e media servers, production network switchers, and broadcast cameras). The HELIOS system will automatically integrate system components as they are connected or replaced.

The HELIOS system consists of a processor unit and one or more network switches. The HELIOS Processor is designed to be located near the video source. The HELIOS Processor ingests the source video and converts it into a fiber signal. The HELIOS Processor is also responsible for serving the web based user interface (web UI) that is the user interface of the system. The network switches carry both the video signal and the communication signals to and from from panels. As such, there is information passing in both directions on the HELIOS fiber links that can be up to 10km in length.
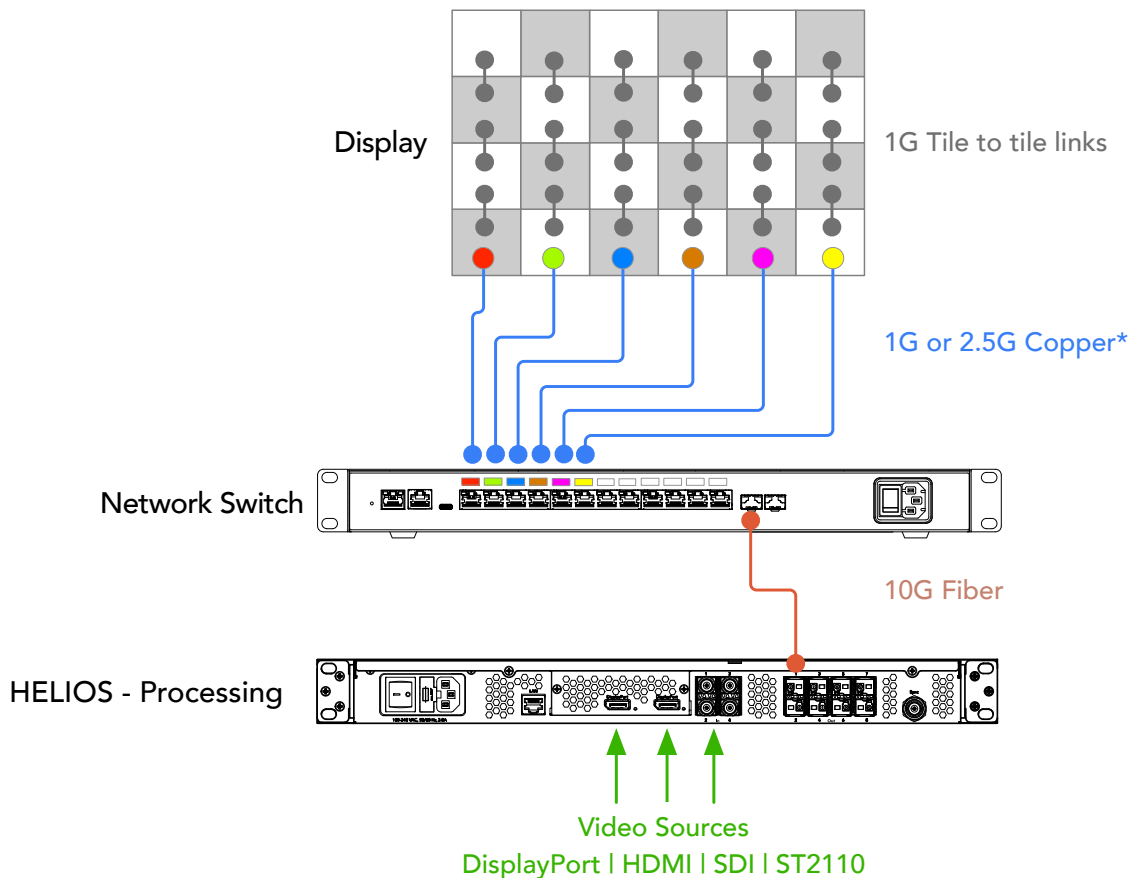


**Figure 1:** HELIOS system diagram.

* 2.5G connectivity is dependent on the tile design capabilities set by the tile manufacturer. Check tile specifications to ensure the tiles are 2.5G capable. Most tiles are only 1G capable.

## Processor Overview

The HELIOS Processor is a one RU (1.75") tall rack mount unit that can receive video in resolutions up to 8K and outputs that video as a proprietary stream to compatible video panels (Figure 2).

The HELIOS Processor is capable of receiving HDMI, DisplayPort, SDI and ST 2110 signals. The HDMI and DisplayPort inputs are designed to be modular. Alternate combinations of DisplayPort and HDMI inputs are supported (e.g. two DisplayPort, or two HDMI). Contact your Megapixel representative for more details. SDI inputs are provided by four Megapixel SFP+ units which can receive quad 12G SDI. In order to receive ST 2110, the SDI SFPs are replaced with ones that support the ST 2110 protocol. The default 8K processor configuration consists of (1) x HDMI, (1) x DisplayPort and (4) x SDI.

The system is configured remotely via a web UI running Chrome or Safari browsers. The input image can be scaled up or down to suit LED panel configurations and also has all the common controls for brightness, gamma, color temperature, etc.
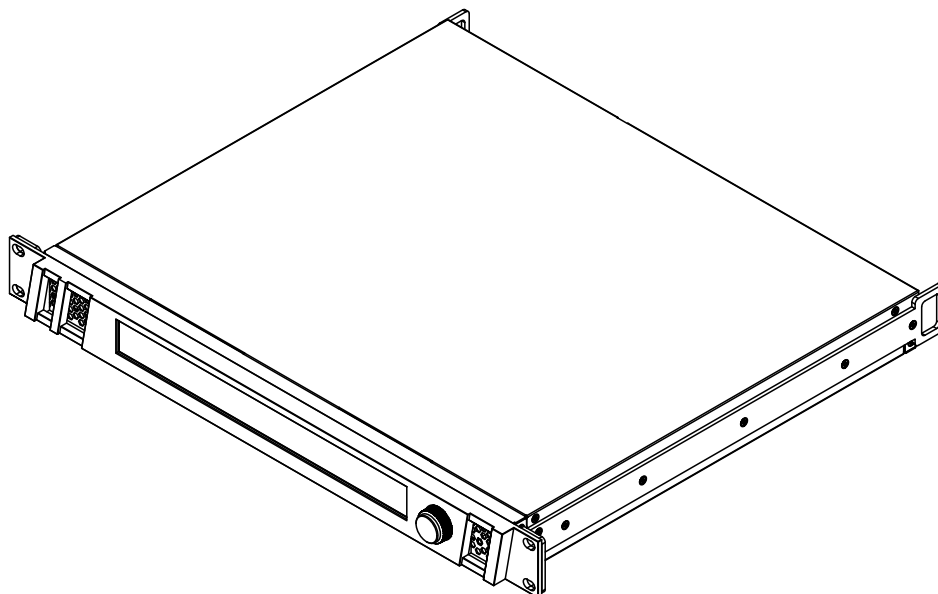


**Figure 2:** HELIOS Processor.

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# Processor Front Panel



**Figure 3:** HELIOS Processor front.

**Configuration Interface** – the front of the HELIOS Processor has an LCD display and turn/push knob interface.

**Air Inlets** – slots to the left and right of the LCD display are filtered vents for chassis airflow.

# Processor Rear Panel



**Figure 4:** HELIOS Processor rear.

1 – **Control Port –** On the left side is an Ethernet port. This port should be used to place the processor on the system control LAN. A laptop may directly connect, or in larger systems a wireless router connects here.

2 – **VFMC Video Inputs –** The video inputs are modular. At the center of the unit is a removable plate that houses removable VFMC input boards. The HELIOS system supports HDMI and DisplayPort cards in these slots. HELIOS units can be configured with dual HDMI or dual DisplayPort cards.

2A – **VFMC Video Input Indicators –** A small status LED next to each VFMC input link.

| Indicator Color | Meaning |
|---|---|
| White | System boot |
| Black | No link (no cable) |
| Yellow | Valid link, no video |
| Blue | Valid link, valid video |
| Red | Error detected in the last 1.25 sec |
| Green / Cyan / Magenta | Training cycle |

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**3 – SFP+ Inputs –** Four (4) SFP+ slots provide copper SDI inputs. Each input requires a Megapixel 12G SFP+ and supports formats up to 12G SDI. See the **Input Capability Matrix** in Appendix J for details. Indicators on each SFP+ slot show link status.

| Indicator Color | Meaning |
|---|---|
| Green | Receiving a carrier signal |
| Blue | Valid frame detected |

**4 – SFP+ Outputs –** HELIOS Standard units support up to eight (8) Megapixel 10G fiber SFP+ outputs for data transmission to the display. Likewise, HELIOS Junior units support up to eight (8) Megapixel 1G copper SFP outputs. Indicators on each SFP+ slot show link status.

| Indicator Color | Meaning |
|---|---|
| Green | Link to switch |
| Blue | Connected to tiles |

**5 – External Sync –** The BNC connector to the right of the fiber outputs allows the HELIOS Processor to receive genlock timing signals. An external sync is required when using multiple processors for data redundancy.

# Network Switch Overview

The HELIOS system leverages network switches for data distribution to the tiles. The network switch connects to the HELIOS processor via 10Gb fiber SFP+ uplink and has twelve (12) 1 / 2.5Gb copper Ethernet ports that serve as outputs to the display. Systems may have up to eight (8) switches per HELIOS and are typically co-located with the display. All user controllable functions of the network switch are accessed via the HELIOS web UI.

## RS12 Network Switch

The RS12 (MVR-0050) is a ruggedized HELIOS® compatible network switch. Custom-engineered to withstand rigorous outdoor environments (when used with the optional weather resistant enclosure (MVR-0051) or to provide an expanded selection of mounting points for indoor racks or rear of screen, the RS12 offers more flexibility for HELIOS deployments.

**12 x Display Outputs -** 1Gb/2.5Gb copper Ethernet ports, transmit video and control data to and from connected panels. The RS12 makes use of etherCON CAT6A panel mount connectors. These connectors  are compatible with; etherCON TOP, etherCON, and etherCON CAT6A.  They are NOT compatible with etherCON CAT6 family connectors.

**Fiber ports -**  Port 13 is used for connections to HELIOS Processors. Port 14 is for future use. Either Neutrik opticalCON DUO with single mode fiber or an individual LC single mode fiber cable can be used.

**Power Inlet -** a NeutrikTM powerCON TRUE1 Input (100V-240V, 50/60Hz, 16A).



**Figure 5:** RS12 Network switch.

> **NOTE:** Do not  factory reset switches. A factory reset switch requires an RMA to Megapixel in order to restore to functionality.

# Network Switch Overview (continued)

## M4250-12M2XF (MSM4214X) Network Switch

**OOB and Console ports –** These ports are never connected in a HELIOS system.

**Display Outputs –** 1Gb/2.5Gb copper Ethernet ports, transmit video and control data to and from panels.

**Port 13 –** Input from HELIOS, a 10Gb fiber SFP+ input, receives display data from HELIOS processor.

**Port 14 –** Unlike the legacy switch (GSM4210P) the MSM4214X switch does not support copper SFPs. This port is intended for future use.

**Power Inlet –** IEC C14 A/C power connector. The switch will boot as soon as power is supplied and switched on.



**Figure 6:** Network switch MSM4214X.

**NOTE:** Do not  factory reset switches. A factory reset switch requires an RMA to Megapixel in order to restore to functionality.

# Network Switch Overview (continued)

## M4200-10MG-PoE+ (GSM4210P) Network Switch

**OOB and Serial Console ports –** These ports are never connected in a HELIOS system.

**Display Outputs –** 1Gb/2.5Gb copper Ethernet ports, transmit video and control data to and from connected panels.

**Input from HELIOS –** 10Gb fiber SFP+ input, receives display data from HELIOS processor.

**Power Inlet –** IEC C14 A/C power connector. The network switch will boot as soon as power is supplied.
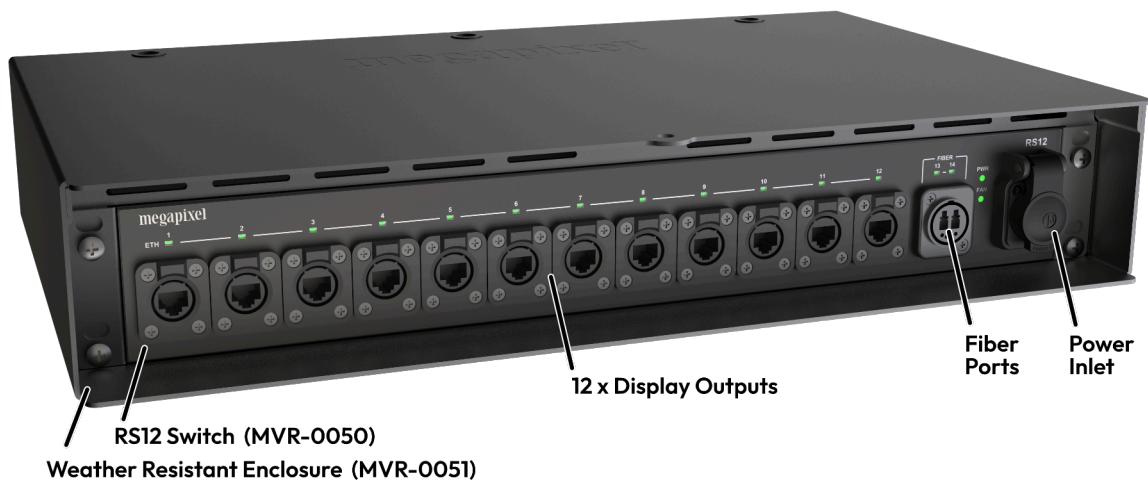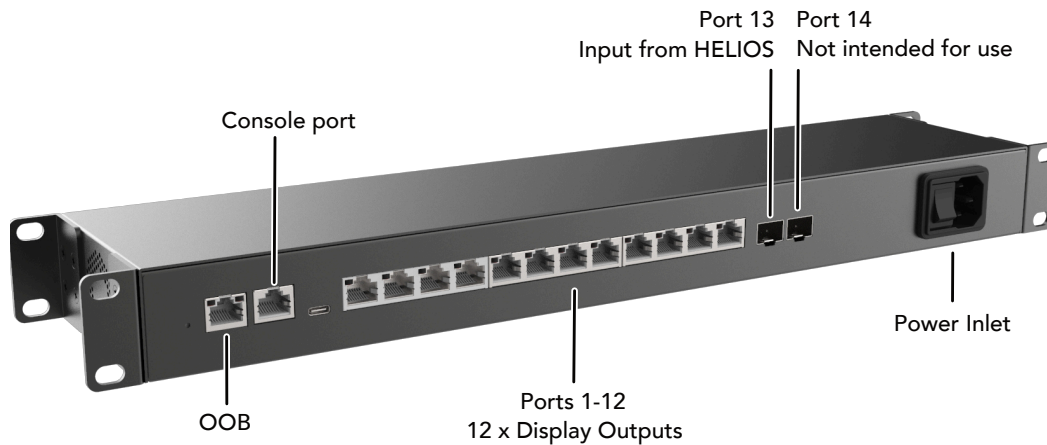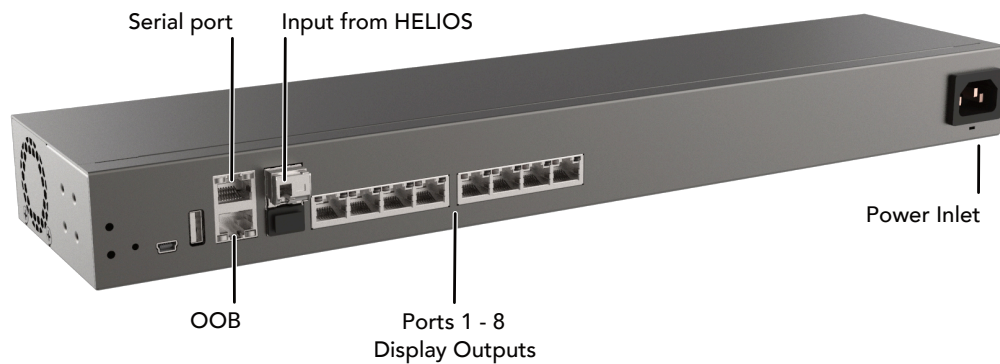
**Figure 7:** Legacy switch GSM4210P.

NOTE: Do not  factory reset switches. A factory reset switch requires an RMA to Megapixel in order to restore to functionality.

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# Display Tiles

Display tiles are light emissive video panels containing receiver cards. They operate at the end of the video signal chain. Display tiles come in many shapes and sizes from a variety of vendors. Below are some common characteristics.

**Input –** Copper Ethernet input receives display data from a network switch or from another tile ahead of it in the chain.

**Output –** Copper Ethernet outputs send video and control data to the tiles downstream.

**Power –** Power must be supplied to each tile.  Power connectors differ for each tile type.

**Status Indicators –** On the rear of each display tile is a multi color indicator button, the exact location varies by tile type. The table below details the buttons functions and the meaning of each indicator color.
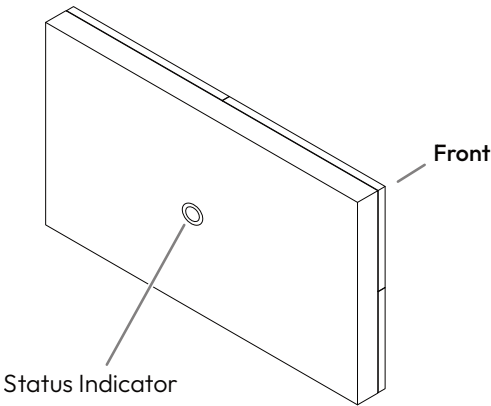


**Figure 8:** Status Indicator

| Indicator Color | Meaning |
|---|---|
| White | Booting |
| Cyan | Booted into safe mode |
| Green | Ready (No network connection) |
| Blue Single Flash | No HELIOS connection (1 tile link active) |
| Blue Double Flash | No HELIOS connection (2 tile links active) |
| Blue Solid | Connected to HELIOS (Normal operation) |
| Yellow | Internal Pattern (press and hold center button 4 seconds to enter and leave this mode). Press and release to advance to the next pattern. |
| Red | Flash once every 10 sec to indicate a system error. |

**NOTE:** Tiles store LDM seams information, the currently selected LDM configuration, and **tile notes**. All other system data is stored on the HELIOS processor.

# System Planning

## Overview

This chapter covers the activities and considerations that need to be made prior to ordering equipment. If assistance is needed with any of the items below, Megapixel is available to assist. Please contact a sales associate.

Ensure compatibility of the display product being considered with the HELIOS system. The HELIOS system can be used with a continuously expanding list of products. Please see the HELIOS software release notes available on the Megapixel website for current product compatibility **https://megapixelvr.com/support/helios**.

## Video Input

**Pixel dimensions -** The number of pixels in the final display is a major factor in selecting a video input type. If at all possible it is best to first settle on a quantity of pixels that need to be driven before selecting an input format.

**Input formats -** Select an input format that can support the required pixels. HELIOS accepts four (4) input formats:

- HDMI
- DisplayPort
- SDI
- ST 2110

A detailed **Input Capability Matrix** can be found in Appendix J.

## Custom Input Data Rate Calculations

HDMI, DisplayPort, and ST 2110 can support custom input resolutions and frame rates, it is important to confirm that the intended resolution/frame rate fits within the data rate limits. The data rate formula below should be used as a ballpark calculation. It does not include the full-size pixel width/height with blanking for DisplayPort and HDMI. ST 2110 does not need additional blanking, but it does need an additional five (5) percent to account for protocol overhead.

| Input | Data Rate |
|-------------|-----------|
| HDMI | 14.4G |
| DisplayPort | 22.6G |
| ST 2110 | 10G |

**Data Rate = Total Width × Total Height × Frame Rate × Bits/Color × Pixel Format**

*For the Pixel Format value use 2 for 4:2:2 and 3 for RGB or 4:4:4.

As an example, the largest standard aspect ratio DisplayPort signal HELIOS supports is 5K (**5120×2880**) @**60** Hz **8**bit. This example signal is an RGB signal, multiply by **3** for the pixel format value.

$$(5120 \times 2880) \times 60 \times 8 \times 3 = 21{,}233{,}664{,}000 \ (21.2G)$$

# Creating a Raster Map

It is a good idea to create a raster map drawing to document which region of the video signal serves each display tile. The example below contains two separate displays (blue tiles). In this case, the pixel dimensions of both displays will fit on a 6K raster. The larger 8K and DCI 8K rasters are shown for reference.

**1.5mm Display 12x12**

**1.5mm Display 5 x 14**

6k
6016 x 3384

8k
7680 x 4320

DCI 8k
8192 x 4320

**Figure 9:** Example raster map

Sometimes, the 'as built' shape of the system does not fit any horizontal or vertical rasters, but the total number of pixels can. This is the case with a long ribbon display. Rasters can be rearranged, (within certain limitations) on the front end if necessary. In the end, the picture to be transmitted to a display needs to fit inside of the pixel dimensions of one of the four supported input signals (HDMI, DisplayPort, SDI, or ST 2110). For long strip style displays this means that the incoming picture needs to be divided into segments, these are labeled with capital letters in the example below (A, B, C, etc.). Content can be created in segments or the segmentation can be accomplished with media processing equipment prior to the HELIOS Processor. The example below shows a dual HDMI input configuration (see the following section on dual input cards).

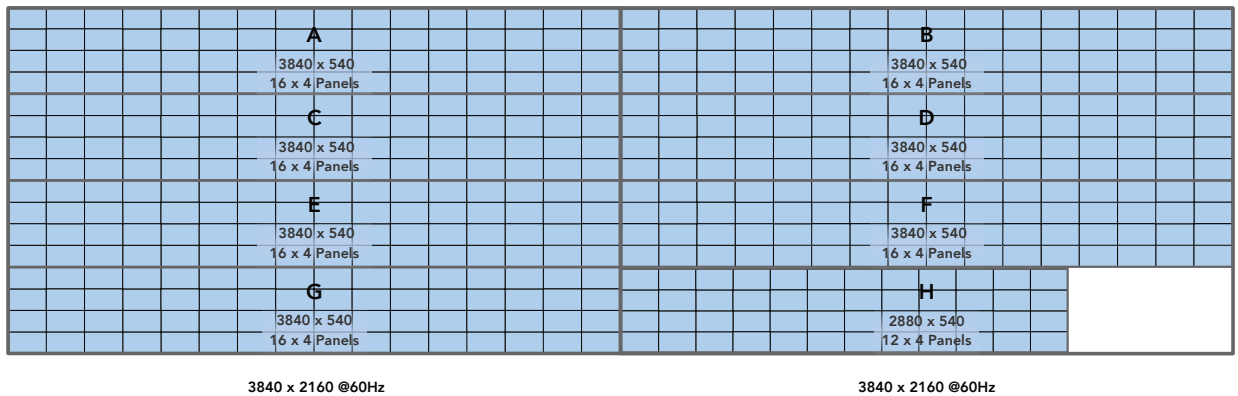| A | B |
|---|---|
| 3840 x 540 | 3840 x 540 |
| 16 x 4 Panels | 16 x 4 Panels |
| C | D |
| 3840 x 540 | 3840 x 540 |
| 16 x 4 Panels | 16 x 4 Panels |
| E | F |
| 3840 x 540 | 3840 x 540 |
| 16 x 4 Panels | 16 x 4 Panels |
| G | H |
| 3840 x 540 | 2880 x 540 |
| 16 x 4 Panels | 12 x 4 Panels |

3840 x 2160 @60Hz

3840 x 2160 @60Hz

**Figure 10:** Long ribbon display map example

**NOTE:** Extreme cases of very tall and narrow displays may not work due to overhead timing constraints of blanking time.

# Dual Input Cards

If the total number of pixels will not fit any single input raster, the system can be fed video from multiple input cards. A HELIOS Processor with the necessary hardware (dual DisplayPort or dual HDMI cards) can receive dual video signals of the same type of signal. When HELIOS is outfitted with two of the same card type (DisplayPort or HDMI) it will stitch the two rasters together into one continuous output to tiles. Please see the **Input** section in Chapter 5 for more information on configuring this mode.
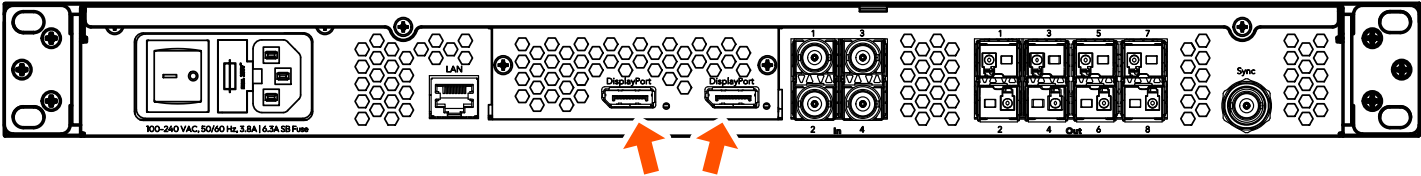


**Figure 11:** Dual DisplayPort Input Card Configuration

# Data Distribution

At this point it can be helpful to draw out the data system topology. Decide if the display will be cabled vertically or horizontally. Calculate the number of network switches it will take to distribute data to the display. In the system example below we use an example tile with the pixel dimensions 480 x 270 (tiles are 129,600 pixels). From the **Output Port Capacity** table in Appendix J we see that a 1Gbps switch port running a color bit depth of 12 at 30Hz can support up to 850,000 pixels (850,000 / 129,600 = 6.5). This tells us we can safely put 6 of these tiles on a 1Gb link. If bit depth and frequency requirements change, the system bandwidth must be recalculated.

### HELIOS Processor – Output Port Capacity (Pixels)

| Bit Depth | 10 | 10 | 10 | 12 | 12 | 12 |
|---|---|---|---|---|---|---|
| Connection | Switch to Tiles | Switch to Tiles | HELIOS to Switch | Switch to Tiles | Switch to Tiles | HELIOS to Switch |
| Ethernet Speed (Gbps) | 1 | 2.5* | 10 | 1 | 2.5* | 10 |
| Video FPS | | | | | | |
| 24 | 1,275,000 | 3,187,500 | 8,500,000 | 1,062,500 | 2,656,250 | 8,500,000 |
| 25 | 1,225,000 | 3,062,500 | 8,500,000 | 1,020,000 | 2,550,000 | 8,500,000 |
| 30 | 1,020,000 | 2,550,000 | 8,500,000 | 850,000 | 2,125,000 | 8,500,000 |
| 48 | 635,000 | 1,587,500 | 6,350,000 | 531,000 | 1,328,125 | 5,312,500 |
| 50 | 610,000 | 1,525,000 | 6,100,000 | 510,000 | 1,275,000 | 5,100,000 |
| 60 | 510,000 | 1,275,000 | 5,100,000 | 425,000 | 1,062,000 | 4,250,000 |
| 120 | 240,000 | 600,000 | 2,400,000 | 200,000 | 500,000 | 2,000,000 |
| 144 | 195,000 | 487,500 | 1,950,000 | 160,000 | 400,000 | 1,600,000 |
| 240 | 100,000 | 250,000 | 1,000,000 | 90,000 | 225,000 | 900,000 |

**Figure 12:** Output capacity table

Check to make sure the entire data load on each network switch is within the limits of 10Gb fiber.  In this case, we are using a color bit depth of 12 at 30Hz. Regardless of the bit depth or frame rate, the 10Gb link can support up to 8,500,000 pixels / 129,000 = 65.58 example tiles per 10Gb link. With only 24 tiles in the example system we know we are well within the limits. Always aim to distribute data evenly, spread the load across switches and switch ports as evenly as possible.

**Cable infrastructure –** Check that the types of cables chosen are appropriate for the display type and for the location. This is the point at which site specific considerations need to be made.

Important items to check:

- Where will the video source device reside?

- Is the HELIOS Processor close enough to the video source device to be within the specification of the video protocol being used. Confirm the distances needed with the protocol and cable type. Even if a protocol supports long distances, cable quality plays a major factor in the signal quality.

- Is there power for the HELIOS Processor at the location?

- Has power for the network switches been allotted?

- What is the distance from the HELIOS Processor to the network switches at the display? Is this under the 10km specification of the single-mode fiber?

- What is the distance from the network switch to the first panel in the display that each drives? Is this under the 100 meter limit of the copper Ethernet signal?

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# 3
# Connections

## Overview

The HELIOS system consists of the HELIOS Processor, the network switches, and the fiber link between them. The HELIOS Processor is designed to be the receiver unit that the primary video signal connects to. We recommend installing the HELIOS Processor near source equipment. The network switches are intended to be placed next to the LED display panels. The system is always aware of the components that are connected to it and where the components are connected.

## System Latency

The task of receiving a video signal, processing it for tiles and sending it through the network to the tiles takes the HELIOS system one (1) frame. Tile latency will vary between tile types. However, tiles typically need one (1) frame to read the HELIOS data and another one (1) frame to send the data to LED driver chips.  The complete HELIOS system, from HELIOS Processor input to viewer eyeball typically requires three (3) frames regardless of the input frame rate. When comparing the latency of one system vs another, it is important to note the contributions each component makes to the overall system latency. Often, manufacturers only state the latency contribution of their processor and/or receiver card, but do not account for the contribution of all components in the signal chain. HELIOS Ultra Low Latency (ULL) allows for as low as one (1) frame of delay through the entire system chain. (See the **Latency (advanced)** section for more information.)

The total delay time from input to eyeball can be reduced even further by running the system at high frame rate. At 60Hz, 3 frames = 50 milliseconds, at 120Hz, 3 frames = 25 milliseconds. However, using a 120Hz input source will cut the maximum quantity of pixels in half (e.g., 4,250,000 pixels per 10Gb HELIOS port to 2,125,000 pixels).

Constructing high frame rate systems can be a challenge. When planning such a system, consider that the entire image pipeline from media server to aligned camera shutters must be in sync.
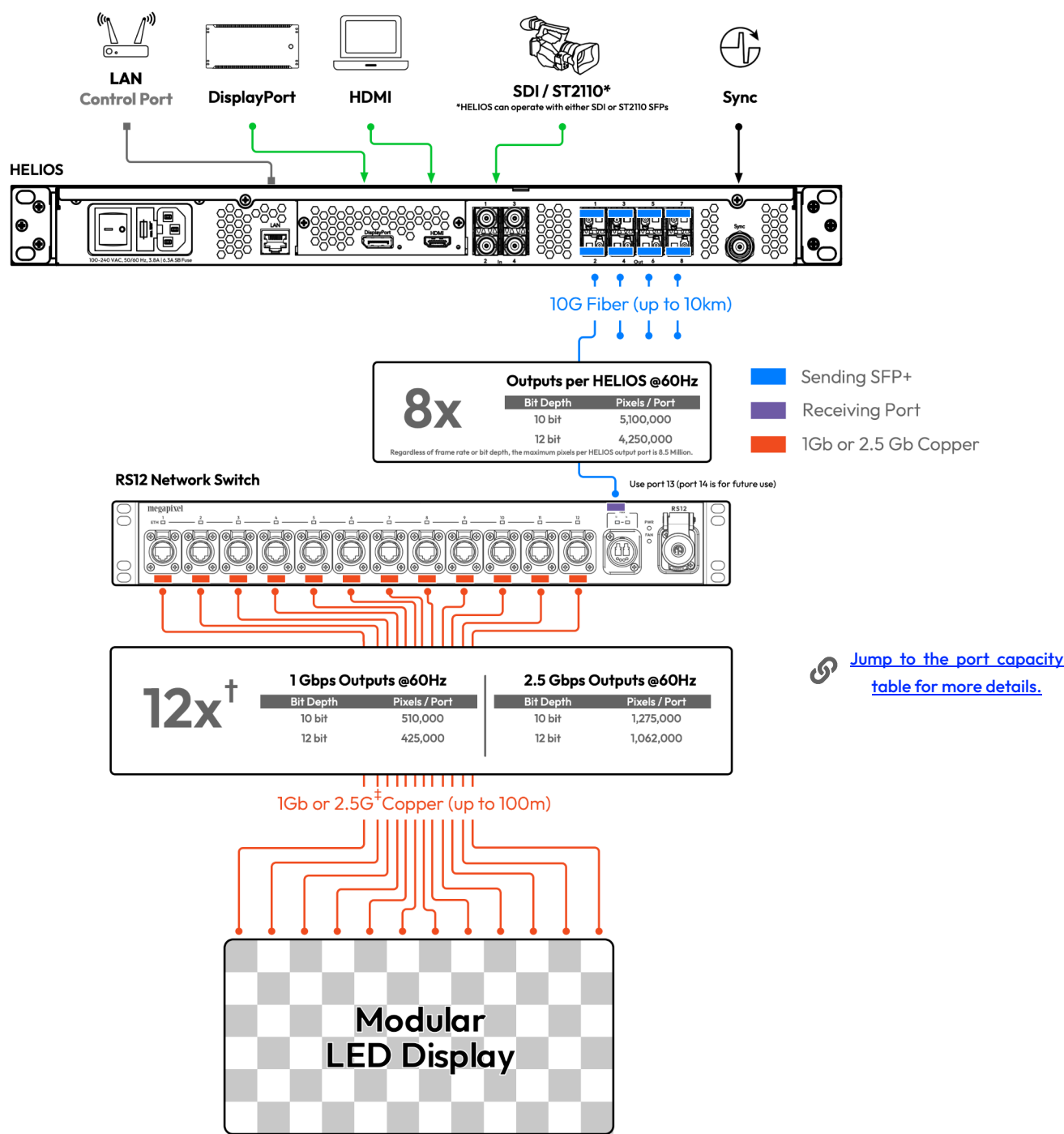
## Processor Connections

**Power** – A/C power is supplied to HELIOS Processor's built-in redundant power supplies on a C14 style IEC connector. Next to the power input connector is a rocker switch. When power is turned ON, the system will begin to boot. After about 15 seconds the front LCD display will be lit. When the boot logo disappears, the HELIOS Processor is ready for use. The HELIOS Processor should be powered OFF via the rocker switch on the rear of the unit.

**User Interface** – The HELIOS system can be used with a wide variety of LED display products. It is necessary to configure the system to the products in use. The mapping of the HELIOS system is accomplished with a web user interface. The web UI runs on any remote host capable of running a modern web browser such as Chrome or Safari. In order to communicate with the HELIOS system, the web UI host must be configured to be on the same LAN as the HELIOS Processor (see Chapter 4, Networking).

**Input Signals** – The HELIOS Processor accepts HDMI, DisplayPort, SDI, and ST 2110 signals for input. See the **Technical Specifications** in Appendix J for the full list of all the compatible formats and resolutions. Interlaced signals are not supported.  When synchronization is needed such as with redundant systems, the HELIOS Processor is provided with a genlock signal.

**Output Signal to Displays** – The output ports of the HELIOS Processor broadcast HELIOS video and control data over LC-LC, 9/125 Single mode (SMF) OS1 (<=1000m) or OS2 fiber to network switches, which in turn send the data on to the display devices via copper cables.

# Processor Connections (continued)



**Figure 13:** System diagram.

Labels in diagram:

LAN **Control Port**  DisplayPort  HDMI  **SDI / ST2110***
*HELIOS can operate with either SDI or ST2110 SFPs
Sync

**HELIOS**

100-240 VAC, 50/60 Hz, 3.8A | 6.3A SB Fuse

10G Fiber (up to 10km)

**8x**  Outputs per HELIOS @60Hz

| Bit Depth | Pixels / Port |
|---|---|
| 10 bit | 5,100,000 |
| 12 bit | 4,250,000 |

Regardless of frame rate or bit depth, the maximum pixels per HELIOS output port is 8.5 Million.

Sending SFP+
Receiving Port
1Gb or 2.5 Gb Copper

**RS12 Network Switch**

Use port 13 (port 14 is for future use)

Jump to the port capacity table for more details.

**12x**†

| 1 Gbps Outputs @60Hz | | 2.5 Gbps Outputs @60Hz | |
|---|---|---|---|
| Bit Depth | Pixels / Port | Bit Depth | Pixels / Port |
| 10 bit | 510,000 | 10 bit | 1,275,000 |
| 12 bit | 425,000 | 12 bit | 1,062,000 |

1Gb or 2.5G‡Copper (up to 100m)

**Modular
LED Display**

† The maximum number of possible outputs is limited by the 10Gb maximum throughput per switch.

‡ 2.5G connectivity is dependent on the tile design capabilities set by the tile manufacturer.

**NOTE:** For convenience or compatibility with wireless-only devices such as tablets, a wireless router can be attached to the HELIOS LAN control port.

# Networking

## Overview

In order to provide access to control the HELIOS system, a LAN port is provided on the rear of the unit. This port provides access to the web UI. Once the client device (tech laptop) is on the same network as the HELIOS, open a web browser and enter the IP address displayed on the front LCD of the HELIOS Processor. In large systems, it is good practice to confirm that the device name at the top of the page matches the intended HELIOS unit.
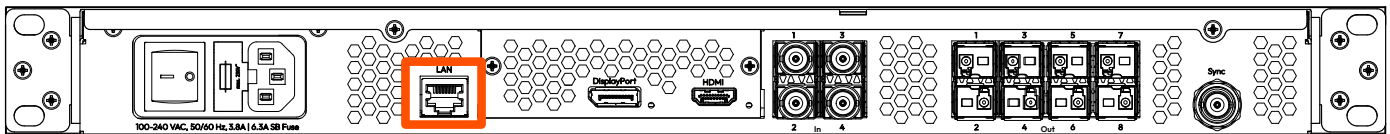


**Figure 14:** LAN Port.

## IP Addressing

The IP address of the HELIOS Processor is reported on the front screen of the HELIOS Processor. Regardless of what the final network settings for the HELIOS system will be, the web UI client must initially be configured to the network that the HELIOS Processor is on so that the web UI is accessible. Each device and operating system has slightly different ways to make these settings, please refer to the instructions of the particular device being used.

A HELIOS Processor that has been factory reset will be set to DHCP/Auto IP by default. This is the mode that should be used when operating the HELIOS Processor with a wireless router attached to the control port. If the HELIOS Processor has discovered a DHCP server, the HELIOS Processor will likely have a 192.168.XX.YY address. If it has not been served an IP address by DHCP, the HELIOS Processor will default to an automatic private address (169.254.XX.YY). If DHCP/Auto IP is the chosen mode, the web UI host device must also be set to DHCP in order to join the same network.

The HELIOS Processor can be configured to a fixed IP as well. If this is the desired mode, ensure both the IP and the subnet mask for the web UI host have been set to the correct range.

The IP address of the HELIOS can be set using the front panel interface.

1. Press the encoder on the front of the HELIOS unit, then turn the encoder to select Settings.
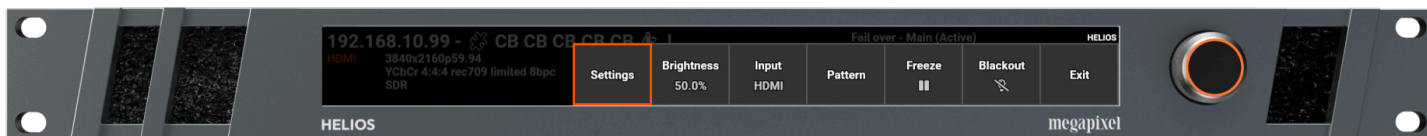


2. Select IP Address.
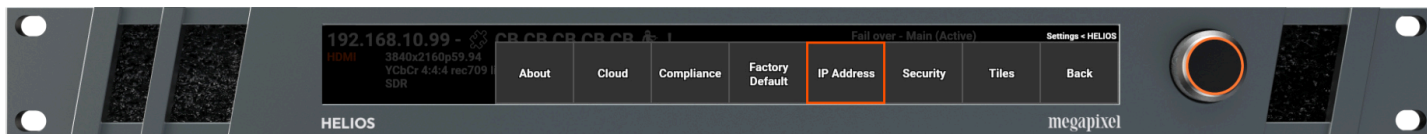


3. Choose between DHCP or Static IP, depending on the network that the HELIOS needs to join.



4. Once the settings have been made press Apply.

The IP address of the HELIOS can also be set using the web UI interface under **Settings > Processors Settings > Networking.**
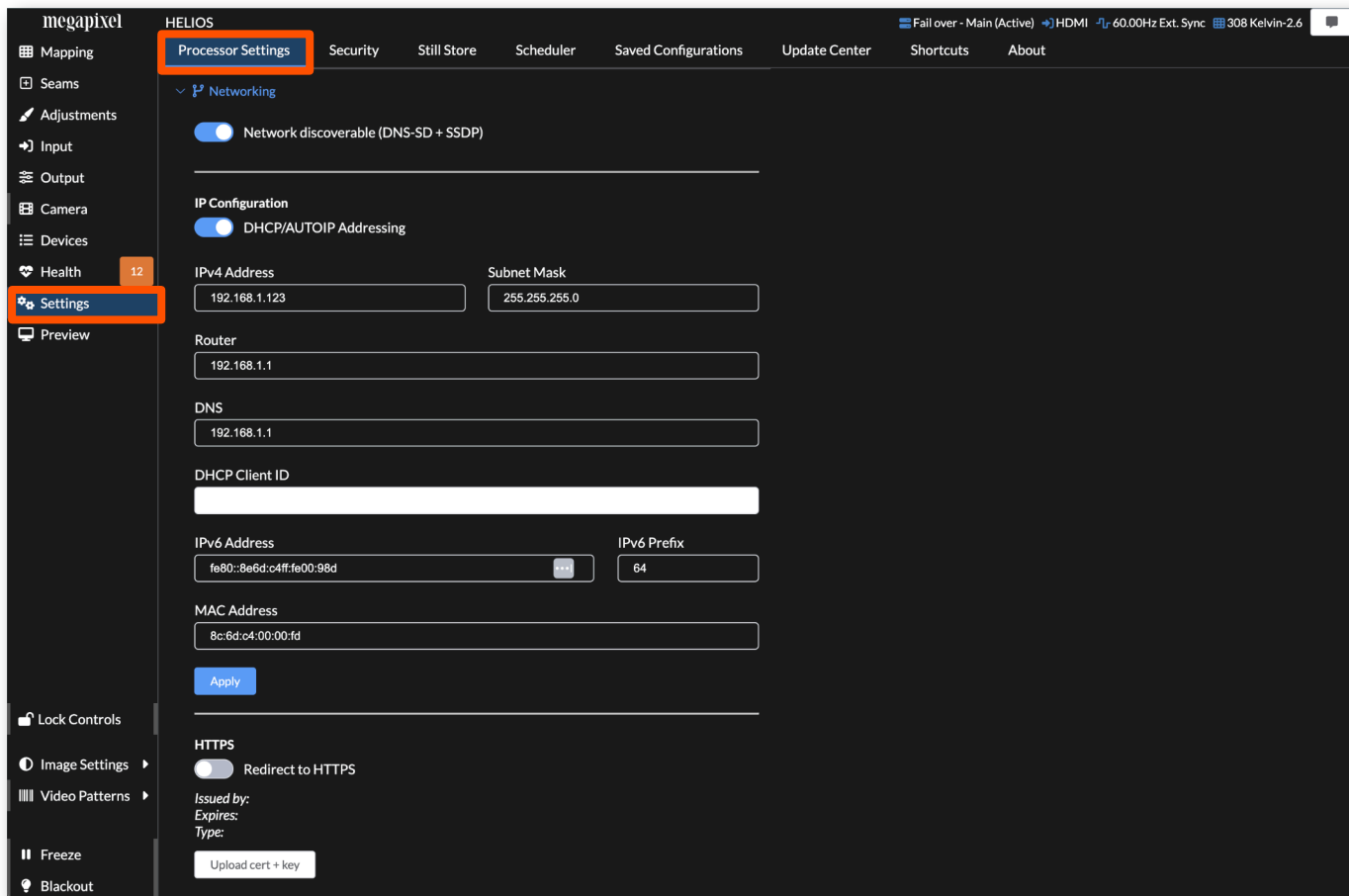


**Figure 15:** Web UI network settings.

**NOTE:** To advertise a MAC address using **DHCP Client ID**, ensure that the MAC address is formatted with colons (XX:XX:XX:XX:XX:XX), otherwise the Client ID will be assumed to be a string

# Configuration

## Overview

Prior to beginning to configure the system, a majority of the components of the system should be physically connected. The HELIOS Processor should be connected to at least one network switch and the switch should have panels connected.

The HELIOS Processor has two user interfaces; a front panel rotary encoder / push button interface with LCD display, and a web UI.

## Front Panel UI

The front panel interface is targeted towards getting remote web UI access to HELIOS. When the encoder is rotated (not pressed) the HELIOS will cycle through four (4) data display pages. The fourth page (shown below) will display a QR code for the IP address of the unit. The front menu also has a few other basic controls for settings and operation of the display.   To configure the IP address settings, press the encoder, highlight the Settings menu option, and press the encoder to select.
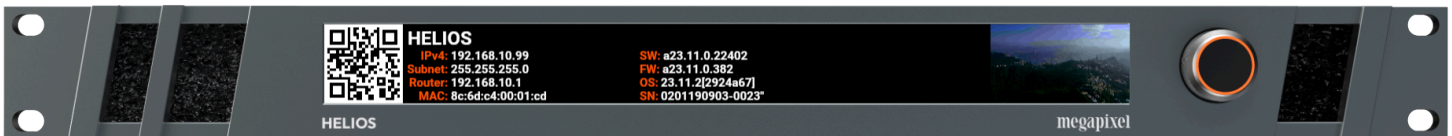


**Figure 16:** Front panel UI.

# Web UI

The web UI contains all of the other controls that are needed for setting up a display system. The web UI configures the HELIOS Processor for the various supported video panels and provides controls to the input and output signal parameters such as selection of source, position, and color.

In the previous chapter on Networking, this guide discusses the necessary settings to both the HELIOS Processor and the device that is to be used as the web UI host. Having configured these settings correctly is a prerequisite. The web UI will not be accessible if this has not been done. The HELIOS web UI runs remotely on any device capable of supporting Chrome or Safari web browsers. Shown below is the pane of the HELIOS web UI.
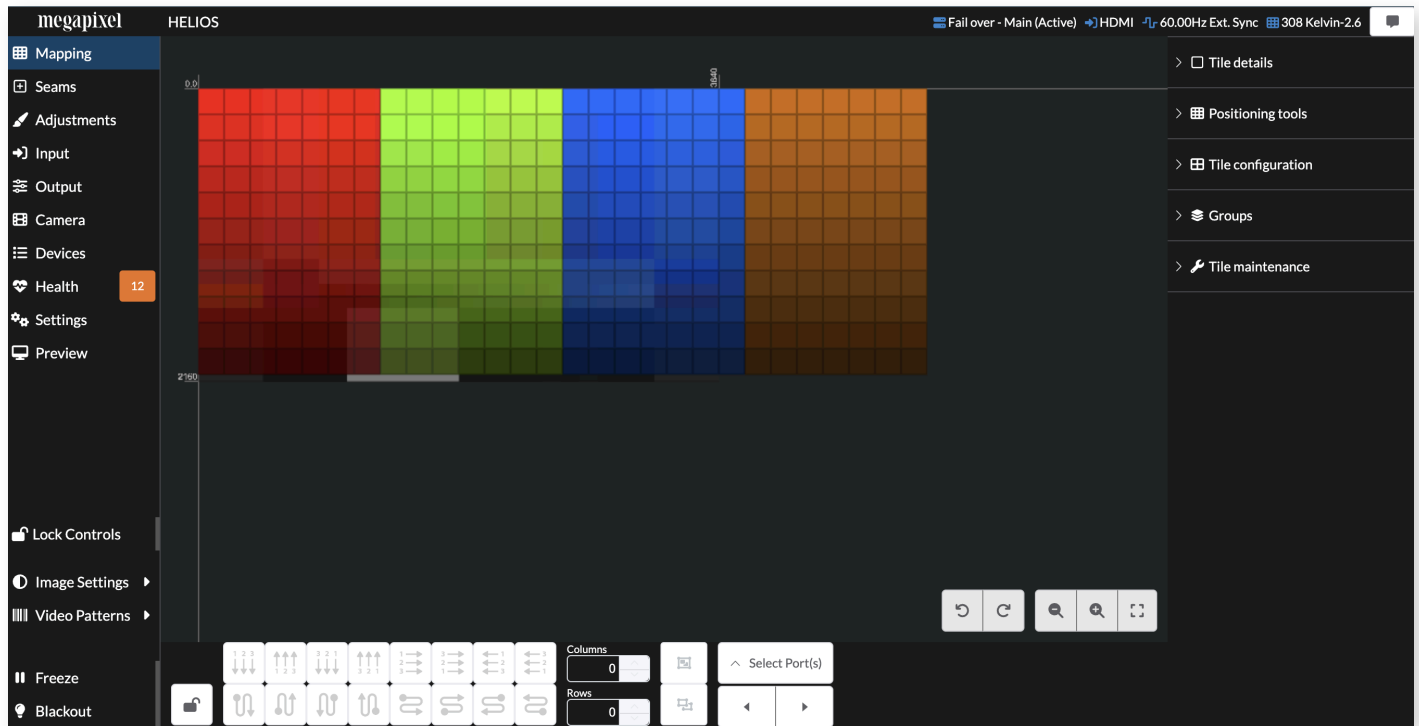


**Figure 17:** HELIOS web UI.

## Processor Name

At the top left is the name of the processor. This can be changed in the **Processor Settings** pane.



**Figure 18:** Processor name and Navigation bar.

## System Status Indicators

At the top right are the essential system status indicators for important system states such as redundancy, input signal, sync signal, and connected panels. Blue indicates good system health. Yellow is an alert, and red is a warning of a critical error. Look to **Devices** > **Display Devices** tab to discover more details about connected devices.
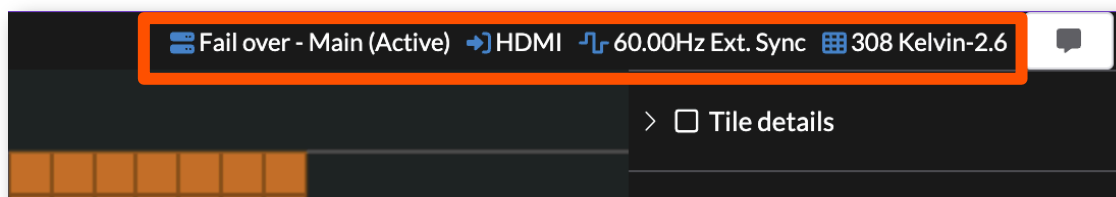


**Figure 19:** System status indicators.

## Feedback

At the top right of the interface is a button [💬] to provide us with feedback.

Use the **Send(remote)** to submit the form. An active internet connection is required for the client device that is accessing the HELIOS interface (the laptop or tablet the user is on). If no internet connection is available use the **Save(local)** option to store the feedback on the tech laptop.



**Figure 20:** Feedback form.

## Command Palette

HELIOS has a command palette for quick access to functions. Invoke the command palette with Command+K / Ctrl+K and start typing a command. HELIOS will search and offer from all the available functions. In the example below 'bl' was typed. HELIOS offers several options. Select one of the options to have it immediately execute the command. If **Blackout:Toggle blackout** is selected, HELIOS will blackout. To turn blackout off, call up the command palette, Command+K / Ctrl+K, type 'bl' and press enter on the top item in the list **Blackout:Toggle blackout** is executed. This time HELIOS removes the blackout since the command is a toggle.
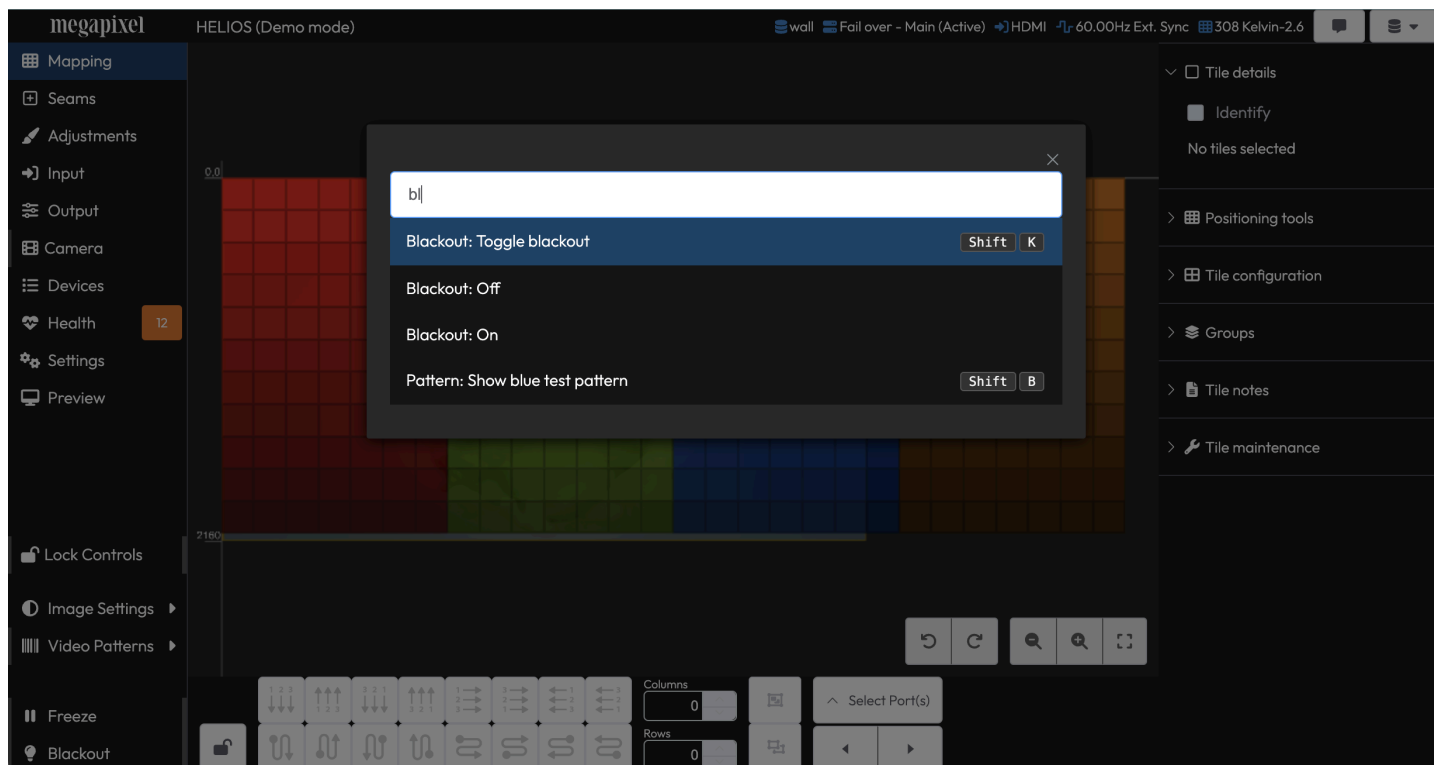


**Figure 21:** Command Palette.

## Command Palette Functions

- Toggle blackout/freeze
- Toggle/Set test patterns
- Toggle controls lock
- Toggle topology
- Download support
- Change theme
- Navigate to a page
- Switch input

## Processor Stacks

When **Stacking** is enabled in **Settings > Processor Settings > Stacking,** a ⬛▾ **Stacks** button appears next to the **Feedback** button at the top right of the UI. The **Stacks** button opens a window that displays all available processors and the stack each belongs to. This feature helps identify the system status of processor stacks and gives confidence that backup units are available. Select the IP address to the right of the processor name to open the web UI page of a processor. Visit the section on **Stacking** settings and **Appendix F** on Redundancy to read more about how this feature is used.
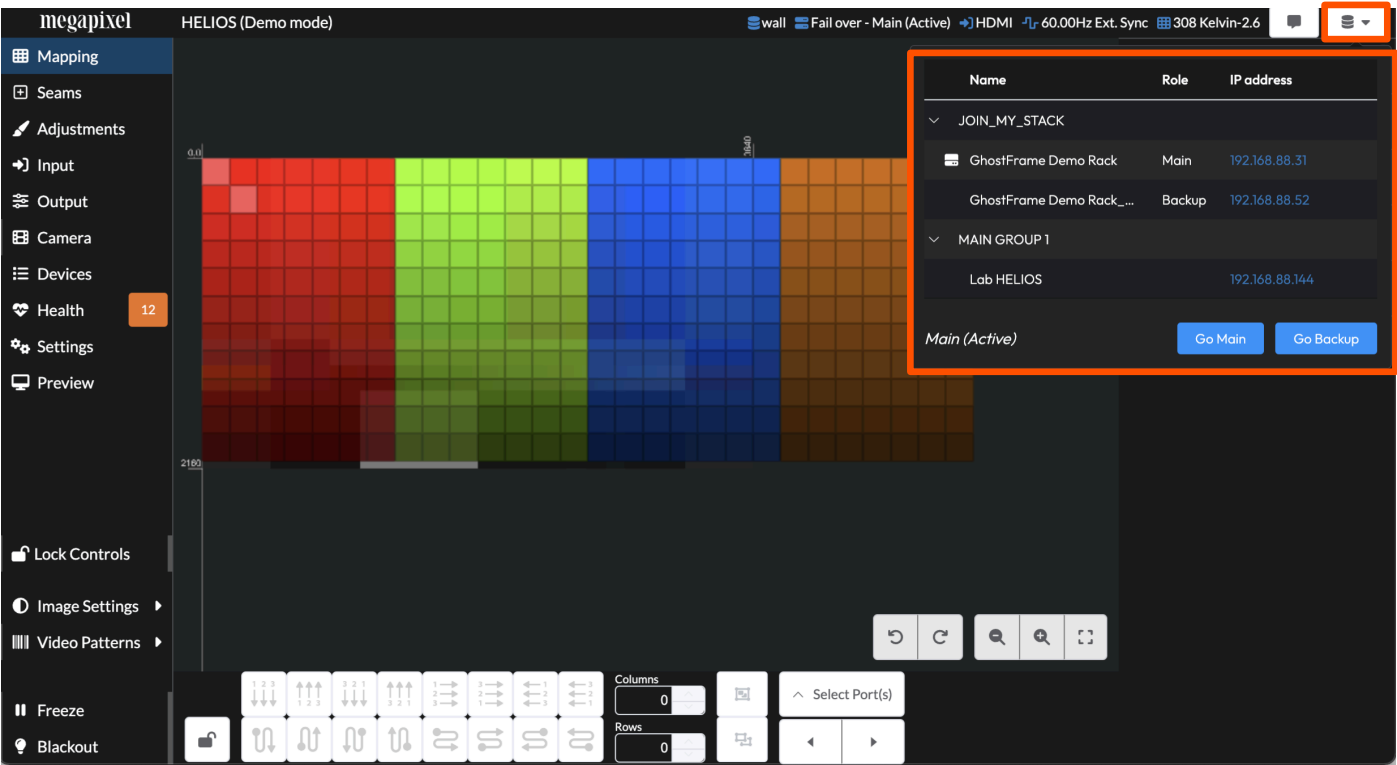


**Figure 22:** Processor Stacks.

## Global Controls

1. **Lock Controls** - Enable this to prevent accidentally triggering any of the controls below it.

2. **Image settings** - contains the **Brightness**, **Gamma**, and **Color temperature** controls (pictured above). These types of sliders can be found throughout the web UI. Once they have been selected with a mouse click, sliders such as these can be controlled with a mouse wheel .
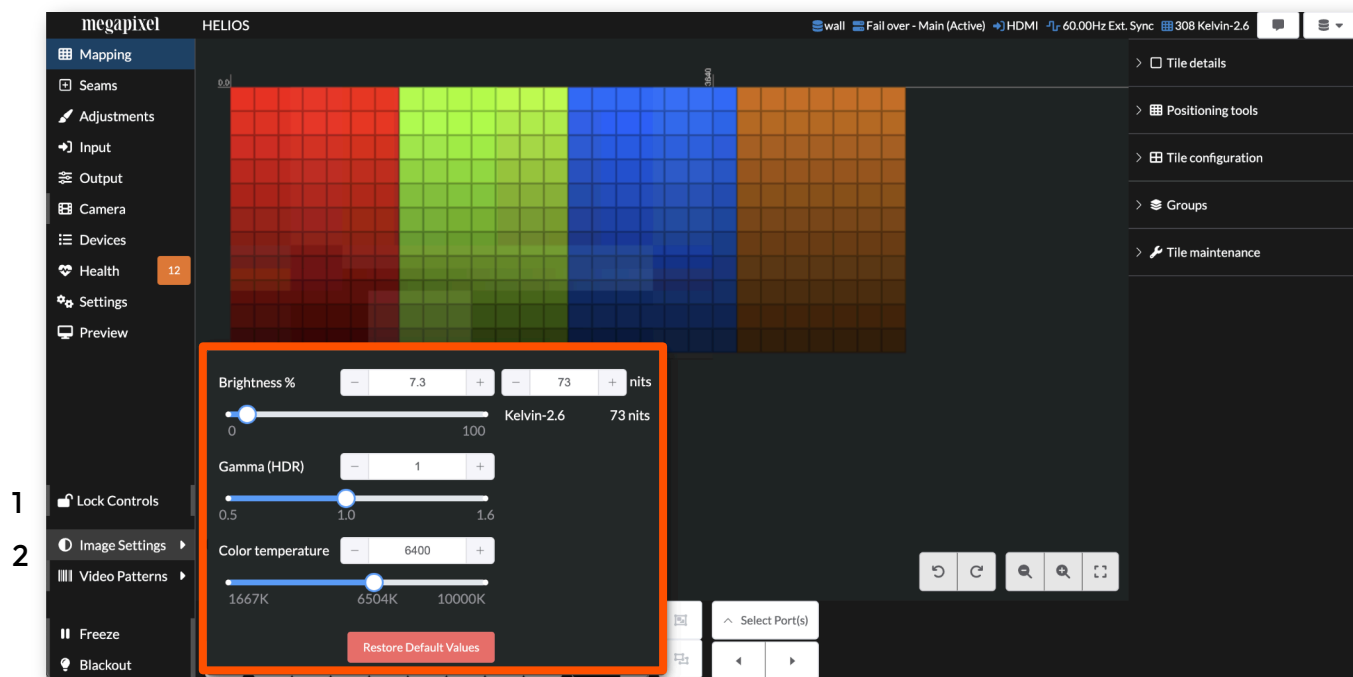


**Figure 23:** Global controls.

> **NOTE:** By default, systems with multiple display device types limit the maximum luminance. This behavior can be overridden, see the **Limit to lowest tile max** section for more details.

**Image settings (Advanced)** – With Advanced mode enabled, the Duv value of a color can be set. This ensures a precise color that is is not possible with CCT values alone.
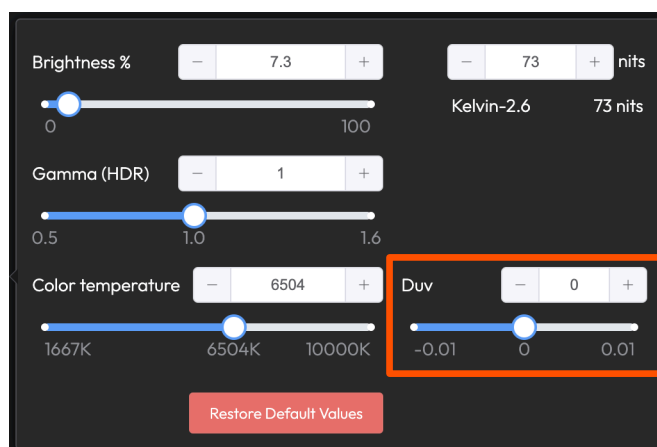


**Figure 24:** Duv control in Advanced mode

# Global Controls (continued)

3. **Video Pattern Selection** – Video patterns over-ride video inputs. A drop down menu provides a selection of HELIOS generated patterns.
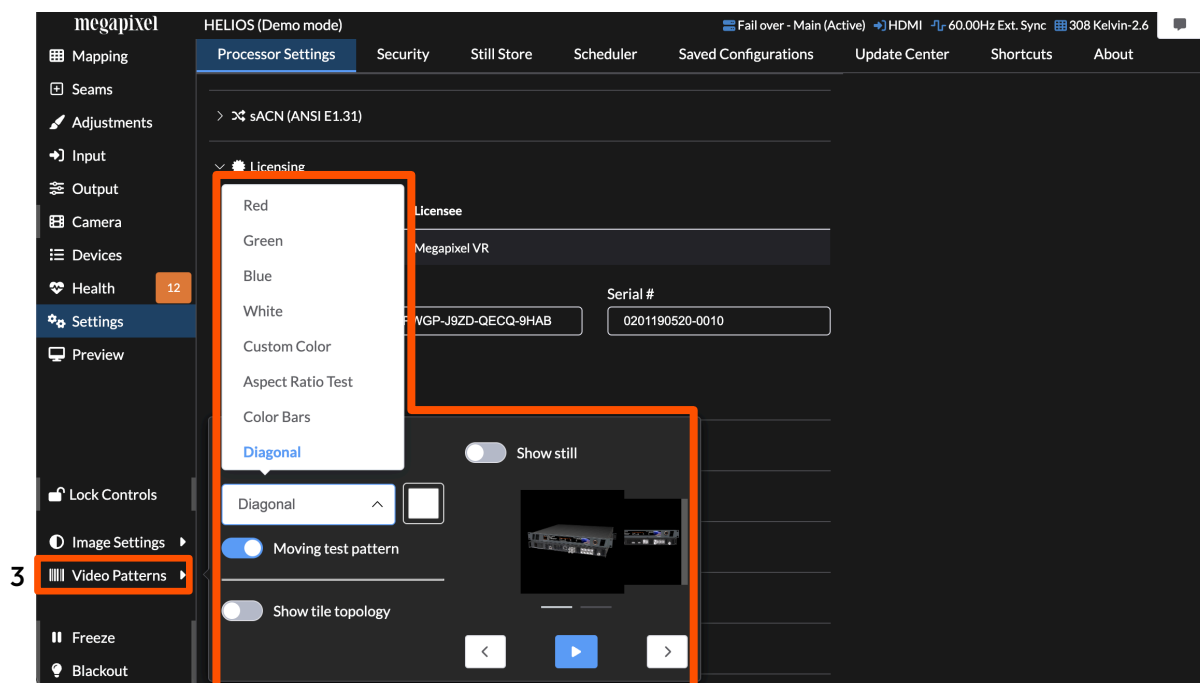


**Figure 25:** Video pattern selection.

**Custom color patterns** – Some patterns can be custom colored. When custom color is available for the selected pattern, select the color box to the right of the pattern selection drop down menu to open up a color picker.
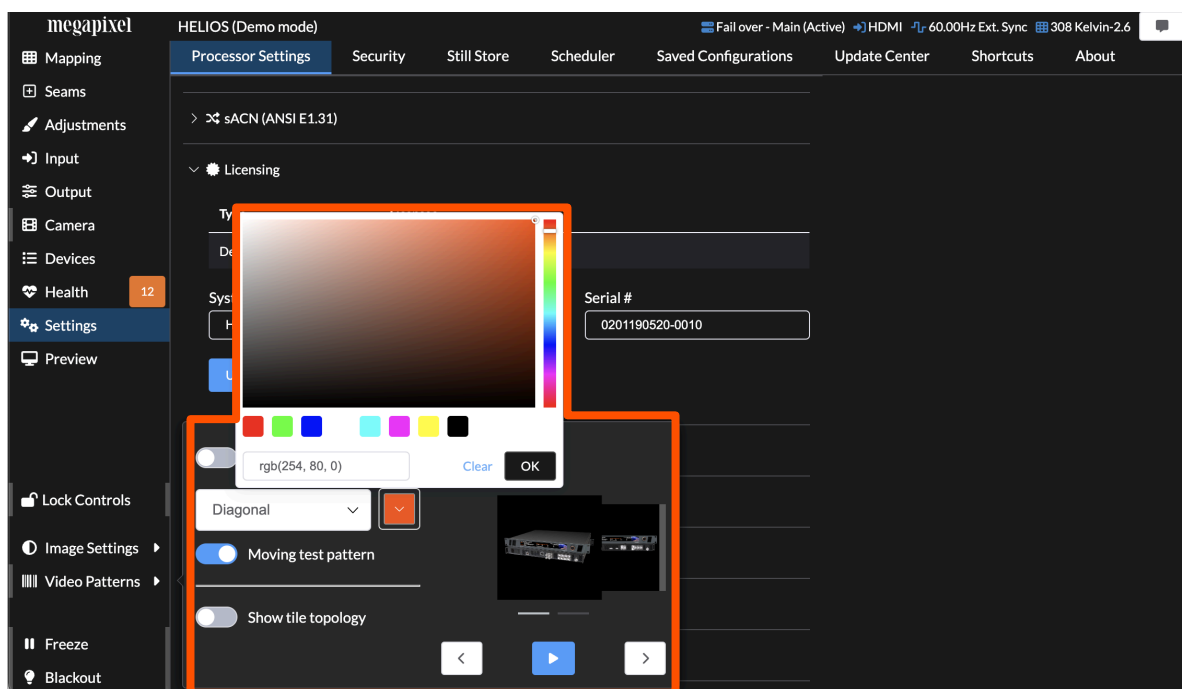


**Figure 26:** Video pattern color picker.

# Global Controls (continued)

**Still images** – Show stills that have been stored on the HELIOS. Select an image from the carousel and press the playback triangle to display the selected image. See the **Processor Settings > Still store** pane to store and manage images. When **Show still** is enabled a small yellow **Show Stills icon** is visible on the top of the app (see orange arrow below).
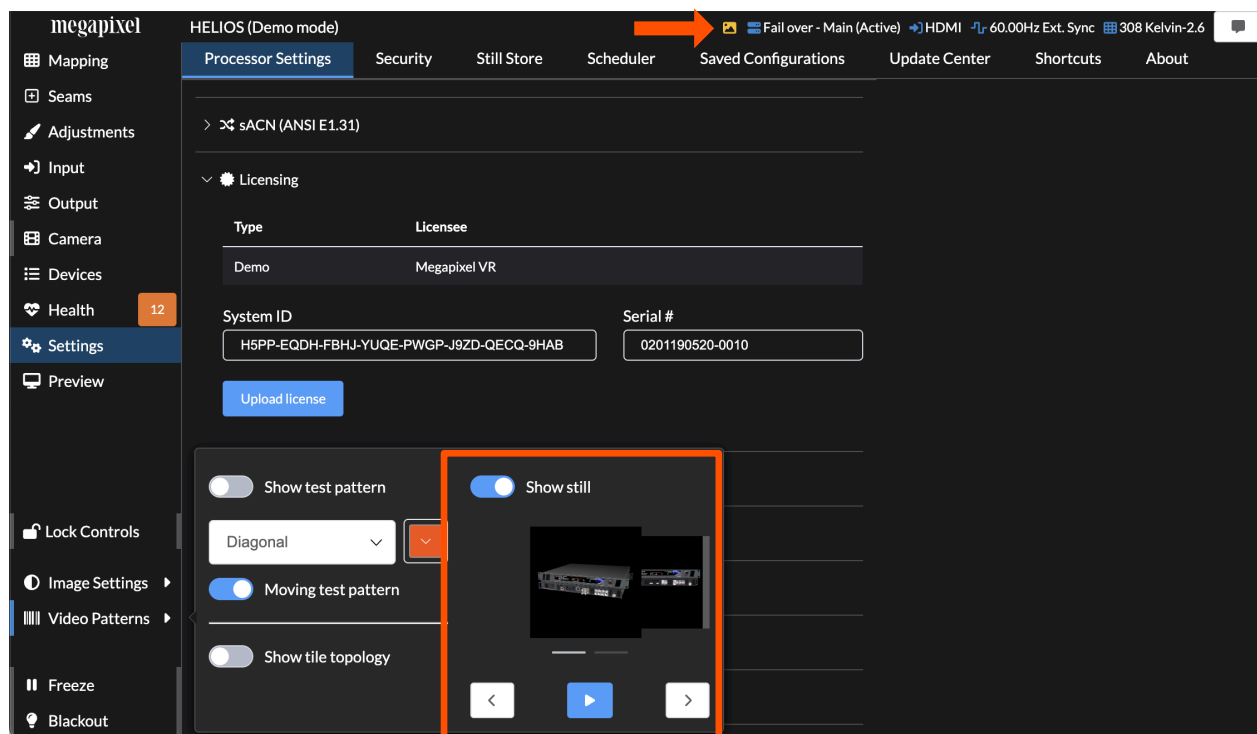


**Figure 27:** Show stills.

## Global Controls (continued)

The bottom two options are controls for freezing or blacking out the output.

**Freeze** - will continuously display a still image of the last input frame at the time the **Freeze** button was pressed. This feature is convenient to use when the input signal must be interrupted, and the live display can show a still image such as a logo. To use this feature, display the desired image and press the **Freeze** button. The input signal can now be interrupted and the HELIOS Processor will continue to display the still frame grab. When it comes time to resume, display the same image again with the connected playback device and toggle **Freeze** off to resume live playback.

**Blackout** - is a black generator that ensures all LEDs are completely off. This feature is ideal to use for situations when panels need to be placed on stand-by with power use at a minimum. HELIOS compatible tiles all have a low power mode that can be set to enable immediately on blackout, one (1) minute after blackout or after five (5) minutes of blackout. See **Settings -> Tiles -> Low power mode** to configure. When low power mode is enabled a green leaf shows up next to **Blackout**.
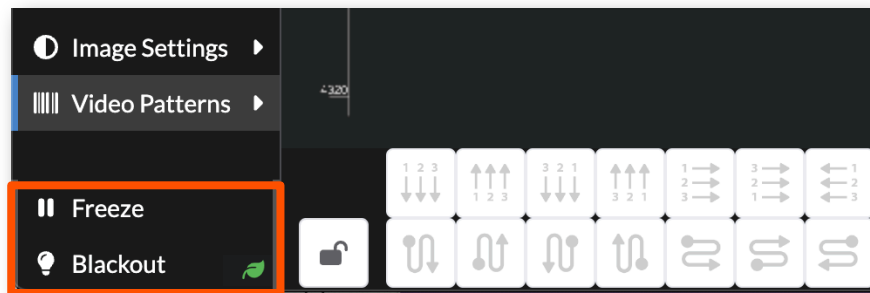


**Figure 28:** Freeze and Blackout

## Canvas Lock

When changes on the mapping pane and the and inputs pane are complete it is good practice to lock the panes to prevent any unintentional changes. The lock mechanism locks and unlocks the canvas functionality simultaneously on both the mapping pane and the inputs pane.
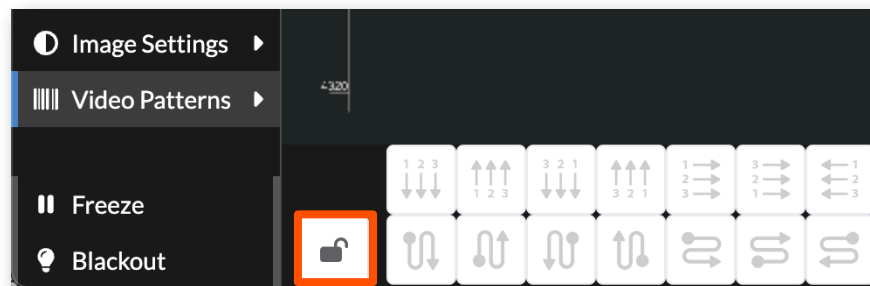


**Figure 29:** Canvas Lock

## Keyboard Shortcuts Menu

Always available with the press of **'?'** on the keyboard, the shortcuts menu provides a list of functions that have been assigned to key combinations. This pane is also available on the **Settings Pane > Shortcuts** tab.
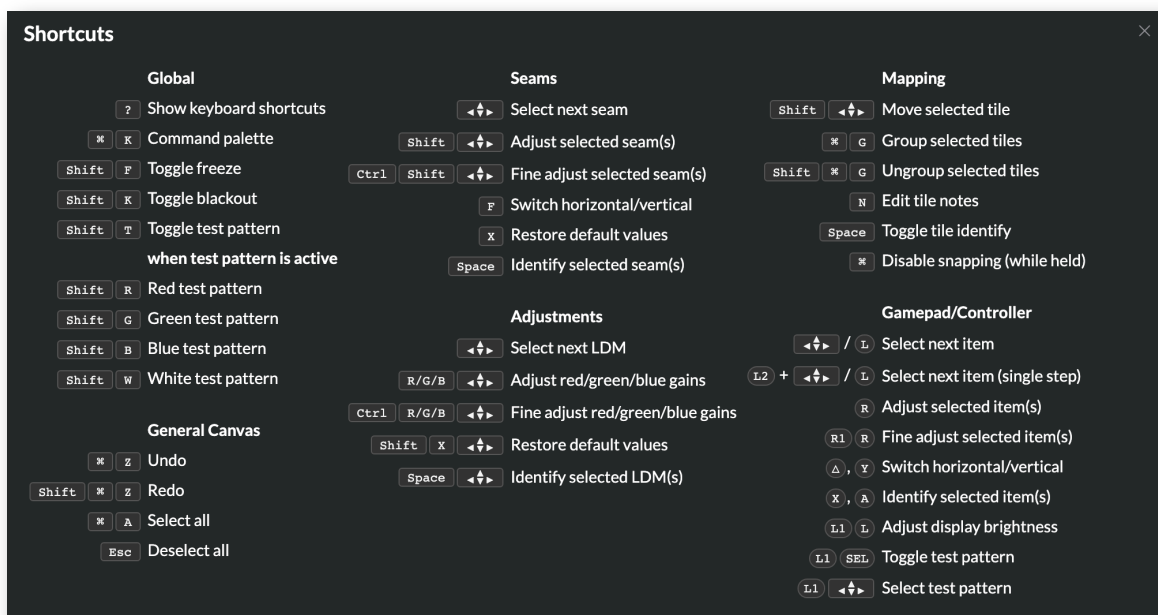


**Figure 30:** Keyboard Shortcuts

## Advanced Mode

Throughout this user guide several features are marked as **Advanced**. This means that the feature is hidden by default and can be accessed by enabling **Advanced Mode**. When **Advanced Mode** is enabled, HELIOS reveals numerous hidden features that have not been selected for general release. The **Advanced Mode** toggle can be found under **Settings > Processor Settings > Advanced**.
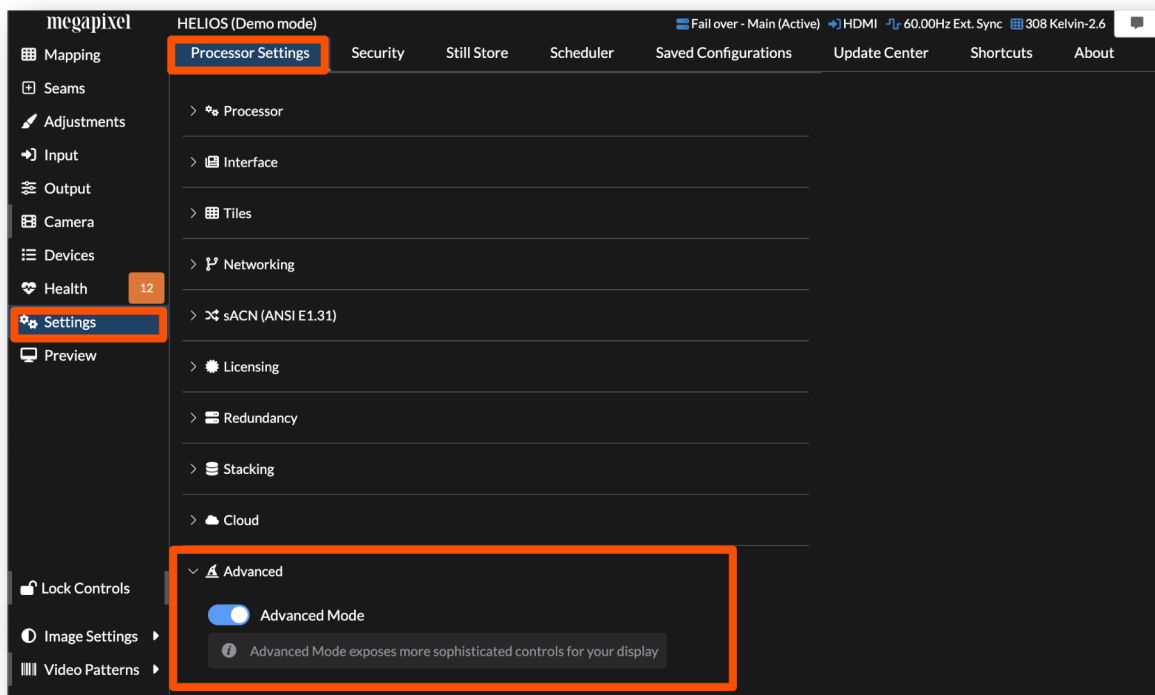


**Figure 31:** Advanced Mode toggle

# Creating Maps

The HELIOS Processor uses a map to determine which segments of the incoming raster to consider as an 'active pixel region'.  Areas of the incoming raster that are not associated with display fixtures, are never transmitted to the system. If only two fixtures are mapped, only two fixtures worth of panel data is transmitted.

If tiles have been discovered they will be placed on the map. By default, when panels are discovered, they are all collected in the top left (0,0) position. HELIOS does not support offline mapping. Only automatically discovered tiles can be mapped.

The thin light gray line on the outside of the tile region marks the boundaries of an 8192 x 4320 pixel space. It can be used as a guideline for placement, but maps do not need to be constrained to it.  On a layer below the colored panel icons is a preview of the selected input (or a grey rectangle if the input is unavailable) that represents the incoming signal's raster area. It will only be visible if the input signal raster is set larger (using the Input pane) than the space occupied by the tiles. In the example below it is slightly oversized to  the panels.

The mapping tools at the bottom of the page are used to move the panels into the positions that they occupy in the physical system. Select a group of panels, define the columns and rows that they should be arranged in, then select the cable order. When the cable order icon button is pressed, the selected panels will be re-ordered. HELIOS can undo and redo maps incase something did not turn out as desired.  Panel locations can also be adjusted manually by drag and drop or by typing the desired X and Y coordinates.

Display panels are tinted according to the network switch that the panels are connected to (Red = 1, Green =2, Blue = 3 etc.). In the example below the system has been cabled in columns with seven columns per port. There are four network switches in the system example below.

There are three (3) ways to pan the canvas:

- Hold the middle mouse button while moving the mouse
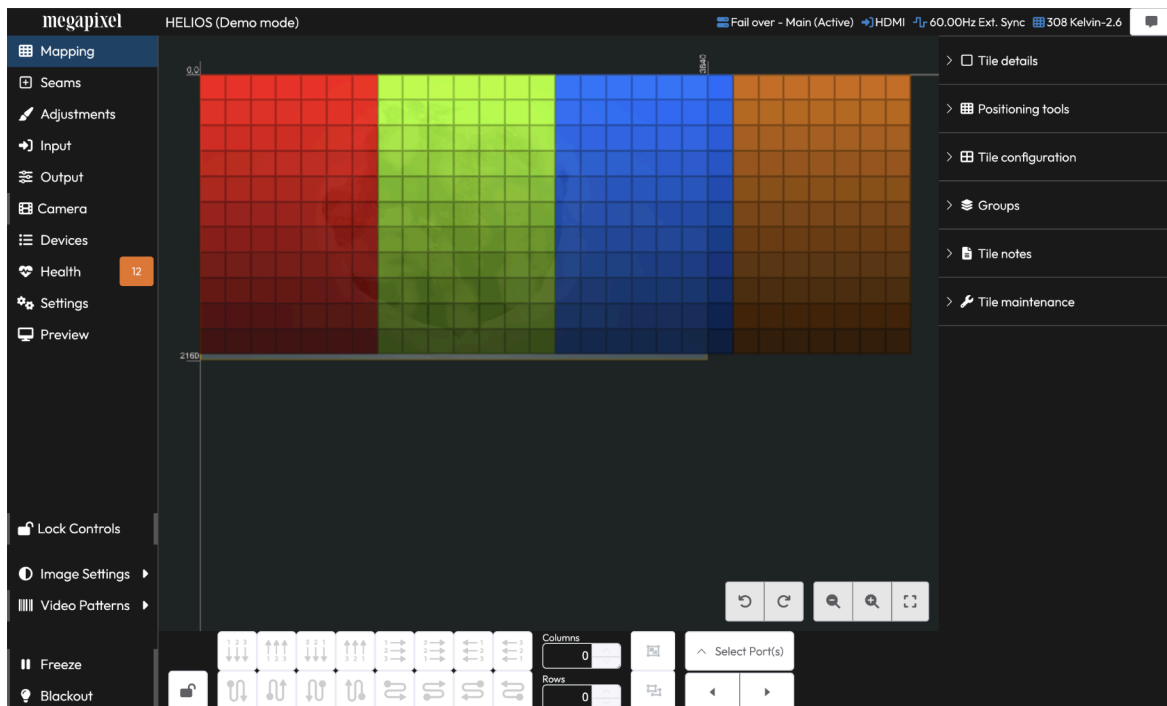- Ctrl/shift + right mouse
- Ctrl/alt + left mouse



**Figure 32:** Mapping pane

## Mapping Pane

The right side of the mapping pane has accordion menus with tools for mapping and configuring tiles. Select at least one tile to see information about it.
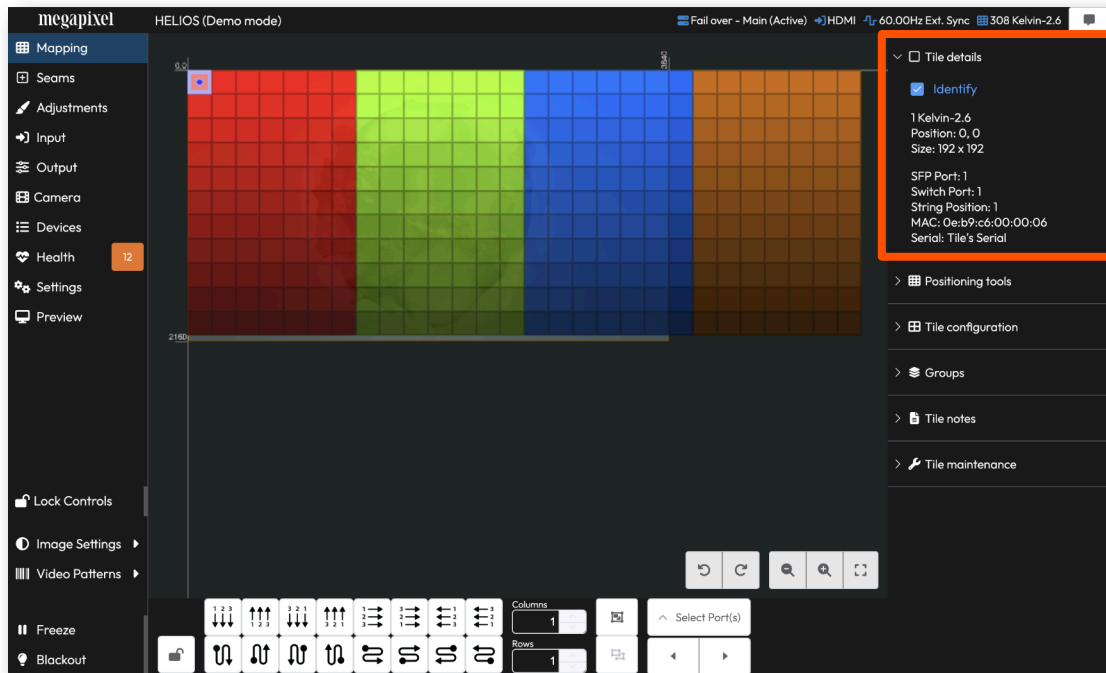
## Tile details



**Figure 33:** Tile details

Directly below, is an **Identify** checkbox. When this is checked ON, selected tiles will be highlighted in the system (blue dot on tile in the user interface). The Identify behavior has two modes (1) **Rear indicators** only or (2) **Front identify & Rear indicator**. On the **Processor Settings** tab in the **Tiles** accordion, a drop down menu offers these two choices.

The **Show Indicators** toggle on the **Settings > Processor Settings** pane, enables/disables the rear tile run time indicators (i.e solid blue, red, etc.). The **Identify** function operates independently, it will be available even when this setting is disabled.
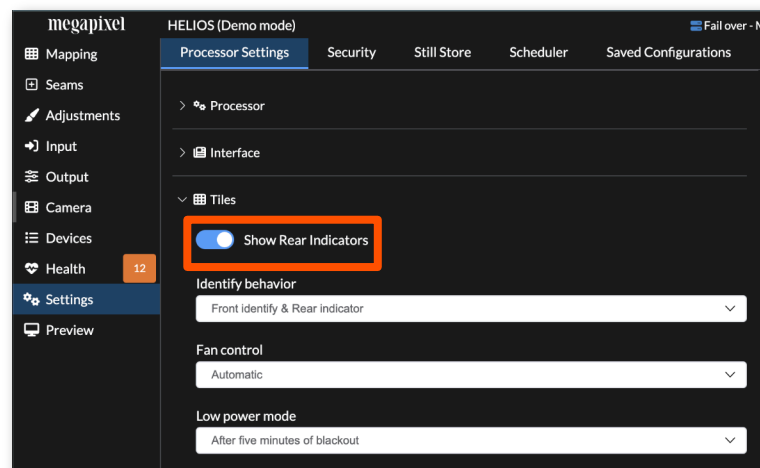


**Figure 34:** Tile Identify behavior
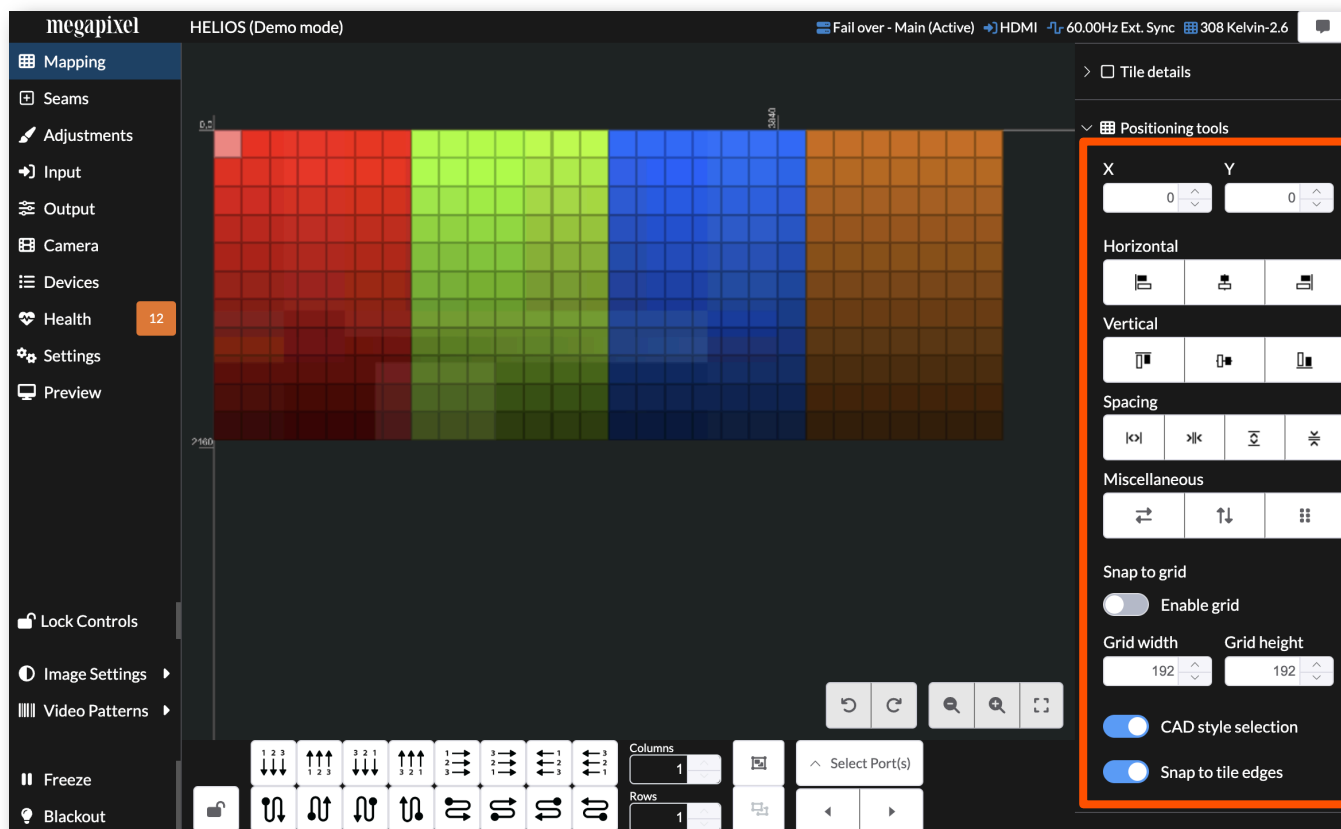
# Positioning Tools



**Figure 35:** Positioning tools

The mapping tools section contains alignment and spacing tools to aid in manual positioning tiles on the map. A grid with a Snap to grid function is available. Set the grid to the pixel size of the tiles being mapped to ensure accurate positioning of all tiles.

The CAD style selection toggle can help make the selection style behave in a more familiar way. When this mode is ON dragging from right to left (⬅) only selects the tiles inside the drag boundary zone. When this mode is OFF the drag right to left (⬅) action selects all tiles that the drag boundary touches. Regardless of how CAD style selection is set, dragging from left to right (➡)  always selects everything that is touched by the selection box.

# Tile Configuration
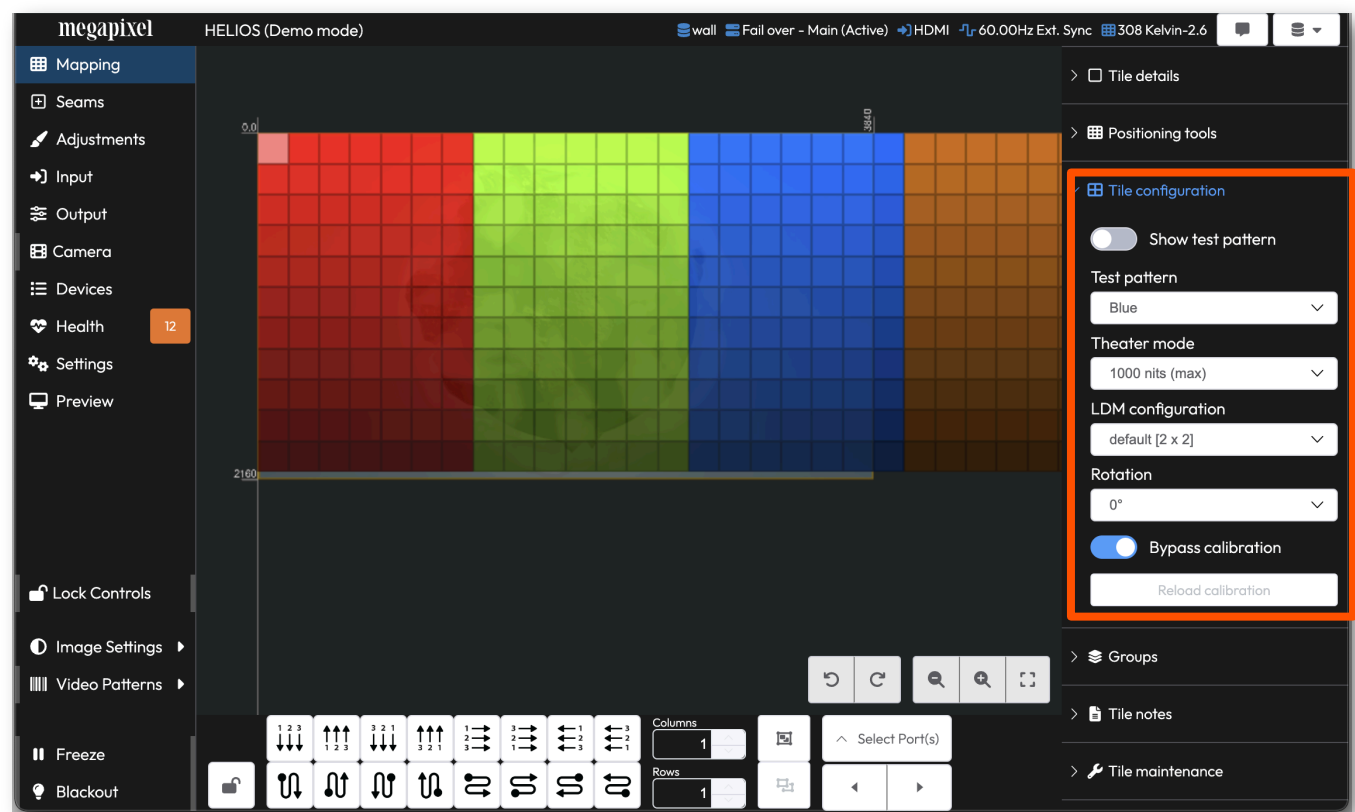


**Figure 36:** Tile configuration

**Test pattern toggle** – Select the tile test pattern desired and then choose to enable it with the toggle. These patterns are tile patterns that each individual tile calls up from on board memory. As such, the list of available patterns can vary based on the tile(s) selected. Tile test patterns are different from the **Video Patterns** located above **Freeze** and **Blackout** that send a video signal from the HELIOS to the entire array of tiles.

## Test Patterns

| Pattern Name | Function |
|---|---|
| Black / Red / Green / Blue / White | Solid color test patterns. |
| Counters | Total run time along with various diagnostic counters to help with troubleshooting. |
| Diagonal Lines (moving) | A pattern of moving white lines. |
| Gradient (moving) | A moving grey gradient. |
| Grid | A cross hatch of white lines on a black background. |
| LDM Details | Batch and serial number information for all the LDMs in each tile. |
| LDMs | ID numbers on each LDM with boundaries of each LDM marked with a cross at each corner. |
| LED Batch info | Manufacturing information for the LEDs. |
| Tile Details | Detailed information for each tile (tile type, firmware version, serial number, PXR number, MAC address, thermal info and fan info. where applicable) |
| Topology | Connection information regarding each tile. At the top of the test pattern is a numerical code that corresponds to how the tile is connected to the system (HELIOS Port / Switch Port / String position). A blue arrow indicates the direction of the data flow to the next tile. |

## Tile Configuration (continued)

**Theater mode** – A special low light level calibration configuration. If a tile has been calibrated for special low light situations, the tile will utilize full bit-depth at the selected lower luminance. If a tile does not have this additional calibration file, it will not support theater mode and will default to showing maximum luminance.

**LDM arrangement** – A single tile type can sometimes have multiple LDM configurations. If the tile type being used supports this, the drop down menu will list them here.

**Rotation** – Rotate the video being displayed on a tile so that the tile can be physically installed at a rotated angle but still display right side up video. Keep in mind that rotated tiles may not look the same as other non rotated tiles. LED panels with vertically stacked diode SMDs are especially affected by rotation changes to their viewing angle.

**GhostFrame™ Opt Out** – When GhostFrame is enabled, the GhostFrame Opt out controls appear. These controls enable GhostFrame to be turned on/off on a per panel basis. The drop down menu to the right of the toggle assigns a video stream for the tile to display instead of GhostFrame. This feature is used to isolate GhostFrame to 'on camera' tiles. A wall in front of the camera can be displaying GhostFrame with tiles to the side opted out to showing only the human visible stream.
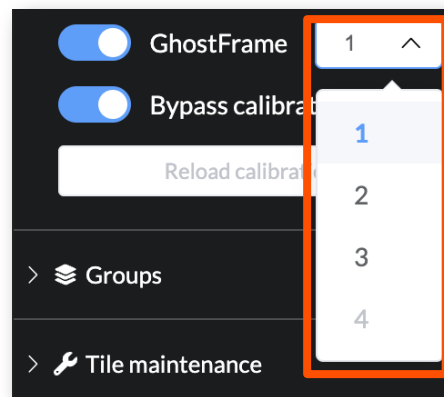


**Figure 37:** GhostFrame Opt Out

**Reload calibration** – Reload calibration is useful if an LDM has been replaced and calibration data needs to be reloaded.

**Bypass calibration (Advanced)** – This toggle is available as an advanced function for rare cases where tile calibration data is suspect. Turn the toggle on to disable tile's uniformity correction and color space retargeting.

---

**NOTE:** Not all tiles are designed to run for an extended period of time in full white with calibration bypassed. Please consult your tile manufacturer's operating instructions.

## Tile Groups

Tile groups enable the adjustment of sections of tiles separately from others. This type of configuration is common for systems that contain multiple independent displays. Select tiles in the map and (Command/Ctrl +G ) to create the group, (SHIFT + Command/Ctrl + G) to ungroup. Additionally, the center bottom of the Mapping pane has **Add to Group** and **Remove from group** icon buttons. When tiles are grouped, the boundary of the tiles will be outlined in white and the name of the group will appear transposed on top of the group. HELIOS lists groups as they are created under the **Groups** accordion on the right side of the **Mapping** pane, the **Seams** pane, and the **Adjustments** pane. Double click on a group to edit the position of tiles within the group. When using groups with **Stacking,** groups replicate across the stack. It is intended that all HELIOS' within the same stack have the same groups + settings.
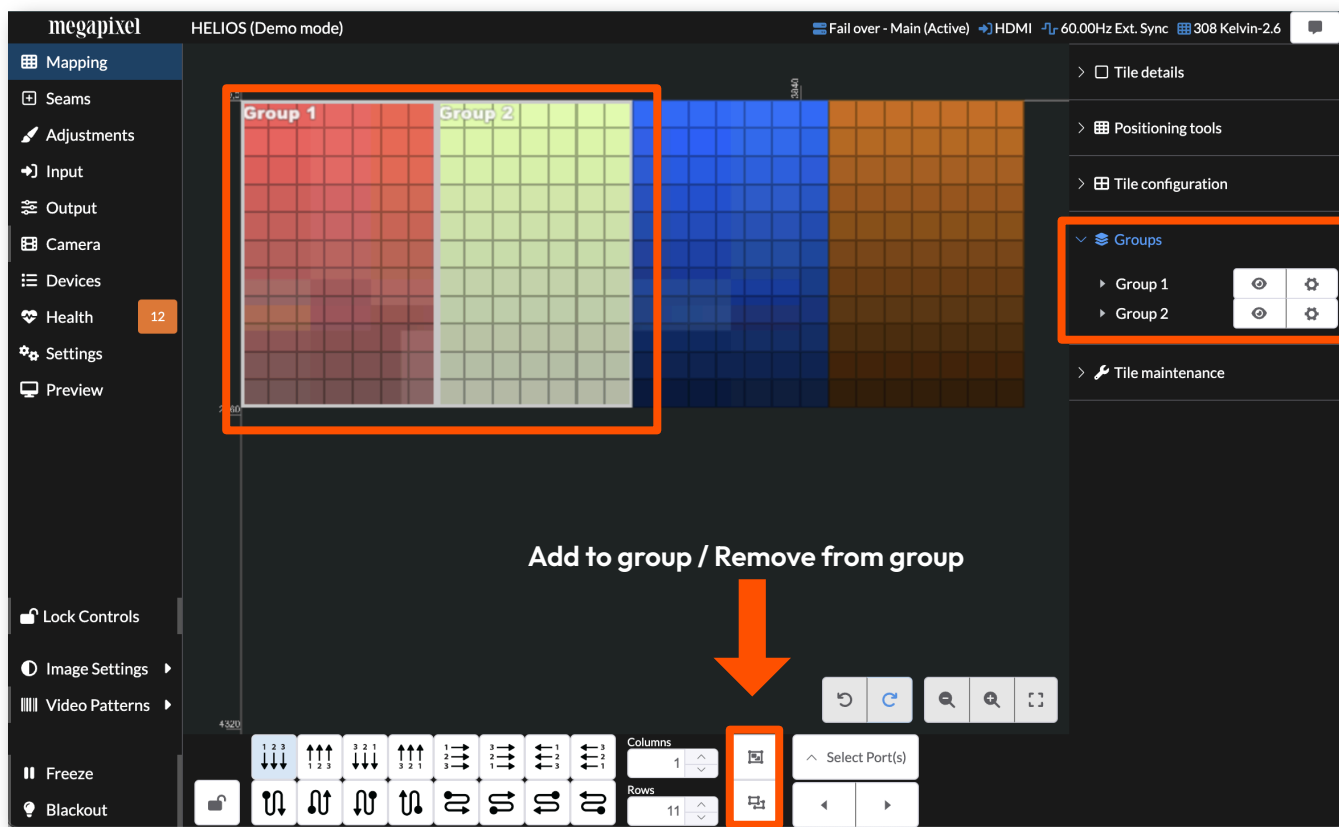


**Figure 38:** Tile groups

## Tile Group Accordion

The **Tile Group Accordion** lists each group and details about the tiles in the group under a disclosure triangle. **Groups** can be re-ordered by dragging the group name to the desired position within the accordion. Next to the group name is a group Visible on canvas button and a Group settings icon button (see figure below). **Group settings** are also available by right clicking on a group on the Mapping pane.
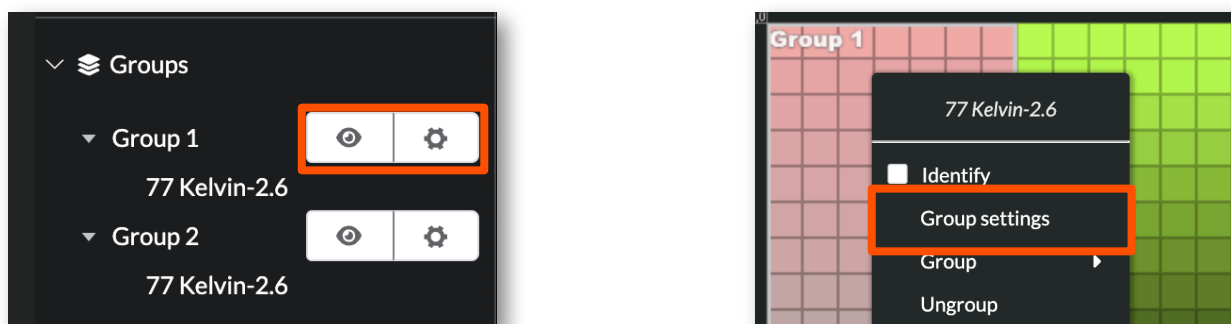


**Figure 39:** Tile group accordion

## Tile Group Controls

The tile group control window contains the settings for each group. Click on the group settings button (shown on the previous page) to open the tile group control window. Group adjustments on tiles require tile firmware to be updated to version 22.04 or higher. The firmware update enables tiles to respond to the HELIOS gains controls.
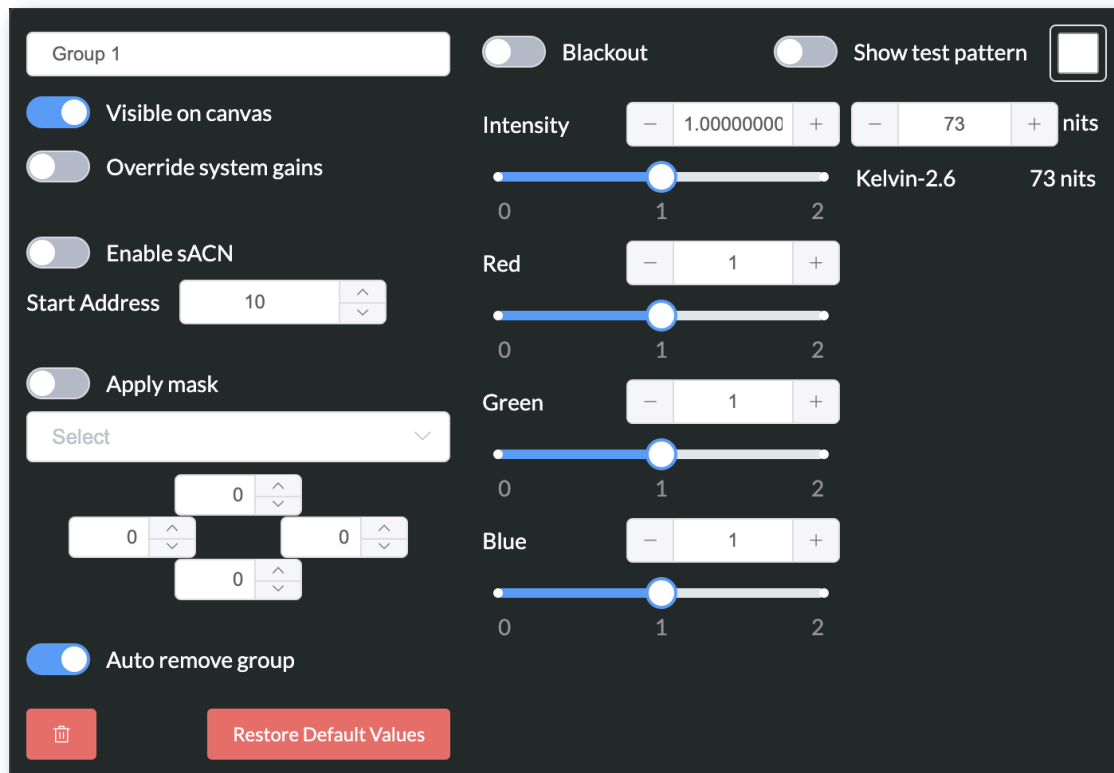


**Figure 40:** Tile group controls.

**Group name** – By default, HELIOS names groups with the word **Group + n** (an auto incrementing number). The name can be changed here.

**Blackout** – Enables Blackout for the selected group of tiles.

**Show test pattern** – A toggle to enable/disable a solid color pattern override.

**Visible on canvas** – A toggle to show/hide the tile group on the system canvas. This is the same as using the visibility button, ⊙ .

**Override system gains** – A toggle that gives priority to tile group gains (**Intensity**, **Red**, **Green,** and **Blue**). With this toggle enabled, the tile group gain settings are absolute, the group of tiles operates independently to the rest of the system. Global blackout overrides these group gains.

## Tile Group Controls (continued)

**Enable sACN** – A toggle to enable remote control of a group via the sACN protocol. sACN functionality must also be enabled in the **Settings > Processor** settings. With sACN enabled, channel assignment values appear in brackets in front of the name of each control. In the following example, **[10]** is the sACN channel for Intensity control of the group. This channel assignment is defined by the **Start Address**. Each new group is by default assigned the starting address of **[10]**. If individual sACN of groups is desired, manually increment the starting address to the next available sACN channel. See the sACN section under **Settings > Processor Settings > sACN** for more information on controlling HELIOS remotely with sACN.
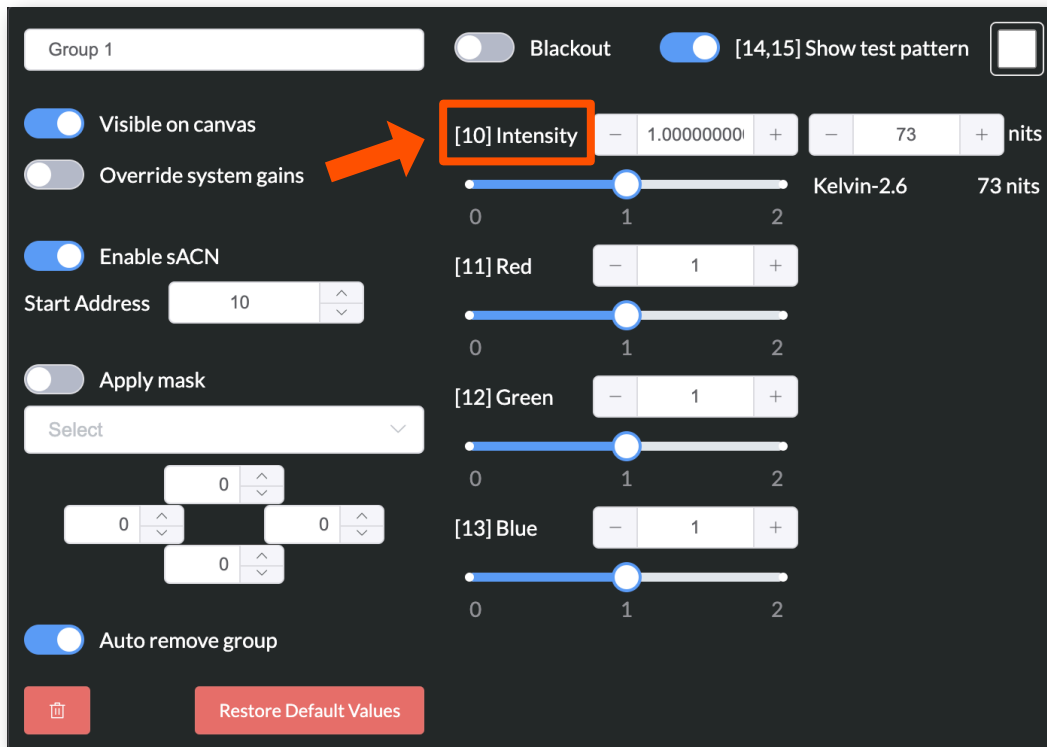


**Figure 41:** SACN enabled tile group controls

**Apply mask toggle** – Still images loaded using the **Settings > Still Store** pane are available in the drop down. Select an image for HELIOS to use as an outer edge mask for the display. This feature is useful for displays that have rounded physical bevels obscuring the display. Masking the pixels with HELIOS prevents color aberrations that can occur when LEDs are partly obscured by scenery. The four adjustment coordinates shift the mask image up, down, left and right respectively. Each field can accept a value as high as +100 or as low as - 100. However, the amount the mask moves is dependent on the mask pixel size. Smaller masks move less as there are less pixels available for adjustment. See the **Mask Appendix H** for more details.

**Auto remove group** – By default, when all of the tiles in a group have been ungrouped (removed) the group will also be removed. For cases where it is important to retain a group configuration, turn off the **Auto remove group** to avoid HELIOS removing this group if it becomes empty, and keep its relevant settings. This way, tiles can be added and removed from groups without fear of losing the group settings.

**Gains** – **Intensity**, **Red**, **Green** and **Blue** are gains controls for the group. The brightness (nits) is proportional to the overall system brightness (system brightness = intensity × RGB). Use the **Override system gains** toggle to have tiles operate independently.

**Remove group** – A button 🗑 to delete the current group.

**Restore Default Values** – A button to set tile group controls to default values.

## Tile Notes

Tiles can be individually notated by selecting the tile on the **Mapping** pane. Then press the note ✐ icon button under the **Tile notes** accordion or by the mapping popup menu.
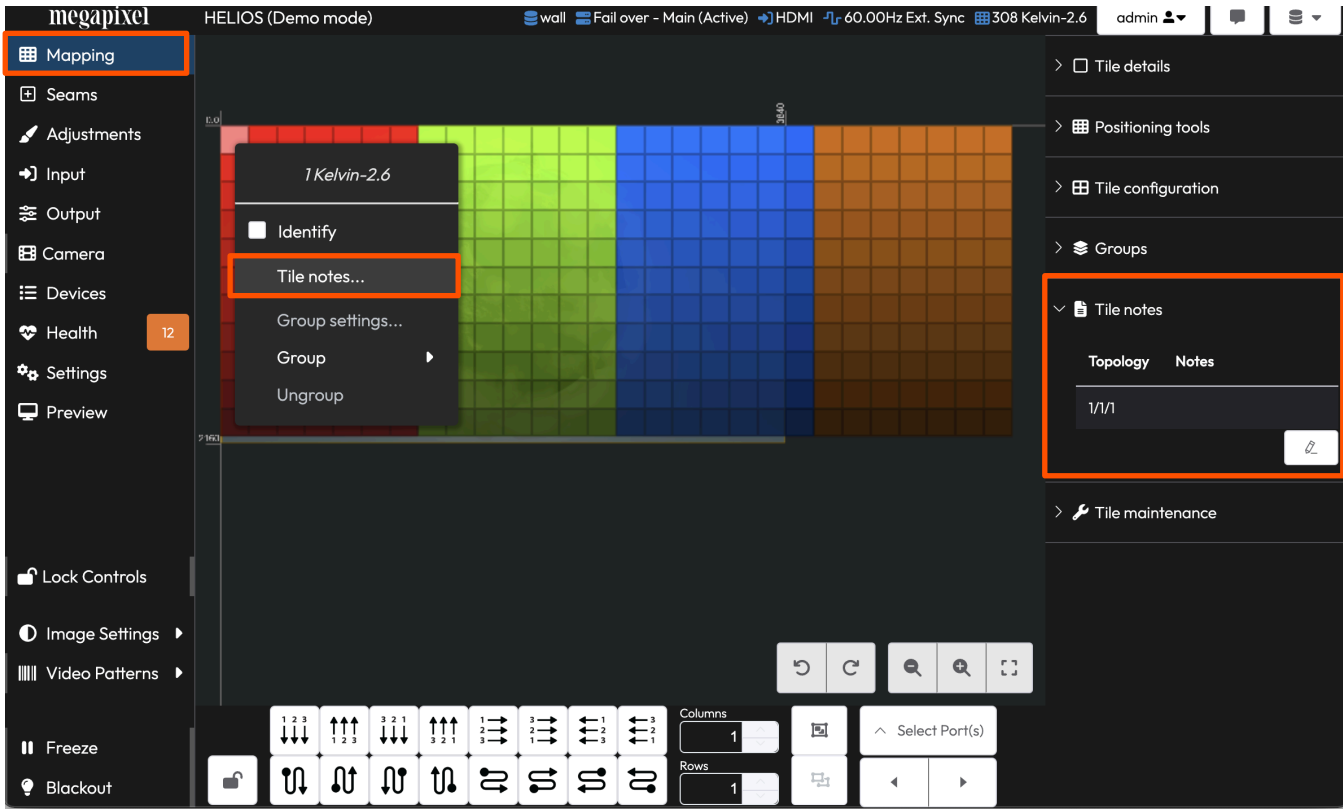


**Figure 42:** Tile notes

A note entry form pops over the main window. Add the desired note to the Notes field and tint the note a color if desired. Coloring notes can help categorize notes.
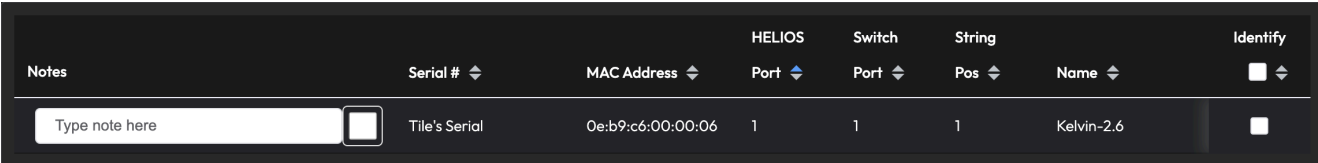


**Figure 43:** Note entry form

Once a note has been made, an icon will appear on the notated tile.



**Figure 44:** Note icon on tile.

## Tile Maintenance

This accordion contains commands that HELIOS can send to tiles; Reboot Tile(s), Eject, and Download tile support logs.
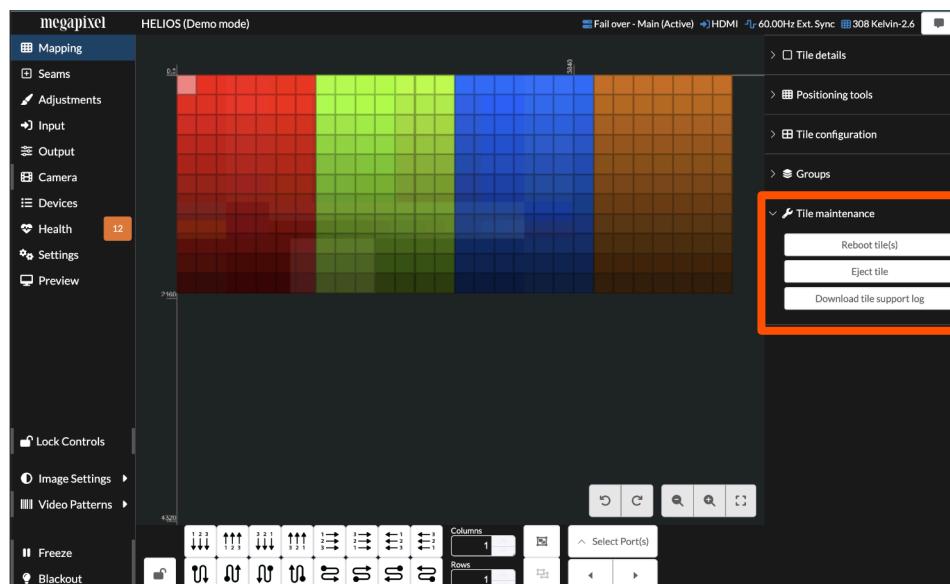


**Figure 45:** Tile maintenance.

**Reboot tile**(s) – HELIOS can send soft reboot commands to selected tiles. Select tiles to reboot and press the Reboot Tiles(s) button. **Caution using this feature in a show environment!** The tile(s) will go black as they reboot.

**Eject tile** – Some tiles have an ejection mechanism this button can be used to trigger it. Once ejected a tile will lose communication with HELIOS. For safety reasons only one tile at a time can be ejected.

**Download tile support log** – Requests technical support logs from selected tile(s). These logs contain current state and some activity logs since boot that are used by Megapixel technicians and developers for troubleshooting. When tiles report information in this manner they may show visual artifacts for a few seconds as the tile is processing and sending the log.
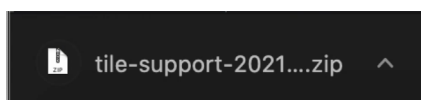
1.  Press the Download tile support log button.
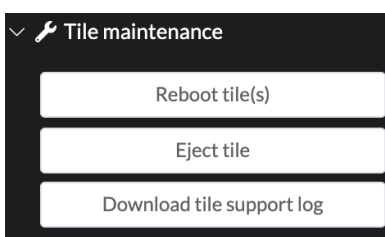


2.  A warning will appear. Press OK to continue with the download.
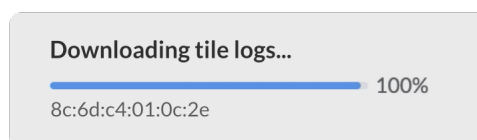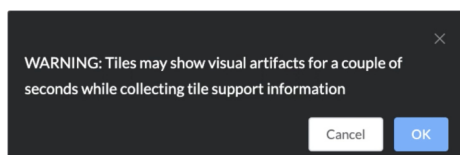


3.  After pressing OK a zip'ed log file is downloaded to the download location set in the browser.

# Input Pane

The HELIOS Processor supports four different types of input formats (HDMI, DisplayPort, SDI, and ST 2110). After a factory defaults restore, HELIOS will automatically select the first valid input that it receives. As an example, if the first valid input HELIOS receives is SDI, HELIOS will remain selected on SDI even if the signal is no longer present. If SDI is unplugged and DisplayPort plugged in, the HELIOS needs the user to select the DisplayPort source manually. Changes are sent live to the entire system immediately.

**Inputs select drop down** – The HELIOS interface for selecting inputs is a drop down menu on the **Inputs** pane (highlighted by the orange rectangle below).
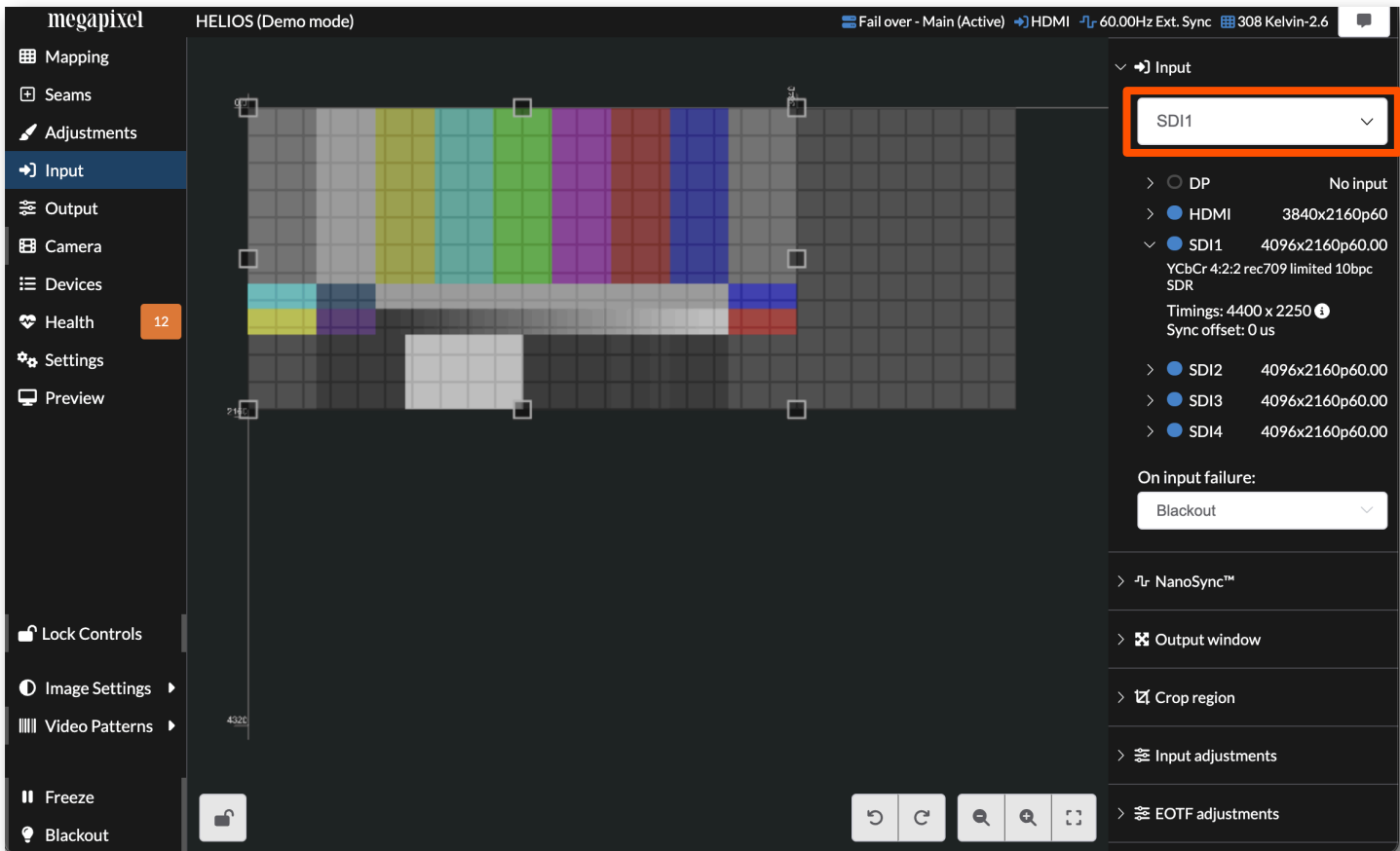


**Figure 46:** Input select.

# Input Pane (continued)

**Input Details** – Below the input select dropdown is the input details region. Each HELIOS input format has a line with a disclosure triangle to view signal details. It is good practice to verify that the resolution and frequency HELIOS has identified matches with the signal source.
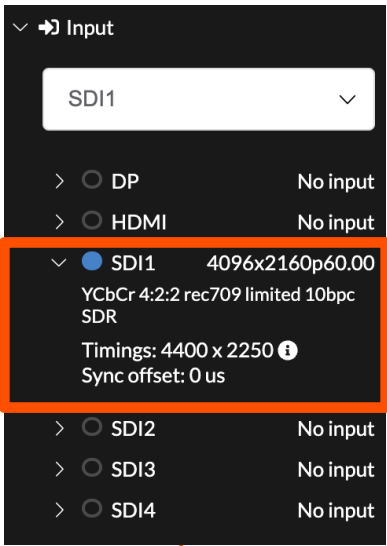


**Figure 47:** Input details

HELIOS displays details for color timing, and sync. With advanced mode enabled in the HELIOS settings, an information icon (arrow below) serves as a button to display advanced timing information.
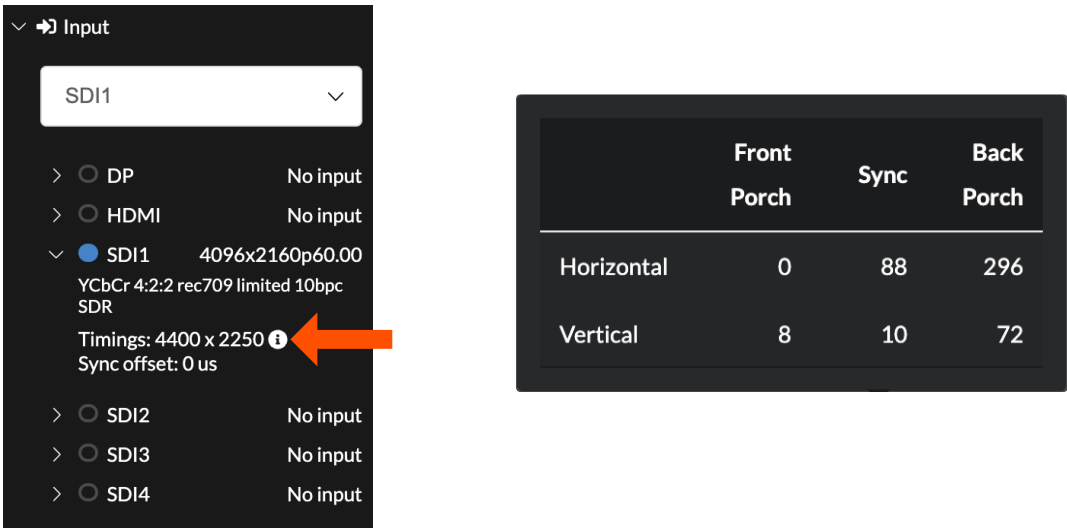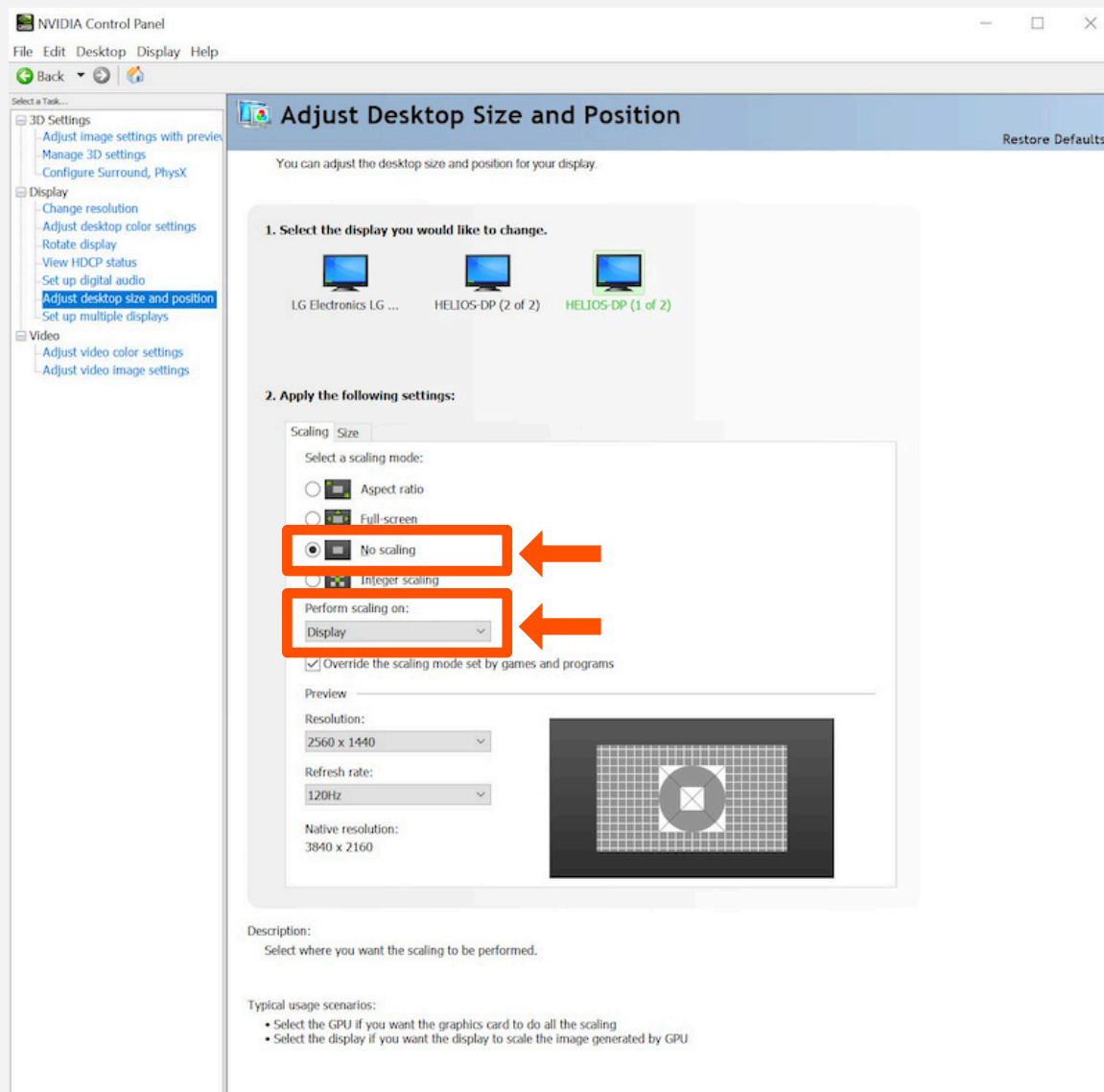


**Figure 48:** Advanced timing

## Input Pane (continued)

**NOTE:** The when connecting a PC with an NVIDIA graphics card, the scaling settings can have an impact on how the video signal is identified to HELIOS. Ensure that the scaling mode is set to **No scaling** and the dropdown, **Perform scaling on**: is set to **Display**.

# Input Pane (continued)

**Sync** - When an external sync (genlock) is not present, HELIOS will lock to the frequency of the input signal. If using an external sync we strongly discourage using a different frequency than the selected input signal. Mismatched frequencies can cause stuttering and vertical tearing between displays, along with other undesirable artifacts.

**Sync offset** - Shows how far away that input's sync is from the system's sync. If HELIOS is locked to input it should be close to zero. For external genlock it should be a fixed value (non-changing). The key thing to look for is a stable value. If sync offset is incrementing or decrementing, the source is shifting relative to the sync. A shifting sync offset is a reliable indication that the source is not locked. If the sync offset frequency is shifting more than half of a frame time, something is adding a large delay to the signal.
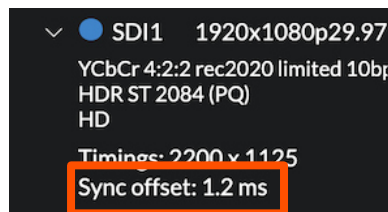


**Figure 49:** Sync offset

In the case of multiple inputs, the joined inputs will show the sync offset for the primary input. Expand the other input details to check that they also have similar sync offsets to the primary. If the inputs are not in sync, a warning will appear and the stitching option will turn orange to warn about the sync issue.
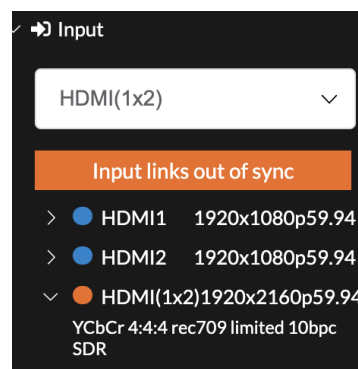


**Figure 50:** Sync warning

Ideally the **Sync offset** between inputs is close to zero. If they are not, or if the sync offset values are not stable, those signals are not using the same clock.

## Input Pane (continued)

**EDID (Advanced)** – HELIOS makes use of the EDID (Extended Display Identification Data) protocol to communicate the capabilities of the HELIOS DisplayPort and HDMI cards to media playback devices. DisplayPort and HDMI input cards each have a unique default EDID configuration that has been preconfigured to work with most common resolutions and frequencies. However, there are situations when a custom EDID file is needed. This can be the case when a media player needs to confirm with HELIOS that it supports a non standard resolution or alternate frame rate. Typically, an EDID file has multiple allowable resolutions and frame rates to ensure universal compatibility. By custom making a limited EDID with only a single resolution and frequency, issues can be eliminated after reboot or disconnect where the system comes back in a different state .

The DisplayPorts and HDMI ports on a HELIOS support loading custom binary EDID files. With **Advanced** mode enabled, HELIOS reports **Default** or **Custom** when a custom EDID file has been loaded. Two icon buttons to the right provide easy access to the Upload EDID and Reset to default functions (see figure below).
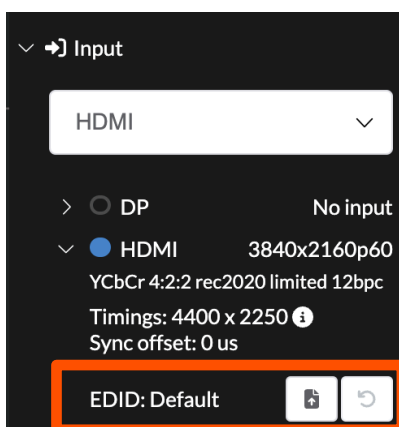


**Figure 51:** Upload EDID and Reset to default icon buttons

## Input Pane (continued)

**HDCP** - HELIOS supports only HDCP 2.2 signals. HELIOS requires a separate HDCP license in order to receive an HDCP signal. Please contact your Megapixel sales representative for this license. Once licensed, HELIOS will automatically negotiate an HDCP 2.2 connection when possible. On a successful handshake the input details will report HDCP 2.2 (example below).

**Prerequisites:**

- HELIOS v22.04.0 software
- HDMI 2.0 (rev 2) VFMC card. (Megapixel part number: PCB-0215)
- HELIOS HDCP license
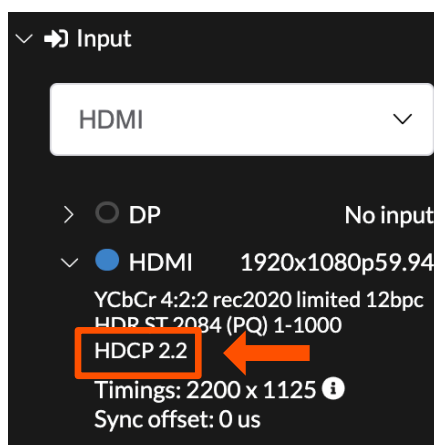


**Figure 52:** HDCP details on the HDMI input

---

**NOTE:** When troubleshooting HDCP protected input signals, ensure the upstream device generating the signal is set to negotiate HDCP 2.2. HDCP 1.4 protected signals can appear to be valid on the input details report, but display as black, blue or other aberrant color.

---

**120HZ** - HELIOS supports 120Hz input signals (see the **Input Capability Matrix** in Appendix J). 120Hz operation can decrease system latency by half (compared to a 60Hz setup) and improve the on camera appearance of some displays. Using a 120Hz input source will reduce the maximum quantity of pixels by half (e.g. 4,250,000 pixels per 10Gb HELIOS port to 2,125,000 pixels).  720P and 1080P are the best suited input resolutions for 120Hz operation.

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# Input Pane (continued)

**Stitched SDI** – HELIOS supports input stitching. This feature will join from two (2) to four (4) rasters depending on the option selected. The inputs with a formula in the line (e.g. **SDI (1x2) 4096x4320p60**) are stitched inputs. **(1x2)** indicates one (1) raster wide and two (2) rasters tall. In this case, HELIOS is stitching two vertical (top to bottom) rasters. If selected on an input with a **(2x1)** designator, the picture is made up of two (2) side by side rasters. The position of the SDI rasters matches the physical port layout on the HELIOS unit viewed from the rear; the top left input (input #1) is the top left quadrant, the bottom right input (input #4) is the bottom right quadrant.

---

**NOTE**: Stitched inputs can not be scaled. When stitching is enabled, the output window is locked to the stitched input size. Inputs combined with square division also can not be scaled.
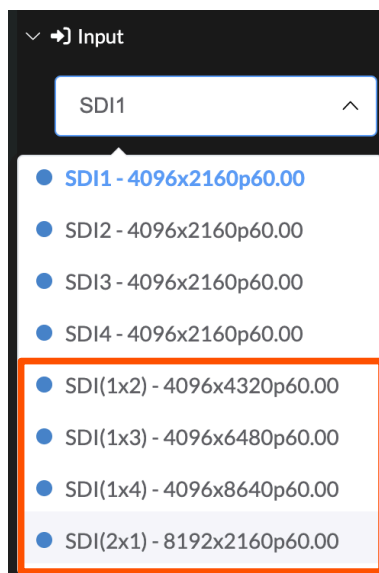
**Figure 53:** Stitched SDI

**Stitched Dual HDMI / Dual DisplayPort** – When HELIOS has dual HDMI or dual DisplayPort cards installed, the two rasters are stitched together automatically. The input drop down menu will show the stitched rasters as two options **(1x2)** one wide by two tall or **(2x1)** two wide by one tall.
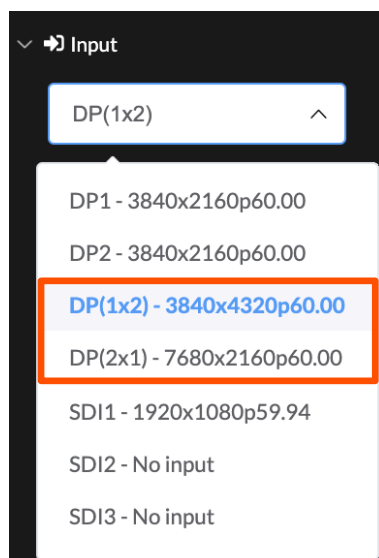
**Figure 54:** Dual DisplayPort options

# Input Pane (continued)

**ST 2110** - HELIOS supports ST 2110 digital media over IP. See **Appendix G** for more details about ST 2110 systems. Megapixel branded blue or purple label SFPs are installed in the four input SFP cages of the HELIOS instead of the default SDI SFPs. If the 100GB input module is used, any 100G QSFP28 SFP can be used. The HELIOS operating mode **Processor Settings > Operating mode** needs to be set to **ST 2110** mode.
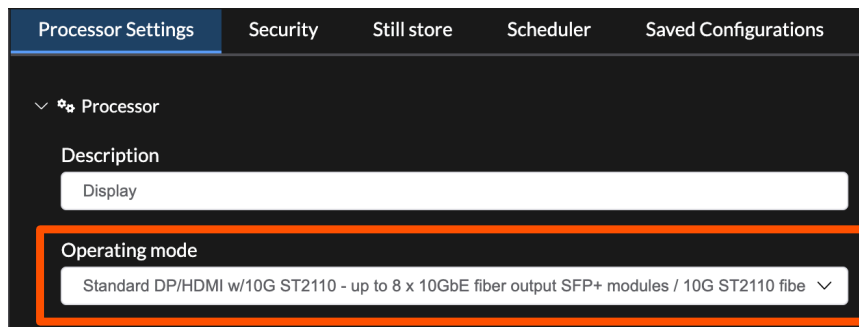


**Figure 55:** ST 2110 Operating mode

In ST 2110 operating mode, HELIOS disables SDI and the input pane will show the available ST 2110 inputs. ST 2110 inputs are stitching capable. Select a single input to connect only one or select a stitched input to show more than one input at the same time. In the example below **ST 2110(2x2)** indicates that all four (4) ST 2110 inputs are being stitched.
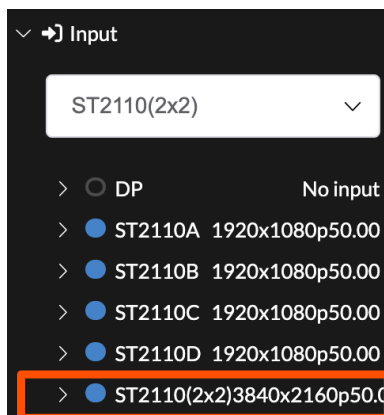


**Figure 56:** ST 2110 inputs stitching

HELIOS needs an SDP (Session Description Protocol) record in order to locate an ST 2110 stream on a network. SDP records are small text files that describe the streaming media's parameters to HELIOS. SDP records are essential for locating and configuring an ST 2110 video signal. Use the upload icon button (see figure below) to send an SDP record to HELIOS. See Appendix G for an **example SDP record**.



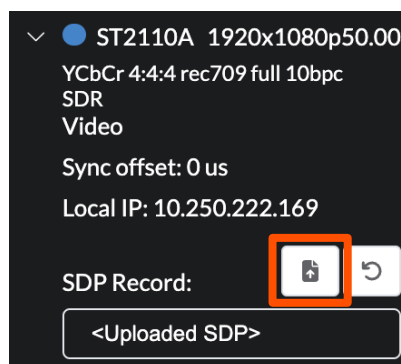**Figure 57:** SDP Record Loading

# Input Pane (continued)

**On input failure** – Select how the HELIOS should behave if the selected input no longer has a valid signal.

> **Blackout** – HELIOS will display black.
>
> **Show still** – HELIOS will display a preselected still image. See the **Processor Settings > Still Store** section for loading images.
>
> **Show input** – HELIOS will show the selected input. When the selected input recovers, HELIOS will revert to it. As an example, SDI1 is the selected on the Input pane. The On input failure > Show input is set to HDMI. If SDI1 fails, HELIOS will display HDMI. When SDI1 recovers, HELIOS automatically switches back to SDI1.
>
> **Switch to input** – HELIOS will switch to the selected input. As an example, SDI1 is the selected on the Input pane. The On input failure > Switch to input is set to HDMI. If SDI1 fails, HELIOS will switch the input to HDMI. When SDI1 recovers, HELIOS does nothing. The input remains selected on HDMI.
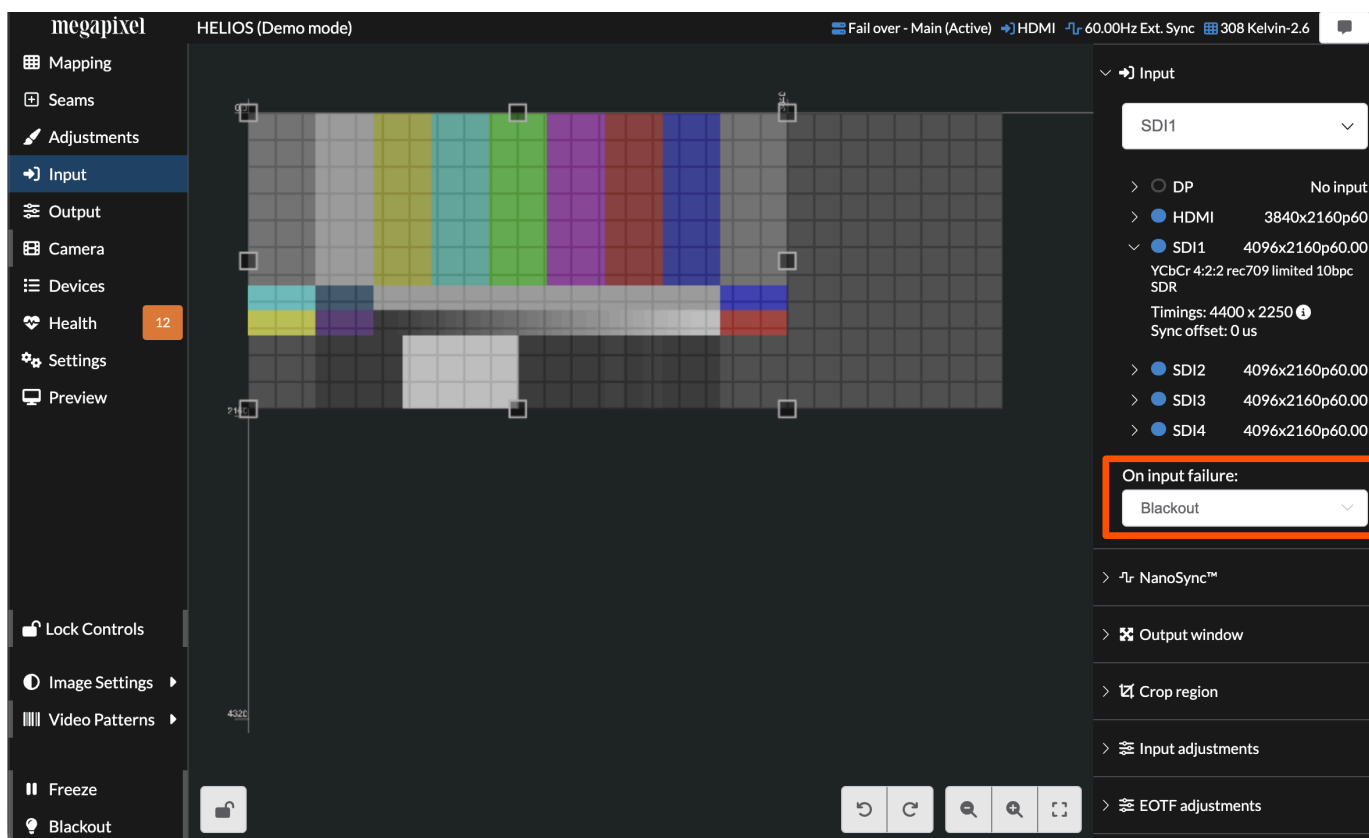
**Figure 58:** On input failure location

## NanoSync™

HELIOS can sync frames to either the frame rate of the inbound signal or to an external genlock. When an external genlock signal is required (as is the case with redundant systems), use the **Allow external sync** toggle to enable it.
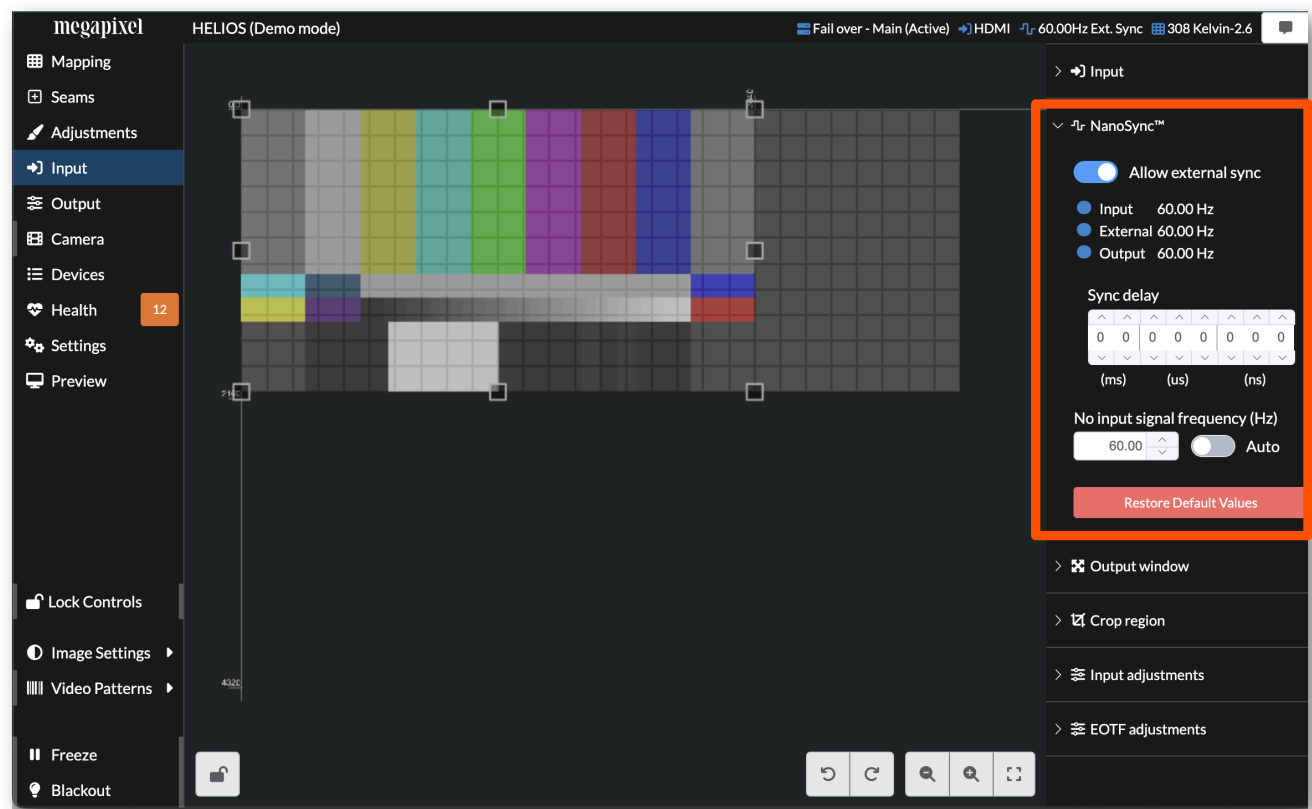


**Figure 59:** Sync settings

When the **Allow external sync** toggle is enabled, the front display of the HELIOS will report the frame rate it is receiving. If the HELIOS does not recognize an external sync signal it will report **No Sync**.
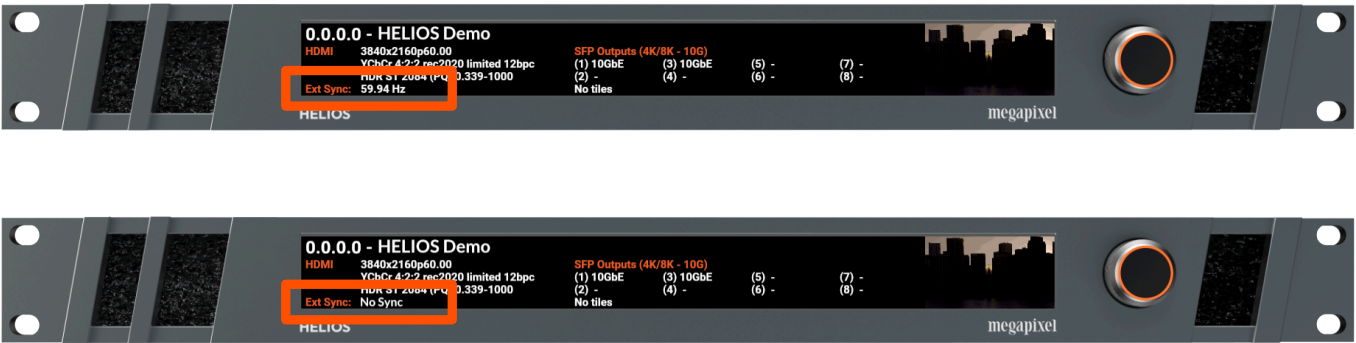


**Figure 60:** Front panel sync report

## NanoSync™ (Advanced)

HELIOS has hidden NanoSync controls under the **Advanced Mode** toggle. Enable Advanced Mode under **Settings > Processor settings > Advanced**, to reveal the hidden controls, then return to the NanoSync panel to use them. HELIOS NanoSync gives users the most accurate sync control of any LED system. HELIOS synchronizes the actual light output of the LED tile to the source within 1/4 microsecond (250 nanoseconds). Often HELIOS delivers frames much faster than other equipment such as projectors.  Cameras can also require precise alignment to match with the shutter exposure.
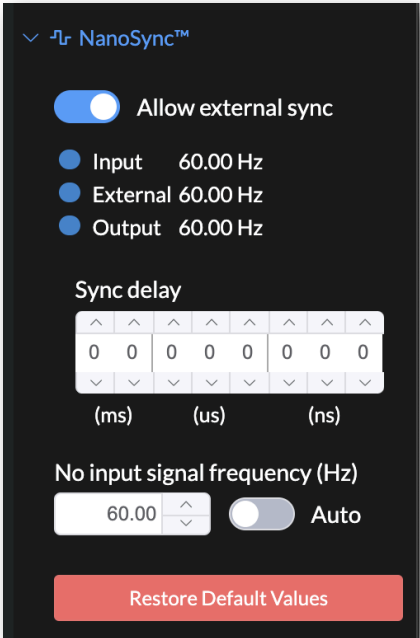


**Figure 61:** Advanced Sync settings

## No Input signal frequency (Hz) – (Advanced)

If the inbound signal is ever lost, HELIOS will continue to output test patterns at the frame rate of the last valid input. There are some cases where it is useful to toggle **Auto** off in order to set the output frequency manually so that test patterns are generated at the frequency of a future valid signal before it arrives.

## Output Window

The input signal is contained within the output window (light grey region with small square handles). The output window allows for sizing and positioning of the inbound video signal using the output window controls. Drag any of the handles (circled below) on the edges of the window to manually resize or use the numerical fields to enter precise values. Generally, the output window size should be set to the aspect ratio of the input signal to avoid distorting the picture.
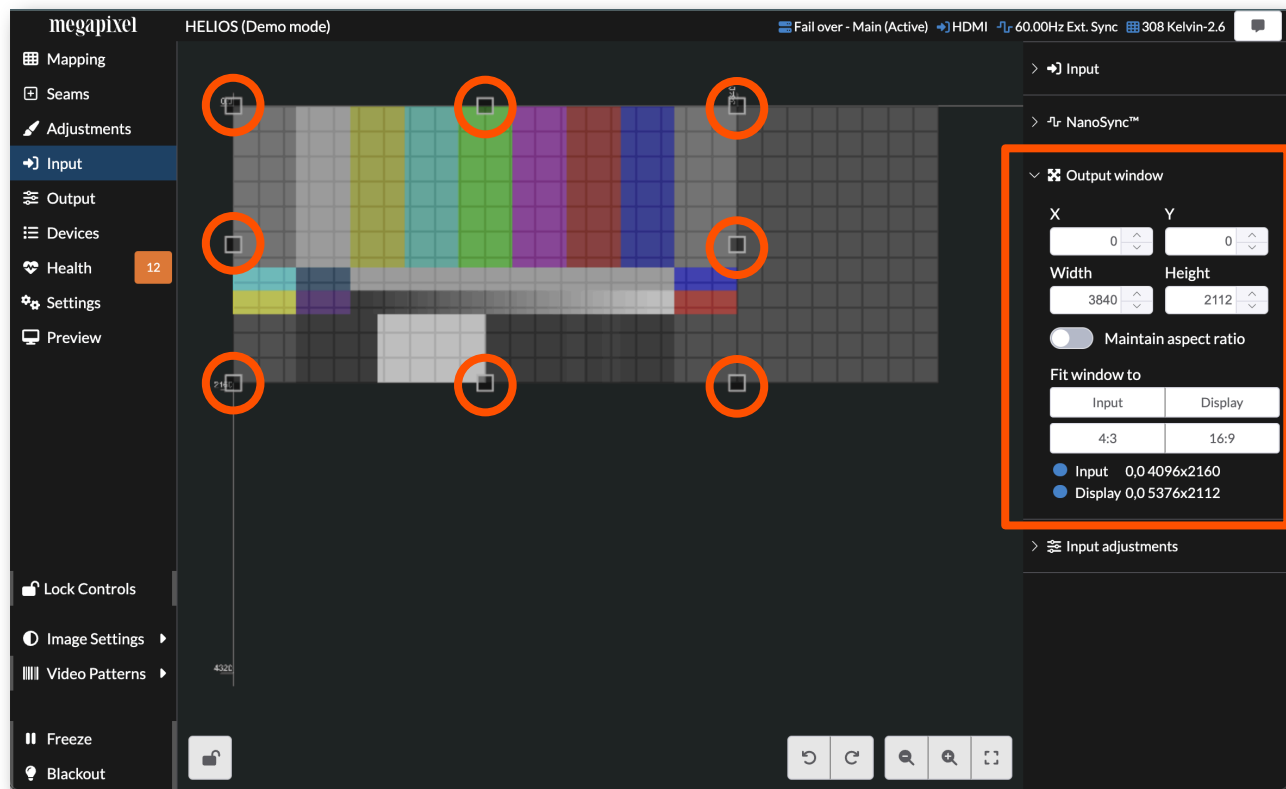


**Figure 62:** Output window

## Canvas Repeat – Output Window (Advanced)

Canvas repeat is useful in cases where multiple screens are driven from one processor and display the same content. Previously, the solution was to layer the mapping (one screen on top of the other). The canvas repeat feature duplicates the content across the canvas so that each screen can be mapped in different regions of the canvas. The advantage is that this separates out the displays in space making it easier to interact with the map for the various displays. In the example below, Canvas repeat has been enabled and numerous copies of the content are visible.
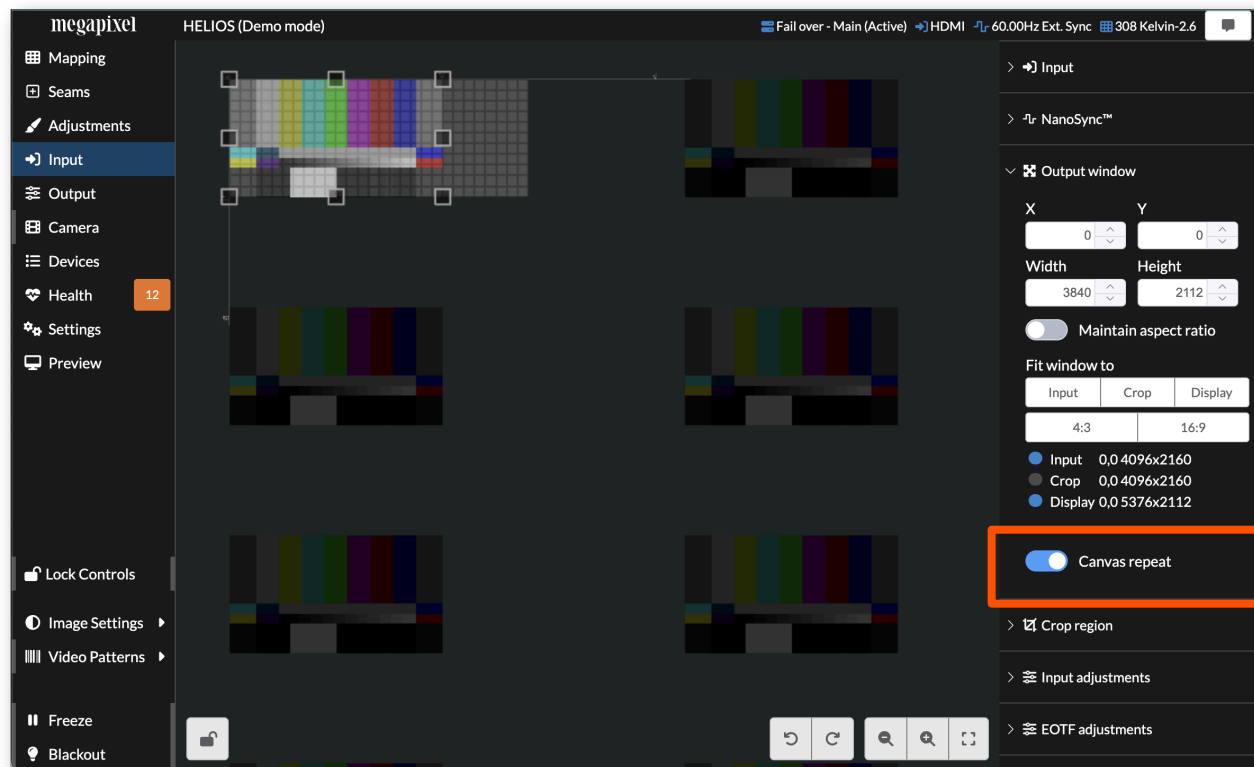


**Figure 63:** Output window

When Canvas repeat is enabled, the **Mapping** pane's tile positioning tools display **X (Local)** and **Y (Local)** controls above the regular **X** and **Y** position fields. Use local positioning to move tiles relative to the copy of the canvas that they are currently using. This tool aims to simplify the positioning of tiles. Each repeated canvas will start at local 0,0. The regular **X** and **Y** position fields can also achieve the same result, but these relate to the entire canvas so there is more math involved with discovering the desired canvas position.
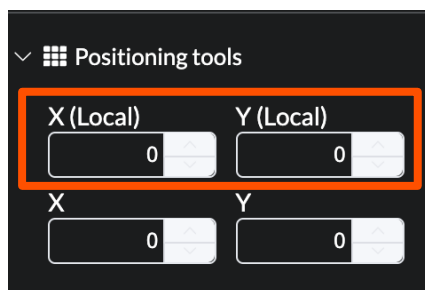


**Figure 64:** Output window

## Crop region (Advanced)

Use the crop function to display only a portion of an input signal. Toggle the Enable Cropping function ON, then enter the size and position coordinates for the crop box.
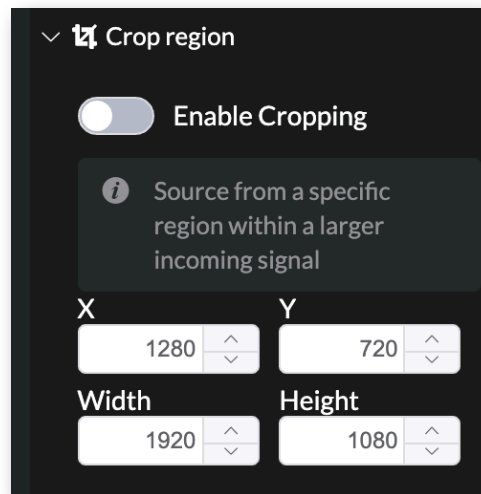


**Figure 65:** Crop region controls

## Input Adjustments

The input adjustments section allows the user to make visual changes (brightness, contrast, saturation) to each of the incoming signals independently. Input adjustment settings are saved separately for each input.
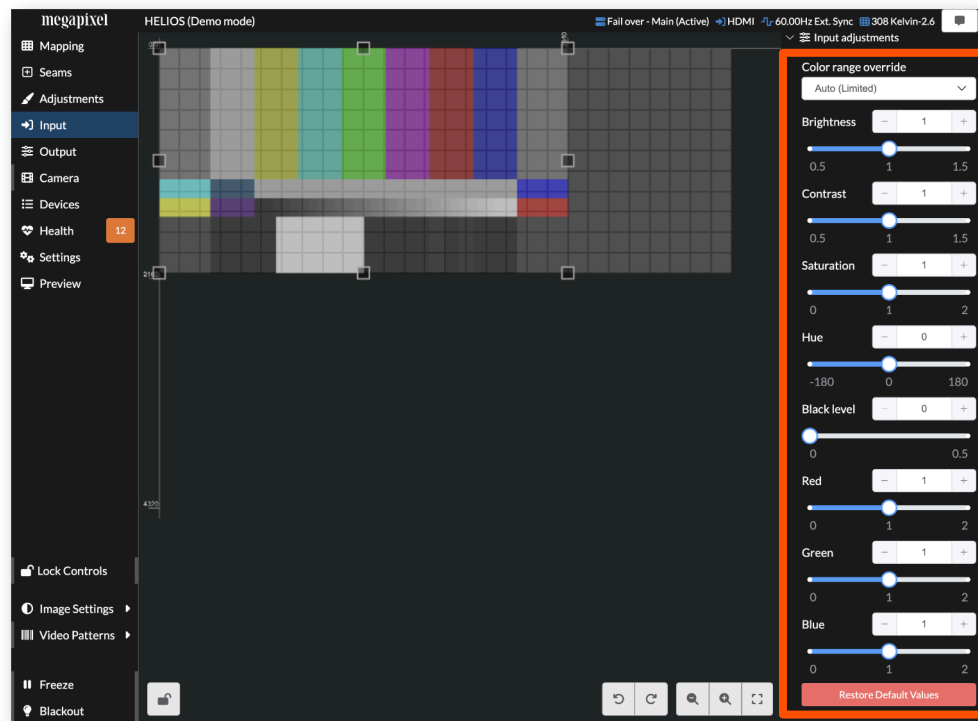


**Figure 66:** Input adjustments

**Brightness** - Adjusts the incoming image to be lighter or darker. First, adjust the brightness to reproduce black correctly then, contrast.

> **NOTE:** This brightness control adjusts the incoming video brightness and should not be used for adjusting the luminance of the display.

**Contrast** - Increases or decreases the differences in brightness across the image.

**Saturation** - Increases or decreases purity of colors. Full desaturation turns colors grey.

**Hue** - Changes the color of the video, re-mapping it around the color wheel.

**Black level** - A combined brightness + contrast control. See **Low Level Noise Reduction** in Appendix D for how this control is used to eliminate low level noise in an image.

**RGB gains** - Boost or reduce the amount of Red, Green or Blue in the image.  Note that these controls are intended for content correction/tweaking. To adjust the RGB levels of the display it is recommended to instead use the **Output > RGB Gains**.

## Input Adjustments (Advanced)

With Advanced mode enabled, the **Color range override** controls will appear as well as the **EOTF adjustments** accordion

**Color range override** – Defines how to interpret the levels of values in the video signal. The range of values used to interpret the video is defined by two quantization ranges, **Auto (Limited)** and **Full**. **Auto (Limited)** video content is contained within (16 – 235) standard for video. In the limited range, 16 and below is treated as pure black and (235 – 255) is treated as pure white. **Full** range video content uses the full (0-255) range (pure black is 0 and pure white is 255). The way that HELIOS interprets the video must match how it was encoded. If this isn't set correctly there can be a complete loss of shadow detail or conversely, washed out highlights. If **Auto** does not identify the encoding correctly, use this toggle to make a manual selection.
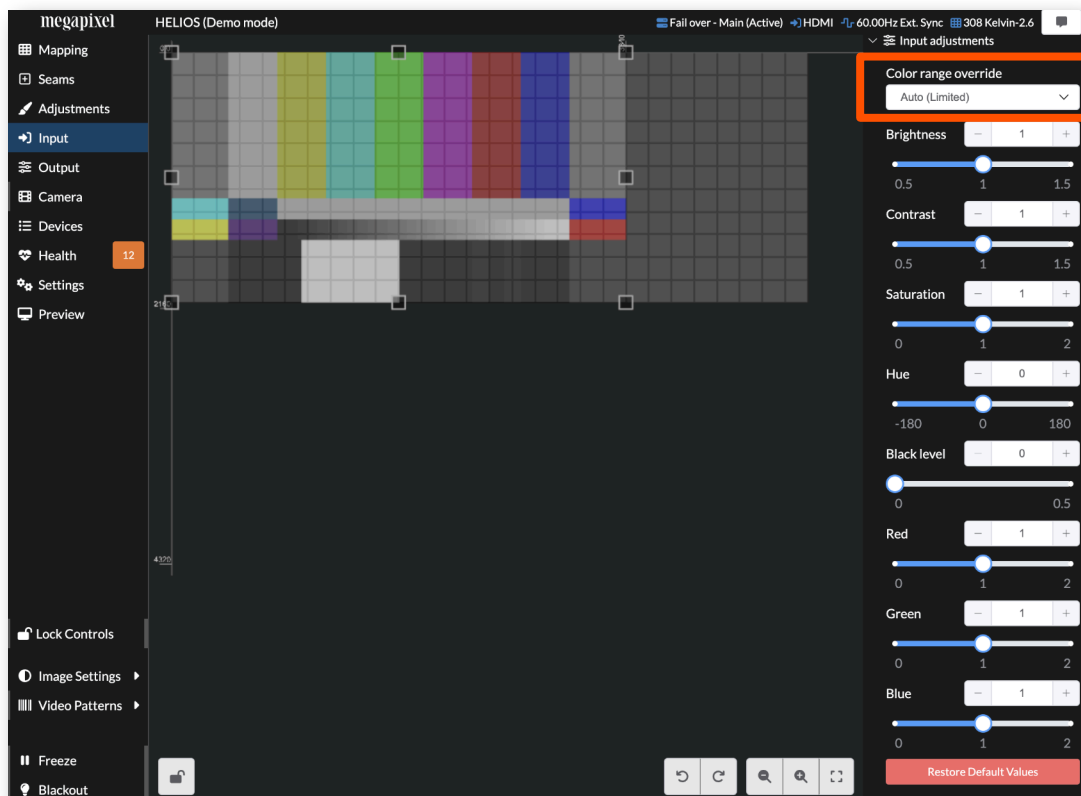


**Figure 67:** Color range override

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**NOTE:** Video routing equipment can change the color range metadata on an input signal. It is good practice to manually set HELIOS onto the correct setting.

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## EOTF Adjustments (Advanced)

The HELIOS EOTF (Electro Optical Transfer Function) adjustments are used to inspect and manually override EOTF settings encoded in the source signal's metadata. If content has a standard dynamic range, it should be interpreted with one of the two SDR options; **SDR (Preserve Details)** or **SDR**. **SDR(Preserve Details)** uses the sRGB curve while **SDR** uses the RAW curve. The correct selection depends on the content. Content encoded with a high dynamic range should be set to the EOTF with which it was mastered. Most HDR content will have a metadata label indicating which transfer function was used. HELIOS with default settings, should automatically recognize and select the correct EOTF for the content.
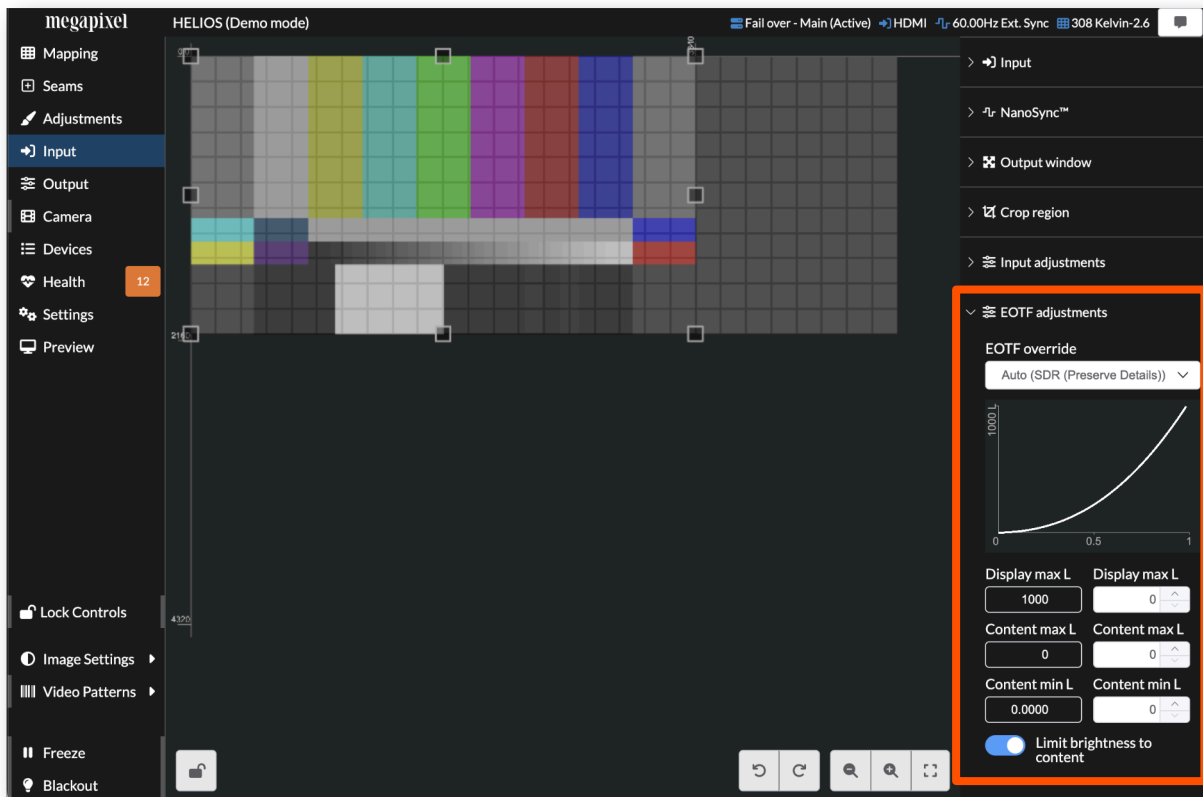


**Figure 68:** EOTF adjustments

**EOTF override** - If HELIOS reports that a PQ signal is SDR when set to **Auto (SDR)** it is possible upstream equipment has stripped the PQ metadata. Use the EOTF override setting to manually set HELIOS correctly.
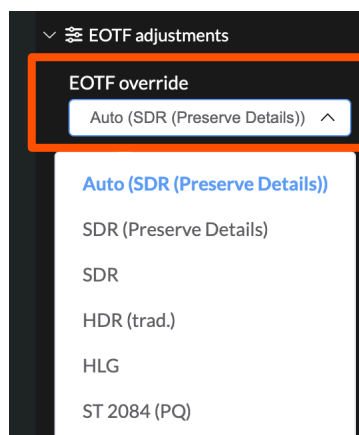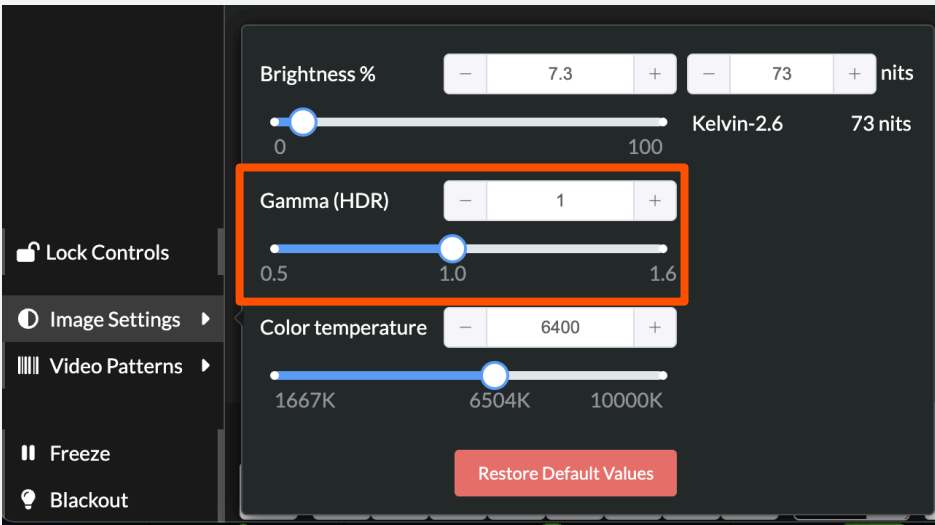


**Figure 69:** EOTF override

## EOTF Adjustments (Advanced) - Continued

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**NOTE:** The visible slider range for global Gamma is re-mapped when HELIOS is operating in HDR so that a nominal PQ gamma is reported as 1.0. In SDR mode, the nominal value for Gamma is 2.4.



**Display max L**, **Content max L**, and **Content min L** are read only values on the left side with manual override fields to the right. Advanced users may enter specific numbers here. If the correct values are not known, keep the field values at zero. The system is in automatic mode when these values are at zero. If non-zero values are entered, keep Advanced mode **ON** so that the values affecting the system are visible.
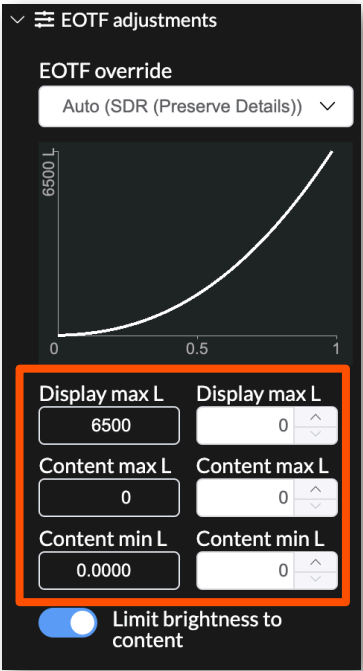


**Figure 70:** Advanced mode adjustments

## EOTF Adjustments (Advanced) - Continued

The PQ curve is defined in nits. As such, PQ content reports a max L (luminance) to HELIOS. In other words, PQ content needs to be displayed at the brightness level at which it is mastered. The graph below the drop down is provided to help explain the relationship between the Content max L and Display max L. If there is a max L mismatch between the content and the display, the graph shows how the mismatch is being handled.

**Example (A)** - **Display max L** and **Content max L** are both 10,000 nits.

**Example (B)** -  **Display max L** is 10,000 nits, **Content max L** is 1,000 nits. HELIOS can show all the content directly 1:1.

**Example (C)** - **Display max L** is 1,000 nits, **Content max L** is 10,000 nits. HELIOS introduces rolloff to preserve highlights.

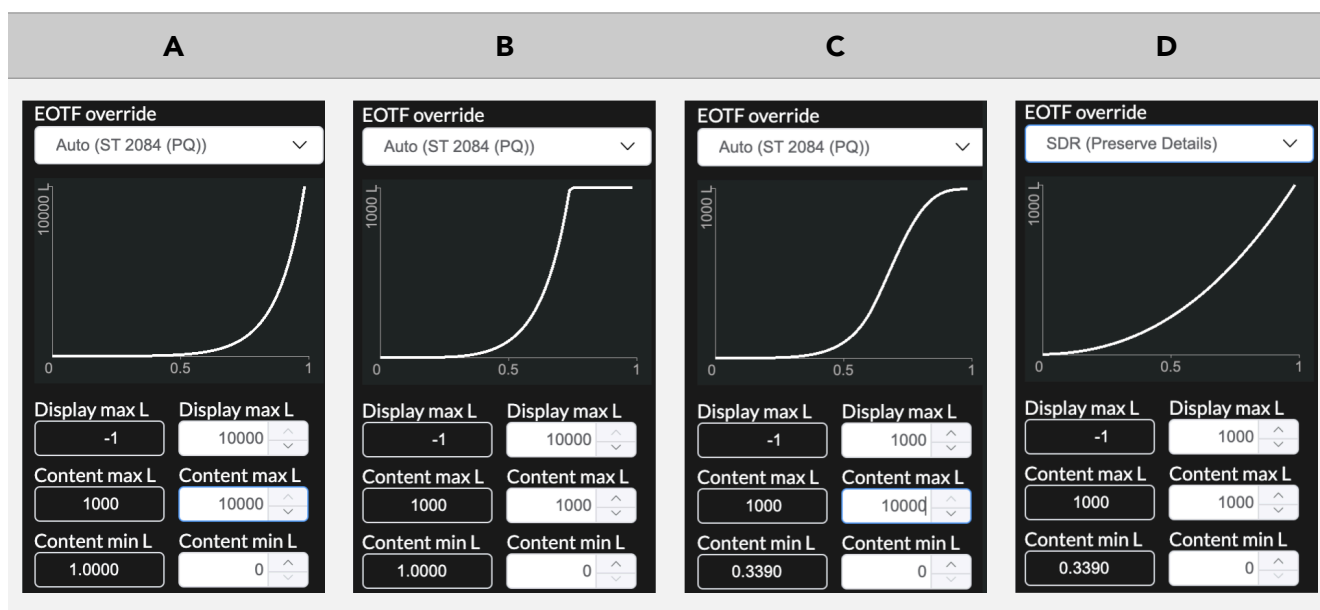**Example (D)** - HELIOS will also show the curves of SDR and other supported transfer functions.



**Figure 71:** EOTF max L graph examples

## EOTF Adjustments (Advanced) – Continued

If PQ encoded content calls for a level that exceeds the capabilities of the tiles, the limit will be the tile's maximum brightness. The Limit brightness to content toggle is available for cases where the content's brightness information is not desired.  If tiles are being limited by PQ encoded content and a brighter display is needed, turn OFF the toggle. The HELIOS will ignore the content brightness and allow the tiles to reach their max brightness.
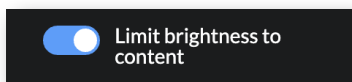


**Figure 72:** Limit brightness toggle

PQ is currently the only signal which advertises and uses content light levels. HLG uses display max L but ignores content levels. The numerical fields are not used for SDR + traditional HDR signals. Display max L is always determined by the connected tiles. Tiles will still respect the Output adjustment > Limit to lowest tile max setting. If it is not set, then tiles should all be at the same brightness regardless of the EOTF. An image settings popup will notify when the Limit brightness to content or the Limit to lowest tile max is being applied. In a scenario where HELIOS is receiving a PQ signal, with content max L set to 100 nits, and the tile max L is 500 nits, the Image Settings adds the words (Limited by content) below the nits value report. If the EOTF is switched to where content max L is no longer used, the input settings message also goes away.



**Figure 73:** Limit message

**NOTE:**

- When the content level is unknown or not advertised, content max L is assumed to be the same as display max L. In other words, content is assumed to have been mastered for the display.

- In the case of mixed tile types, brightness is restricted to the tile type with the lowest peak brightness. Mixed tile type systems are not recommended.

- Please see the section in Appendix E for more information on Content to Panel Luminance Curves.

## High Dynamic Range

HDR on HELIOS is comprised of several features all working together: bit depth, gamut, and decoding with an HDR transfer function. Standard definition content uses the the typical SDR gamma curve. HDR uses an entirely different function to map a higher range of brightness onto a display. HDR is more than just brightness, it also includes a wider range of colors. As such, the system must use, at minimum, 10 bit color. HELIOS should ideally be set to 12 bits if possible. Check that the bandwidth is sufficient under the Outputs pane Display bit depth accordion.

A true HDR end result requires that the entire pipeline, from content to wall, is aligned and capable of supporting HDR.

**HDR Checklist:**

1. The tiles must be capable of a wide gamut.

2. Output gamut needs to be set to Automatic (see the Output pane Display gamut accordion).

3. Content must be encoded in HDR.

4. The playback device must support HDR.

5. HELIOS must receive the signal and recognize it as HDR. Check under the disclosure triangle to see the details of the input signal. In the example below, HELIOS is receiving a PQ signal. If for some reason an HDR input signal is not recognized as HDR, use the manual override discussed on the next page.
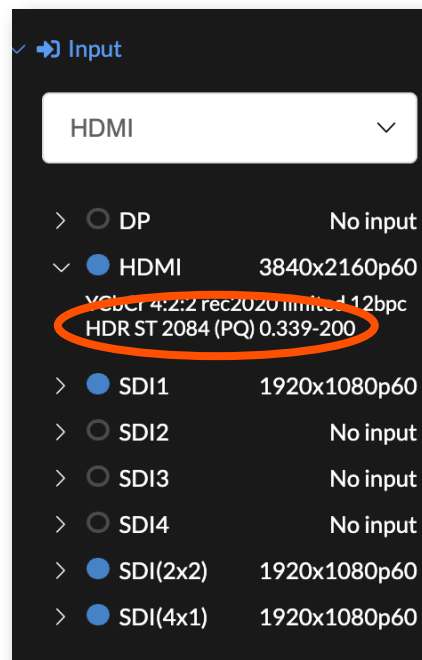


**Figure 74:** Input signal info

---

**NOTE:** When connecting consumer playback equipment such as an Apple TV or an Xbox to be an input source it is important to be mindful that these units default to a 4:2:0 color scheme. HELIOS does not fully support 4:2:0. When HELIOS receives a 4:2:0 color signal, it will send a black and white image to the tiles. Set the input source to 4:2:2 in order to regain full color operation.

---

**Unreal Engine**

Metadata may indicate an SDR signal when Unreal Engine is transmitting PQ content. Unreal Engine takes over the configuration of the outbound video because Unreal Engine prefers to be in control of the encoding entirely in-engine. The Windows video output needs to remain set to SDR. This will cause the HELIOS processor to think that the signal is SDR. If Windows HDR mode is set, it applies an additional encoding to the signal, which is like double-LUTing.

**HELIOS Settings**

• Set the EOTF override to PQ.

• Set the Color range override to Full.

**Unreal Engine Windows Output Settings**

NVIDIA Control Panel > Output resolution settings

• The radio button for Use Nvidia Settings is selected.

• Desktop color depth = 30 bit color

• Output color bit depth = 10 bps

• Color output format = RGB

• Output dynamic range= full

megapixel

# Output Pane

## Display Gamut

The display gamut tool sets the range of each color for the system using CIE1931 chromaticity (x & y) coordinates. Common preset gamuts are available from a drop down menu. HELIOS is set to **Auto (rec. 2020)** in the example below. Just because a system has been set to certain color targets does not mean tiles are performing at those values. The **Target** tab shows the values the system is set to. The **Actual** tab shows tile performance. This data is also represented visually on the dynamic CIE chart.
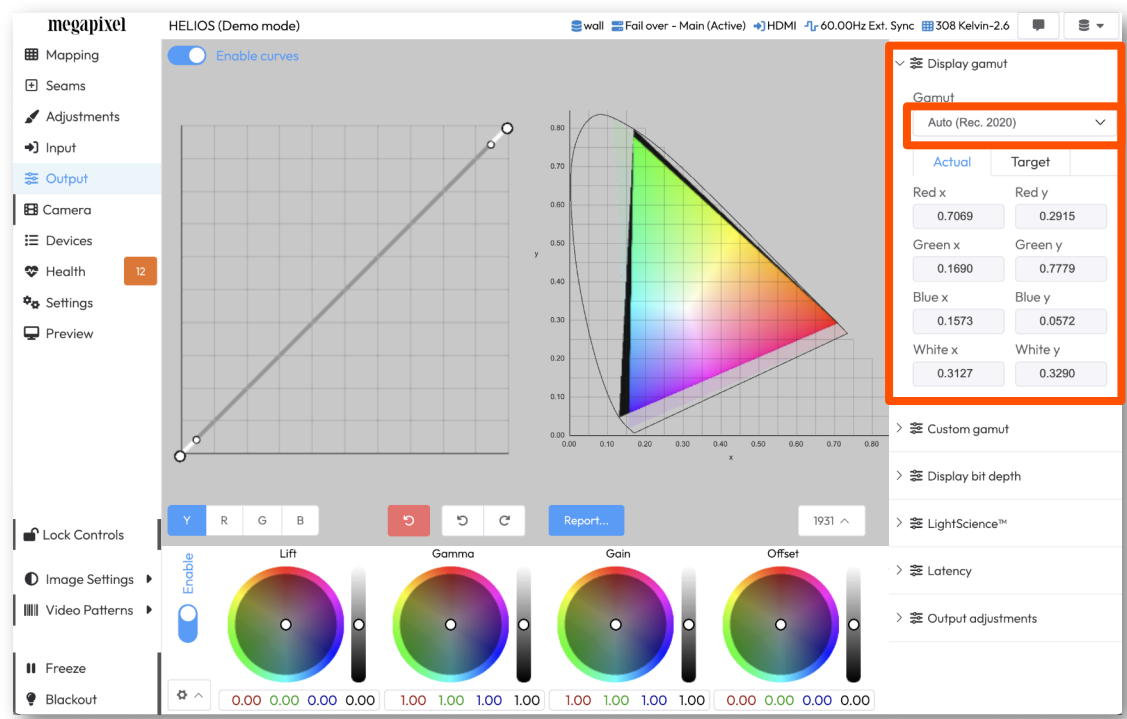


**Figure 75:** Display gamut

On the CIE chart, tile capabilities are indicated by the entire rainbow region, **A + B** (both transparent and opaque regions). The achievable colors for a system are indicated by the **A** center opaque rainbow region. Lastly, a black region **C** indicates colors targeted by the settings that are beyond the capability of the display. If the color targets are set within the display capabilities, this black region will not appear.
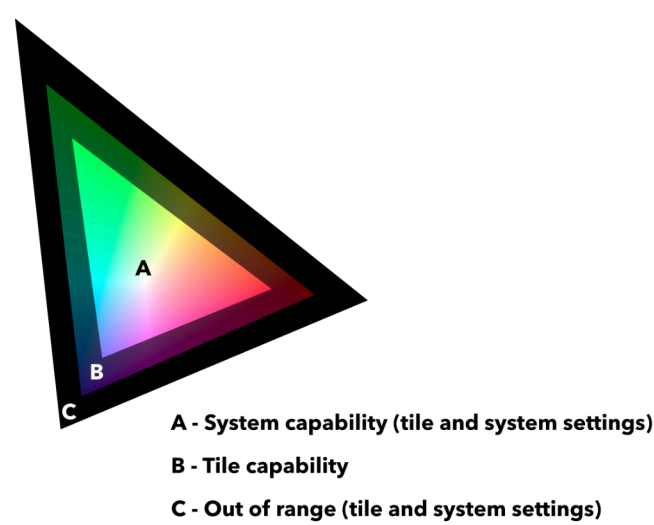


**A - System capability (tile and system settings)**

**B - Tile capability**

**C - Out of range (tile and system settings)**

**Figure 76:** Display gamut chart key

## Display Gamut (continued)

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**NOTE:** When a system made up of more than one tile type, wide gamut tiles can be color restricted by narrow gamut tiles. When a system is made up of mixed tile types, HELIOS is automatically set to **Widest** gamut. HELIOS will determine the widest possible gamut from all connected tiles. This can result in a lowest common denominator color target selection; tiles with wider gamut capabilities will be restricted to the more narrow gamut setting to match all tile capabilities.

---

## Report

HELIOS can generate a **Tile Calibration Report** for a system. Press the blue **Report...** button to open the report in a new tab.
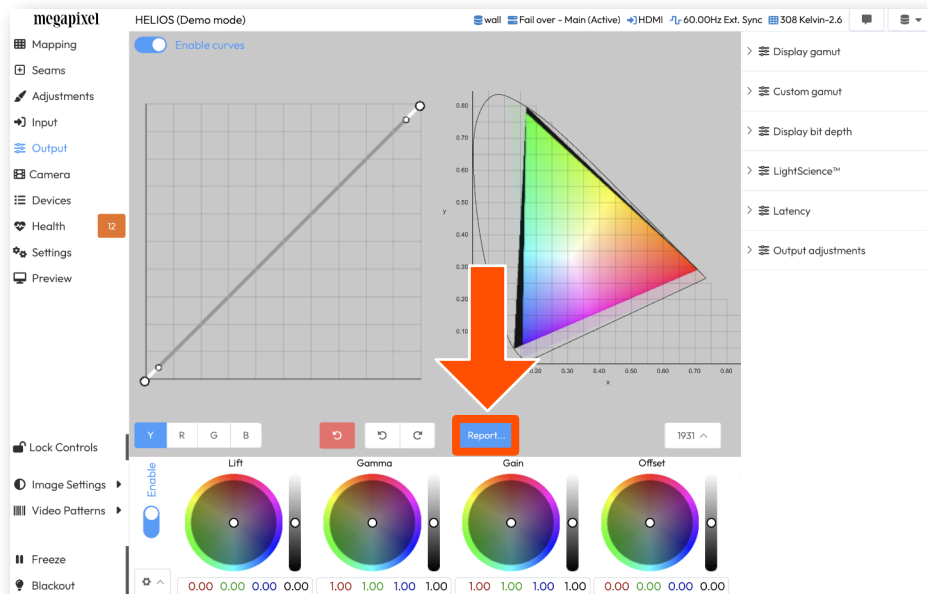


**Figure 77:** Calibration report button

The Tile Calibration Report (shown below) is useful for content creators and colorists who need to know the color capabilities of the system. Use the zoom controls (orange rectangle below) inspect the CIE chart in more detail.
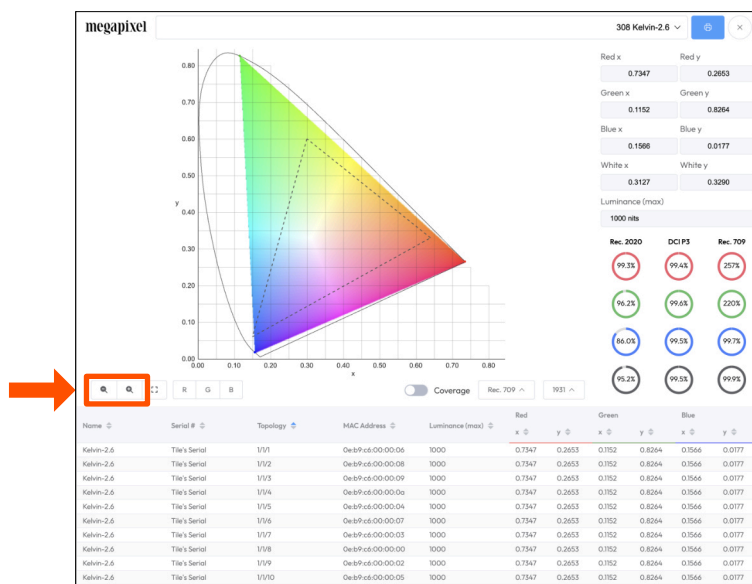


**Figure 78:** Tile Calibration Report

## Custom Gamut (Advanced)

HELIOS supports custom gamut settings. Enable **Advanced Mode** under **Settings > Processor settings > Advanced** to reveal the **Custom gamut** accordion.

1. Set the chromaticity coordinates in the **Custom gamut** accordion.

2. Press **Apply custom gamut**.

3. Selected **Custom gamut** from the **Gamut** drop down. The chromaticity coordinates under the **Target** tab should match the custom gamut values.



**Figure 79:** Custom gamut settings

## Display bit depth

The system can operate at 10 bit or 12 bit. This menu controls the current setting and shows per-port bandwidth percent utilization. 12 bit operation is recommended. Selecting 10 bit operation will reduce bandwidth utilization.
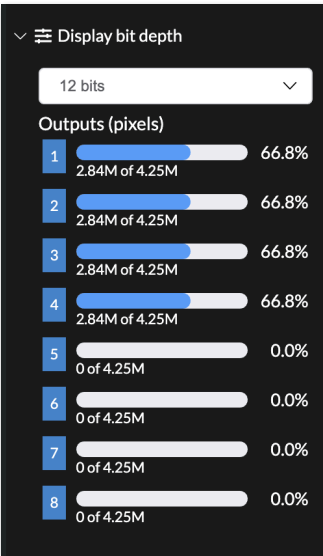


**Figure 80:** Display bit depth

## LightScience™

Low light levels and shadow detail can be challenging for LED displays to reproduce. HELIOS can drastically improve the visual appearance of these near-black video regions by expanding the bit depth of each tile. With LightScience enabled, the proprietary algorithm will increase bits per color to 21 or as high as 32 bits per color.
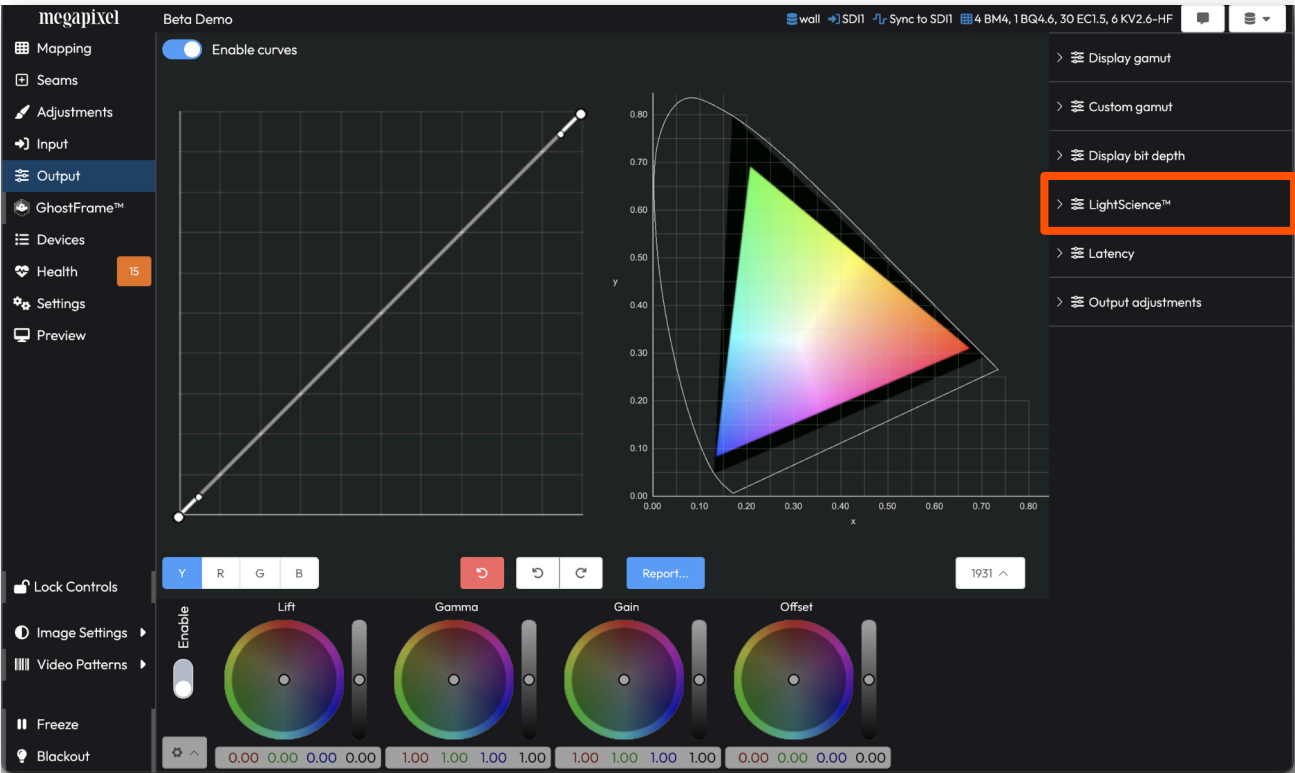


**Figure 81:** LightScience

## Output Pane (Advanced)

With Advanced mode enabled, HELIOS displays two separate interfaces for color grading, a curves graph and a set of color wheels. In the HELIOS processing pipeline, these two tools are applied sequentially. Any adjustment made by the color wheels will come first, followed by the curves. Below is a simplified color processing pipeline diagram for the entire HELIOS system.
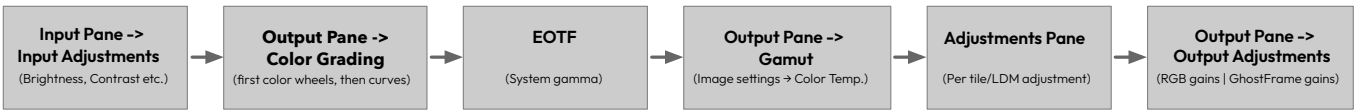


**Figure 82:** HELIOS color processing pipeline

## Color grading tools - Curves

HELIOS offers curve control for luminance (**Y**) and the primary colors (**R**ed, **G**reen, and **B**lue). Select which curve to control from the **YRGB** radio buttons at the bottom of the curve graph.
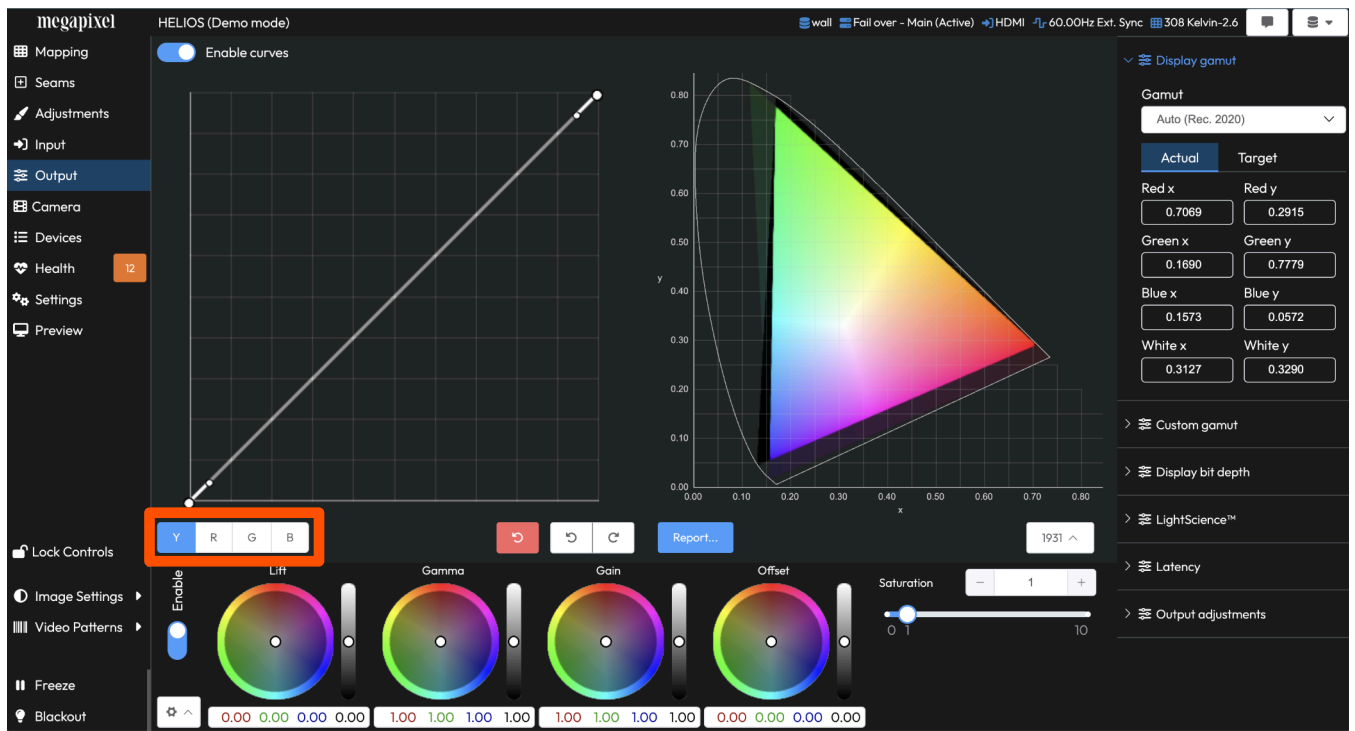


**Figure 83:** Color grading curves

## Color grading tools - Curves (continued)

The curve controls provide adjustment of the image based on tonality regions. The bottom of the graph represents the shadows, the middle are the mid-tones, and the top the highlights. Highlight and shadow points exist by default. Click on the graph to create additional region control points. Place region control points at the boundaries of regions to isolate tonalities. Move the region control point up/down to adjust the region lighter/darker.
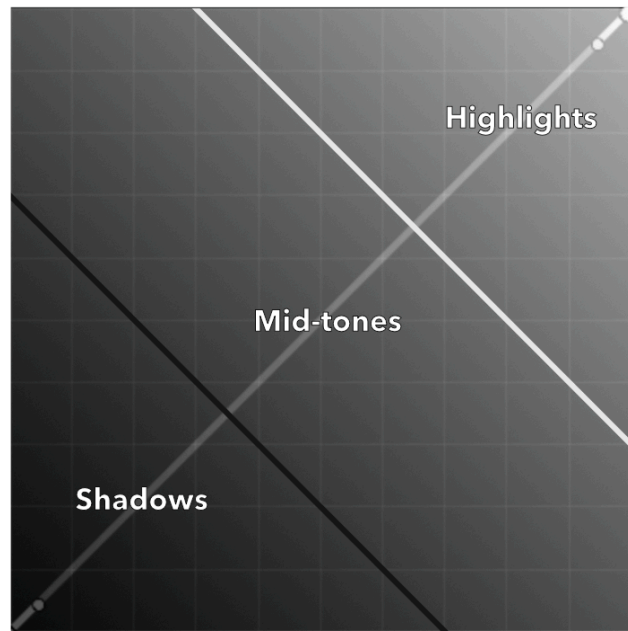


**Figure 84:** Control regions

Region control points have a transition control handle. In the example image below, the red arrow is pointing at the region control point. The green arrow at the transition control. The slope of the transition control sets the steepness/smoothness of the transition into and out of a tonal region.
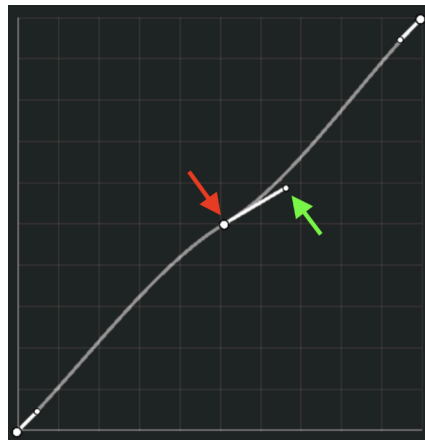


**Figure 85:** Control point slope

## Color grading tools - Color wheels

In addition to curve controls HELIOS has four color wheels for adjusting Lift, Gamma, Gain, and Offset. Each color wheel controls a particular range of tones (shadows, mid-tones, and highlights). When the position of the point on the color wheel is adjusted, HELIOS shifts the hue of the tones towards the selected color. Use the grey slider next to the color wheel to adjust the color brightness.

**Lift** - Dark tones and shadows

**Gamma** - Mid-tones

**Gain** - Highlights

**Offset** - Overall image control

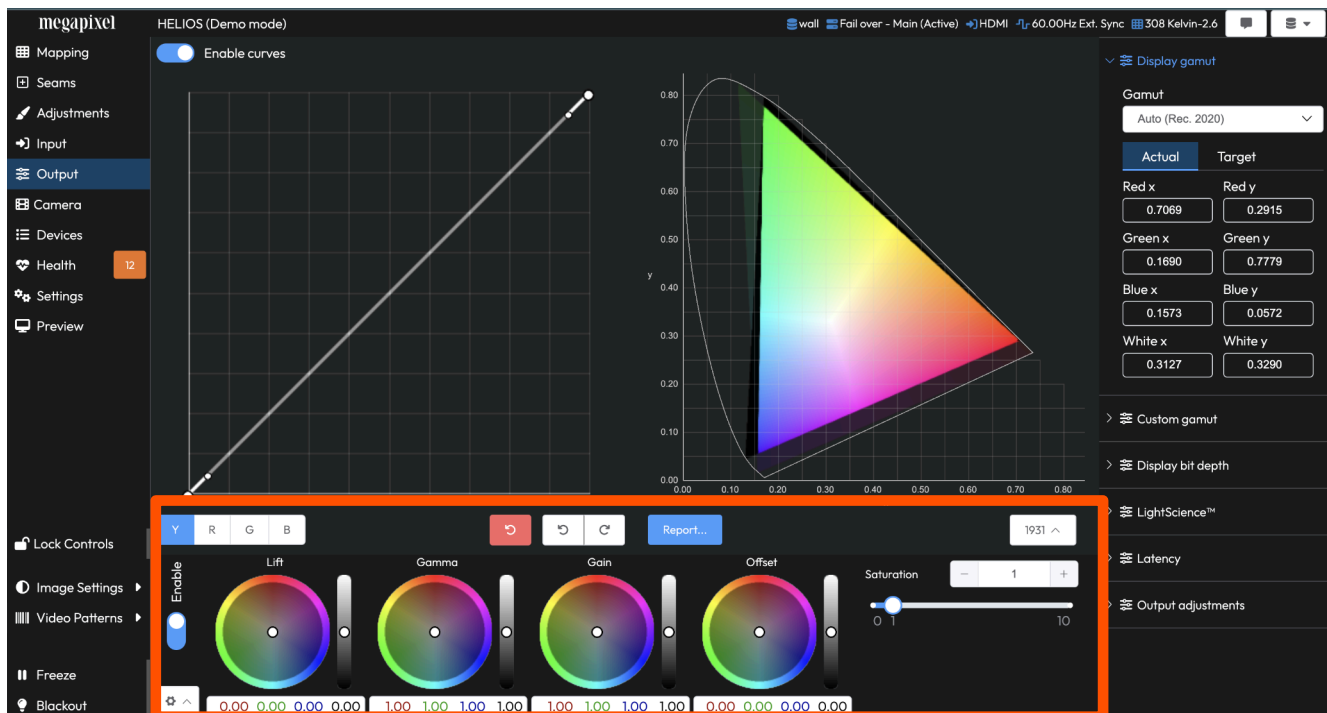**Saturation** - Increases or decreases overall purity of colors. Full desaturation turns colors grey.



**Figure 86:** Color grading color wheels

## Ultra Low Latency (Advanced)

HELIOS Ultra Low Latency (ULL) allows for as low as one (1) frame of delay through the entire system chain without the need for custom EDIDs or high frame rates from the source. In order to access Ultra Low Latency mode, enable **Advanced Mode**. A hidden accordion menu will appear on the Output pane. Enable ULL mode with two toggles; **Tile low latency** and **Processor Low latency**. Tile low latency reduces latency by one (1) frame. Processor low latency independently reduces latency by one (1) frame. Enabling both reduces latency in the system by two (2) frames. The example interface shown below reports **2.0 frame(s)** of latency in the system. With both latency modes toggled on, latency should report 1.0 frame of delay.

HELIOS is operating in ULL mode when both **Tile Low Latency** and **Processor Low Latency** are toggled on.

1. Toggle **Tile low latency** ON. The only restriction here is the tile firmware must support ULL.

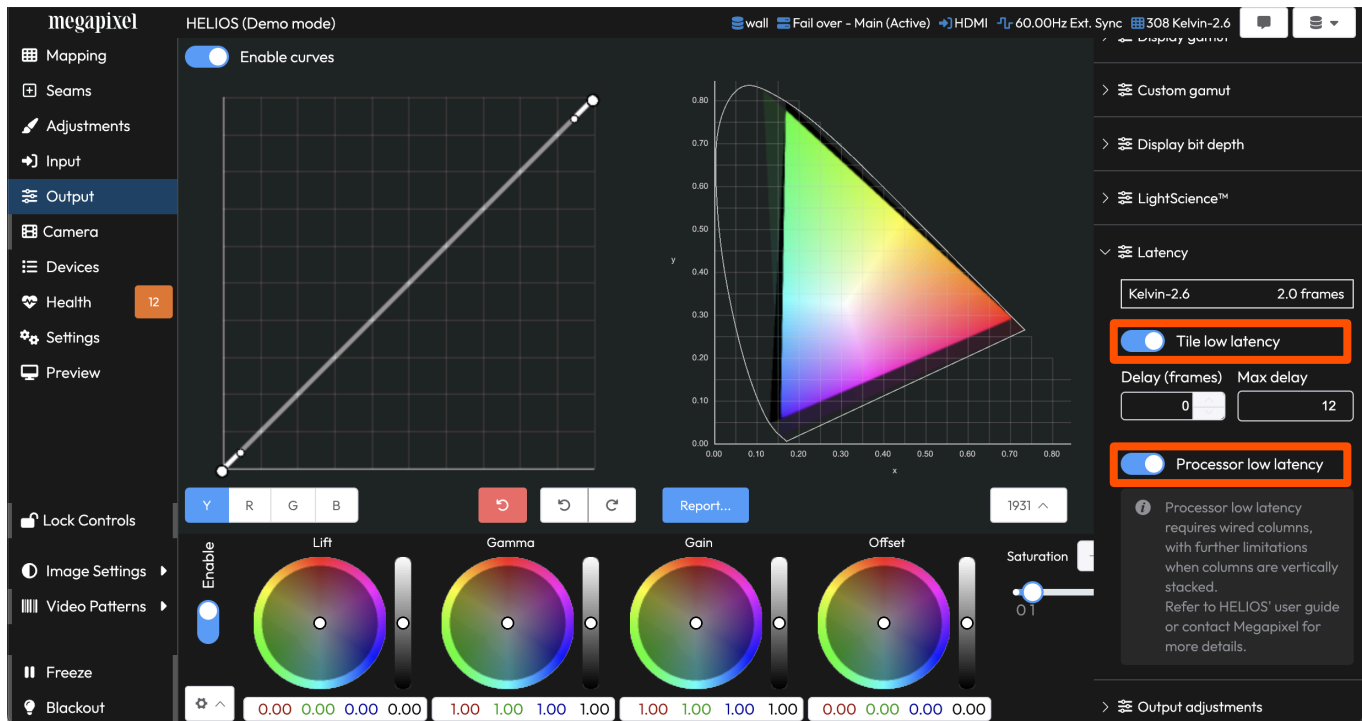2. Toggle **Processor low latency** ON. Stacked column restrictions apply (see next page).



**Figure 87:** Ultra Low Latency settings

## Ultra Low Latency (Advanced) – (continued)

**Key rules:**

- Processor Low Latency is compatible with GhostFrame. When using multiple inputs with GhostFrame Multi-Source, the inputs must be horizontally stitched. As an example, configure SDI as a (2x1) rather than a (1x2). See the Input stitching section for more information.

- Vertical stitching of inputs and Square Division are not supported.

- Tile cabling and mapping must be in columns (top to bottom and bottom to top are both ok).

There are no capacity limitations or reductions when tiles are cabled as a single column high. Therefore, tile quantity per daisy chain is no different than normal (see the HELIOS Output Port Capacity section in **Appendix J**) for data daisy chain limits). In the example below, the tile type has a maximum daisy chain of six (6) tiles. Although some tile types can achieve larger daisy chains, this example is limited to six (6) for simplicity.

- Stacked columns (e.g. a wall that is taller than the maximum tile chain length) will have capacity reductions. The rule of thumb is that when columns are stacked, the maximum string length is halved from that of normal operation. The example tile type at normal operation has a maximum daisy chain of six (6). In a stacked configuration, the system requires chains of three (3). Additionally, only the top ½ of the input may be used. For more specific design guidelines contact Megapixel for assistance.
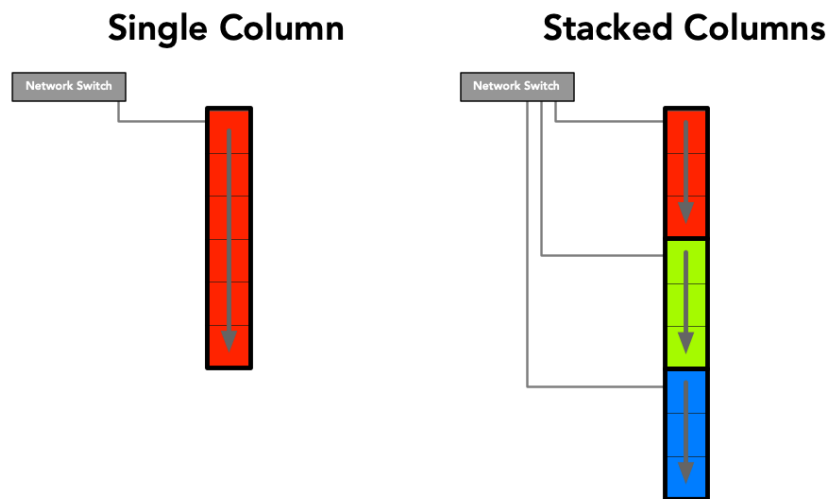


**Figure 88:** Single Column vs Stacked Columns

## Ultra Low Latency (Advanced) - (continued)

Below are four test results with Low Latency off and on. Using the SDI output of an ImagePro-II* connected to the HELIOS system, the yellow line measures a phototransistor reading the tile's light output. The green line measures, the HD-15 (VGA) output of the same ImagePro connected directly to the scope.

**Yellow** - ImagePRO-II 720p50 -SDI → HELIOS → Tile → Scope (photo transistor)

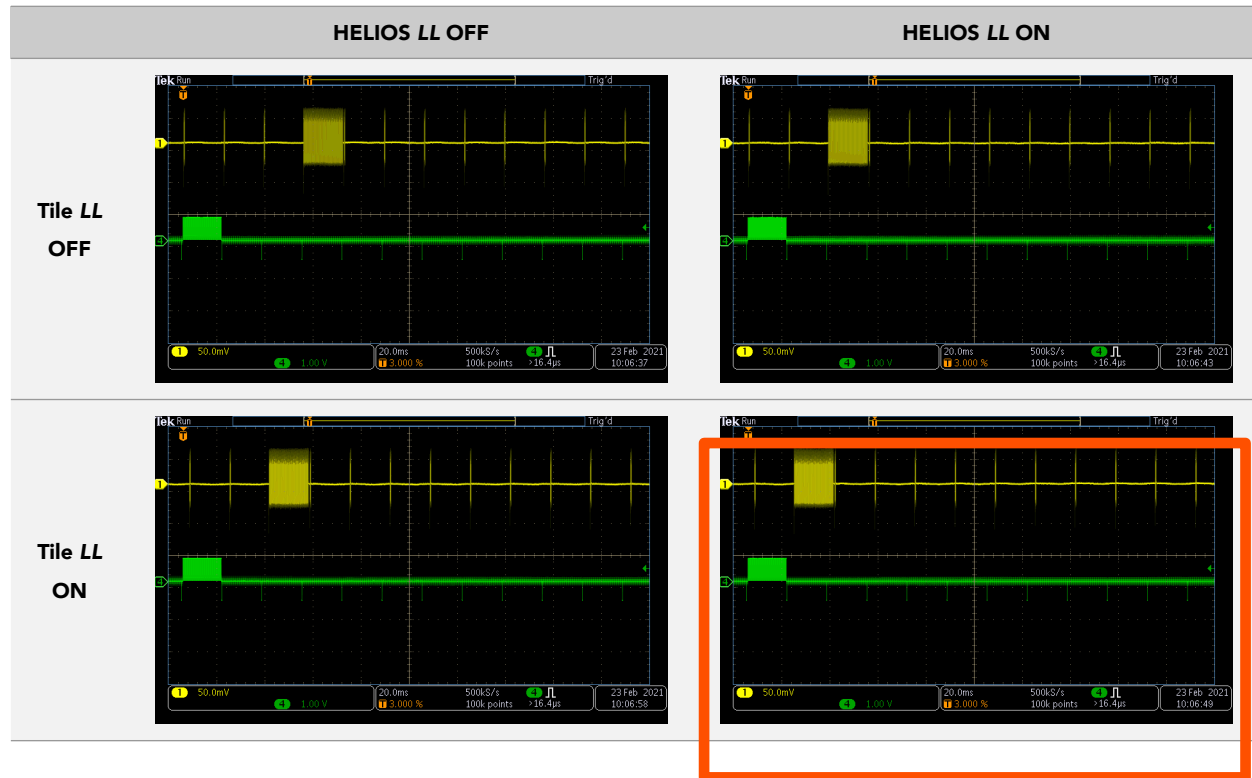**Green** - ImagePRO-II -HD15→ Scope



**Figure 89:** Ultra Low Latency oscilloscope readings

**Top left image** - Both (HELIOS and tiles) LL toggled OFF. Results show, three (3) frames delay.

**Top right image** - Only the HELIOS LL function ON. Results show, two (2) frames of delay.

**Bottom left image** - HELIOS LL OFF and tile LL ON. Results show, two (2) frames of delay.

**Bottom right image** (Orange) - Both (HELIOS and tiles) LL toggled ON (This is Ultra Low Latency enabled). Results show, one (1) frame of delay.

\* The ImagePro-II is a registered trademark of Barco.

## Output adjustments (Advanced)

**RGB gains** – Controls overall tile color gain. This is the final color adjustment point in the HELIOS color processing pipeline.

**Black clipping** – Sets the black threshold. At zero the content will be displayed as it is encoded. Increasing the black clipping value will increase the portion of the content that is pure black. See the Low Level Noise Reduction section in Appendix D for a discussion on how to use this control.
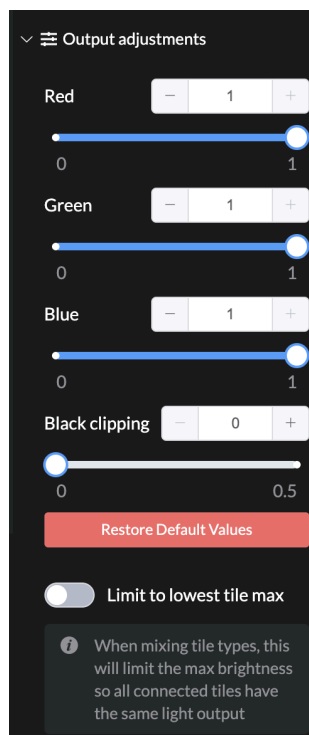


**Figure 90:** Output Adjustments (Advanced)

**Limit to lowest tile max** – Helps in situations where mixed tile types form a contiguous display. HELIOS can restrict the brightness of all tile types to the limit of the tile with lowest max brightness. HELIOS calculates this in two stages. First stage sets the tile target L to the lowest tile when the **Limit to lowest tile max** is set. Then, the second stage will further reduce the brightness based on the PQ content max if the **Input pane > EOTF adjustments > Limit brightness to content** is set. The **Image Settings** menu will add the message (**Limited by lowest tile max**) below the nits report when this function is active.
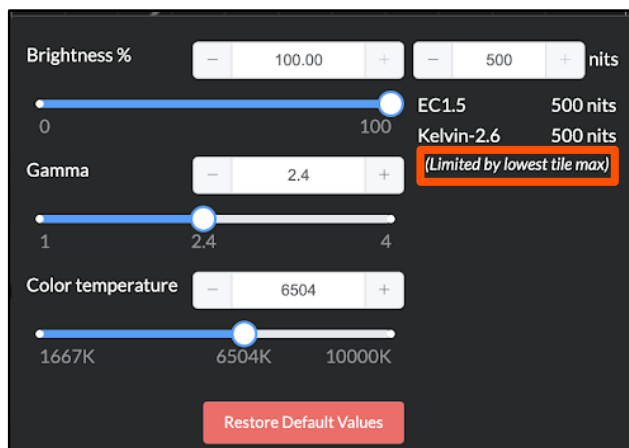


**Figure 91:** Image Settings message

# GhostFrame™ (Advanced)

GhostFrame is a tool for the motion picture and virtual production industries that takes advantage of the high refresh rates of LED displays to interleave content for cameras with content meant for human vision. LED display panel refresh rates are usually many times higher than the video input frequency. With content usually delivered at 60Hz there is plenty of time for HELIOS to add several sub-frames (up to the tile limit) to the primary video signal. These sub-frames can be solid colors, still images and even secondary video feeds to support digital production tools like chroma key or motion tracking. GhostFrame gives the user control of where in time each sub frame is placed, and the luminosity of the frames. GhostFrame's patented process makes the secondary video feeds, chromakey, and tracking markers all invisible to the human eye and free of any flickering or strobing. Multiple cameras can capture independent images simultaneously as camera shutters are put in phase with different frames.

System bandwidth is unaffected by the use of still images, chroma key frames, and inverse images. These are all handled on the tile's processor. It is the video streams which are bandwidth costly. If a GhostFrame configuration makes use of two video streams, the overall system bandwidth is halved.

GhostFrame requires compatible LED tiles. Currently, GhostFrame is available on ROE Visual and Megapixel display products.
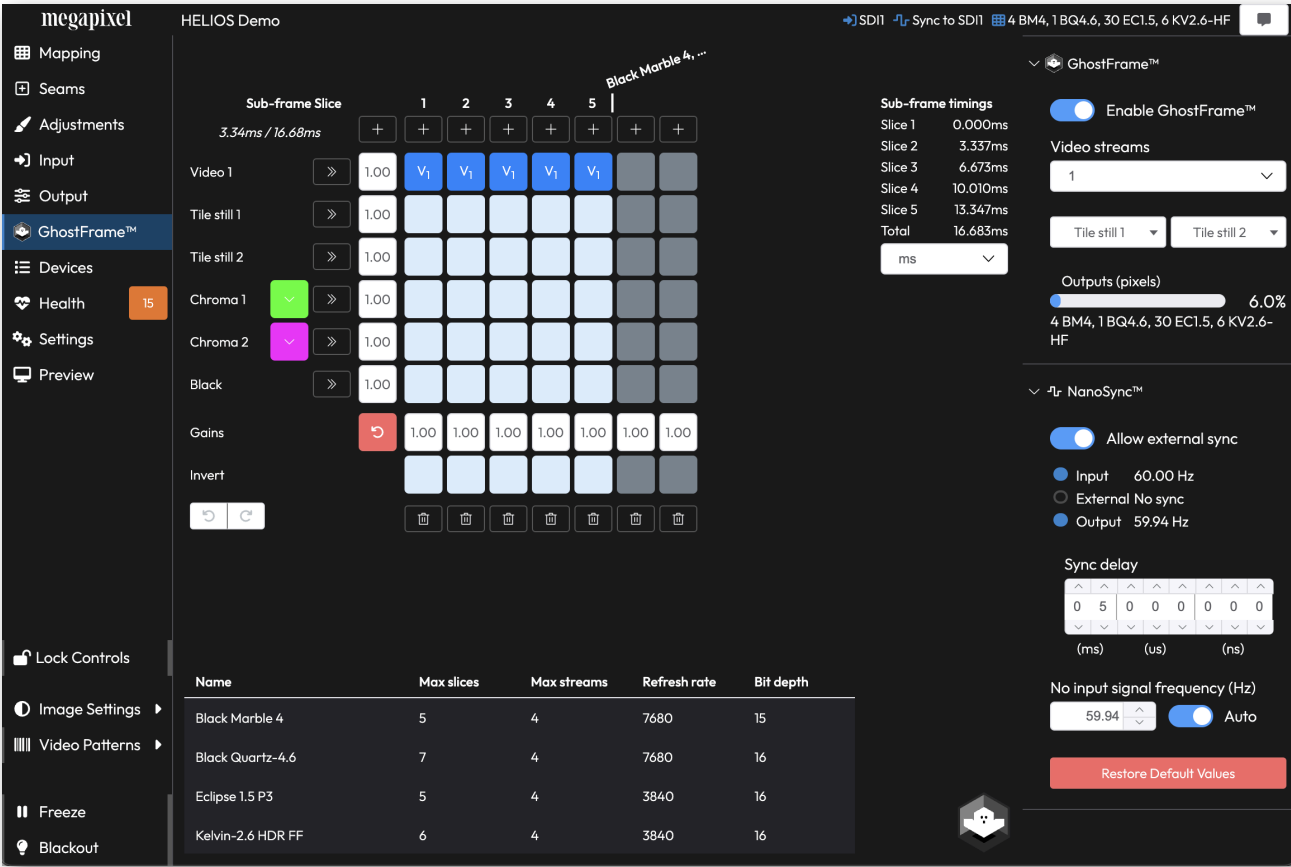


**Figure 92:** GhostFrame interface

**NOTE:** Tile test patterns disable GhostFrame. Tile test patterns and tile Identify are mutually exclusive to GhostFrame.

## GhostFrame™ Licensing

GhostFrame features require a separate license to activate.  There are four (4) different types of licenses.

Four different licenses:

- Camera (default unlicensed)
- Camera+ (expanded Camera features)
- GhostFrame
- GhostFrame Demo

The table below describes the available features for each license.

| Feature | Camera | Camera+ | GhostFrame | GhostFrame (Demo) |
|---|---|---|---|---|
| Chroma | ✓ | ✓ | ✓ | ✓ |
| Slices | ✓ | ✓ | ✓ | ✓ |
| Inversion | X | X | ✓ | X |
| Inversion (watermarked) | X | X | X | ✓ |
| Still Store | ✓ | ✓ | ✓ | ✓ |
| Multi Stream | 2 | 4 | 4 | 4 |

More information about licenses can be found in the Settings Pane **Licensing** section. Please see **http://ghostframe.com** for additional details.

## GhostFrame™ Configuration

The GhostFrame menu is hidden by default, in order to use GhostFrame, enable **Advanced Mode**. Once Advanced Mode is enabled, GhostFrame will appear in the navigation bar on the left. Select the GhostFrame pane to reveal the controls. The accordion on the right side of the page contains the main settings for GhostFrame. The **Enable GhostFrame** toggle enables/disables GhostFrame system wide. Once GhostFrame has been enabled system wide, use the GhostFrame toggle on the Mapping pane to enable/disable individual tiles or groups of tiles.
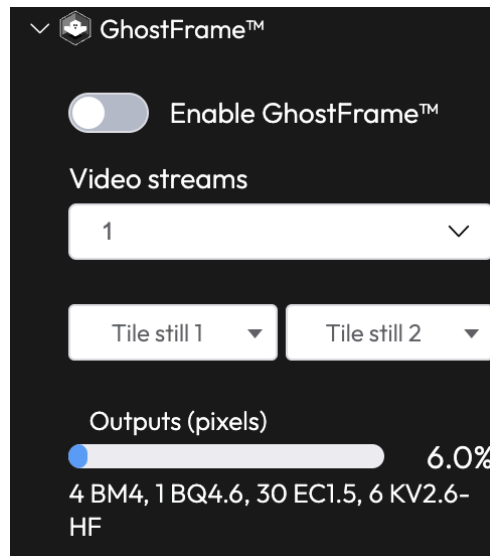


**Figure 93:** GhostFrame controls

The Video streams selection box is used to select the number of streams to use (remember multiple streams use more bandwidth!). **Tile still 1** and **Tile still 2** allow the user to capture a single frame of the live input to be used as a video slice. Captured frames are stored in a tile's volatile memory. If tiles are rebooted, any stored stills will be lost. Similarly, each tile will only store its portion of the video frame. If the tile(s) are re-mapped, the still frame needs to be re-stored. The **Sync** section allows the user to enable or disable external sync, add a delay to the sync, and set the internal refresh rate if there are no active inputs.

The Outputs (pixels) reports the current total pixel load as a percent of capacity.

---

**NOTE:** When using multiple input sources with GhostFrame Multi-Source in combination with **Processor Low Latency** the input sources must be stitched horizontally. As an example, configure SDI as a **(2x1)** rather than a **(1x2)**. See the **Input stitching** section for more information.

# GhostFrame™ Configuration (continued)

The canvas section of the GhostFrame controls (center of the web UI) has a grid of square buttons that are used to activate and assign content to slices. The rows are the various slice type options while the columns represent each individual slice as they occur in time from left to right. Higher input frame rates mean fewer available sub-frame slices. Slices should be chosen based on desired features and camera frame alignment requirements. In some cases it may be better to choose less slices. Having less slices is better in cases where it aligns the number of slices with a multiple of the camera exposure time (consider 2/3 vs 3/4 ). Interleaving the various image options allow the user to hide slices in the video from the human vision that are at exact timings for camera shutters. While all of this is happening behind the scenes, the performer will see a normal video output on the LED wall.

To be optimal for human vision, GhostFrame relies on symmetrical timing. If the slices are not temporally balanced, the audience will see an unpleasant pulsing. To illustrate this, let's pretend like we have six (6) slices available. If the slices are configured as in example 1 below to have a Chroma key and inverted Chroma key, the unbalanced frame can give the audience an unpleasant strobing effect. This is due to 3x 'Video 1' slices in a row then 1 Chroma + 1 Chroma Inverted. To correct this, work towards evenly spacing the Chroma keys across the frame (example 2 below). This eliminates the unpleasant pulsing by giving the human vision even intervals to blend the Chroma frames. Consult your GhostFrame integration partner for configuring and aligning camera capture for use with appropriate GhostFrame sub-frame slices.



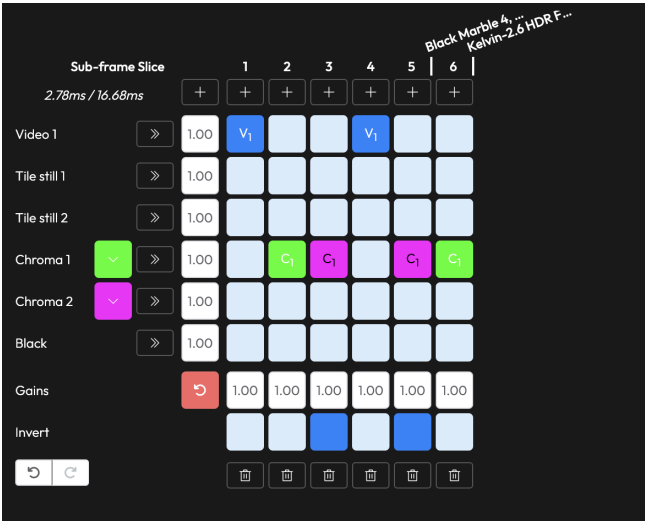**Figure 94:** GhostFrame configuration (example 1)



**Figure 95:** GhostFrame configuration (example 2)

## Sub-frame Slice Gains

Click on a gains button (orange arrow below) to open the Sub-frame gains control window. By default, the gains button reads **1.00**. The gains value is intended to help the user to quickly gauge the net effect the gains settings. The value represents the cumulative effect that the gains sliders are having on the Sub-frame slice. If the gains sliders are increasing the slice gains, the value will be greater than 1.00. If the controls for the group are decreasing the slice gains, the value will be less than 1.00. Use the red reset arrow button to return all gains to 1.00.
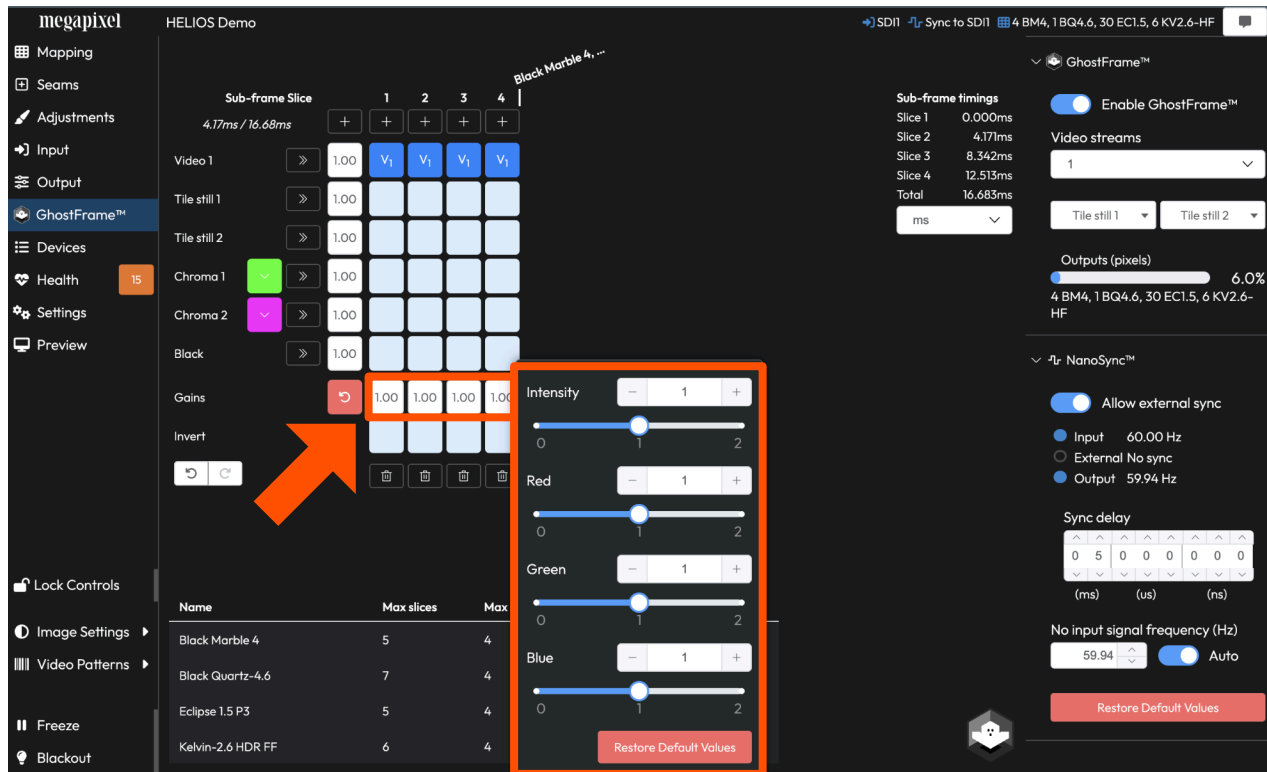


**Figure 96:** Sub-frame Slice Gains

## Video Streams

Below are examples of a 4K canvas (grey area below). The small orange rectangle represents a mapped tile. Inputs are mapped to this canvas.
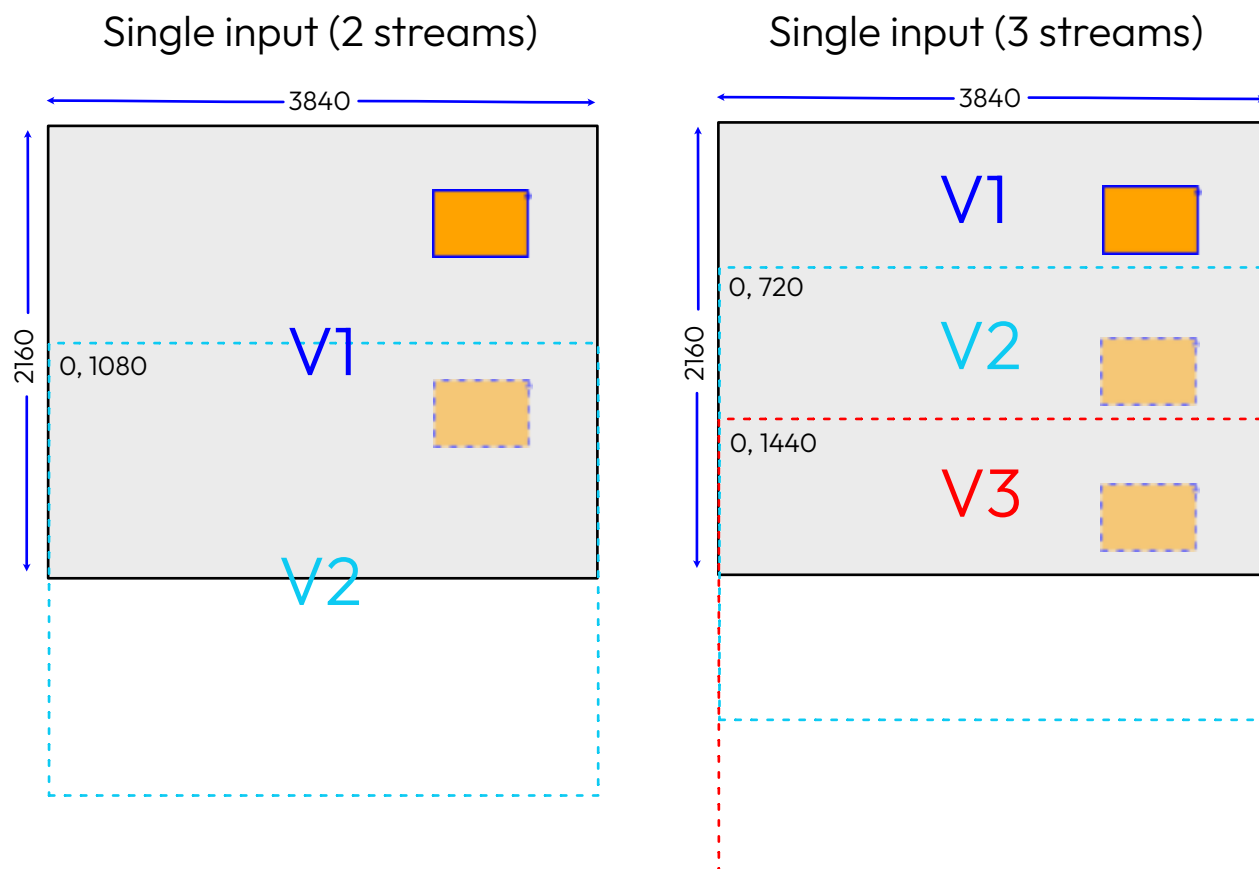


**Figure 97:** GhostFrame video streams

When two streams are selected, HELIOS offsets the second stream vertically by half of the canvas height. This way, the first stream contains the full canvas (as before), and now HELIOS has a second stream containing the bottom half of the canvas. The mapped tile will show content from the top orange section for the GhostFrame V1 slices and the bottom dashed orange section for the V2 slices. Think of the tile as being mapped within each of the dashed sections (V1/V2) ,but then showing its data from the underlying canvas (grey background).

When the number of video streams is set to 3. HELIOS offsets the V2 stream by a third of the canvas size, and the V3 stream by two thirds of the canvas size. So, V1 will show the top section, V2 will show the middle section, and V3 the bottom section.

Notice that the GhostFrame video streams have nothing to do with the input. It's all relative to the canvas.

The point of this technique is that it allows a user to show different feeds on the panels at different points in time. With this system, the user can send multiple feeds into HELIOS. HELIOS will then combine these feeds into the same canvas. GhostFrame is used to split the feeds back out again temporally. The end result is a direct mapping from input to offset video stream output.

## Video Streams (continued)

Below is shown what happens when HELIOS is given two inputs and GhostFrame is set to two (2) streams. The second stream is offset half way down the canvas, and the second input is also placed in the second half of the canvas. This results in V1 showing content from the first input and V2 showing content from the second. All of this happens in the background and allows the HELIOS to use one canvas to interleave multiple video streams.
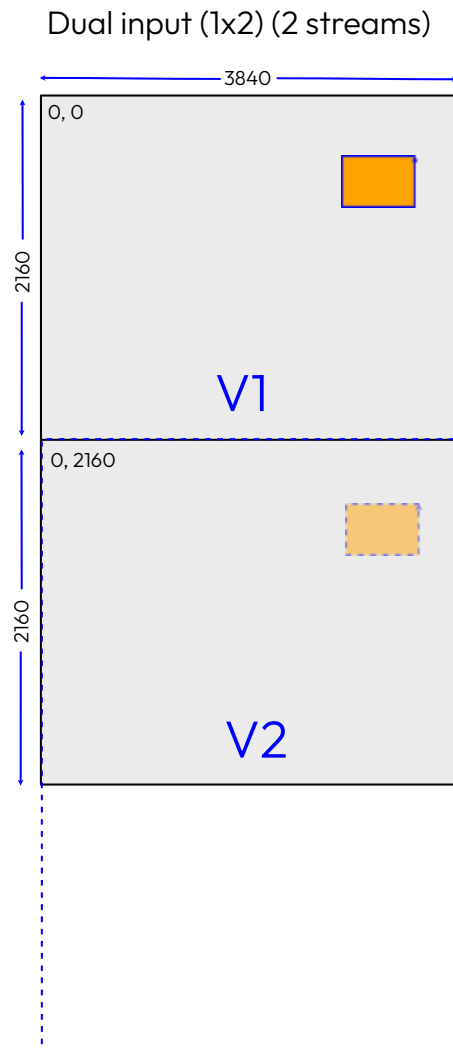


**Figure 98:** Dual input stream position

**NOTE:** Tiles can opt out of GhostFrame and be set to display any of the video streams. See **GhostFrame™ Opt Out** in the **Mapping> Tile configuration** section for more information.

## Camera (Advanced)

Without a GhostFrame license, HELIOS will display the Camera pane. The Camera pane is a limited subset of the full GhostFrame tools. As such, all of the rules and methodology discussed in the previous section of GhostFrame apply to Camera. Camera+ licenses are available for those looking for additional streams. The **GhostFrame licensing** section earlier in this user guide has a table of GhostFrame licenses and the features available with each. The Camera pane is most often used for aligning camera shutters to colored slices.
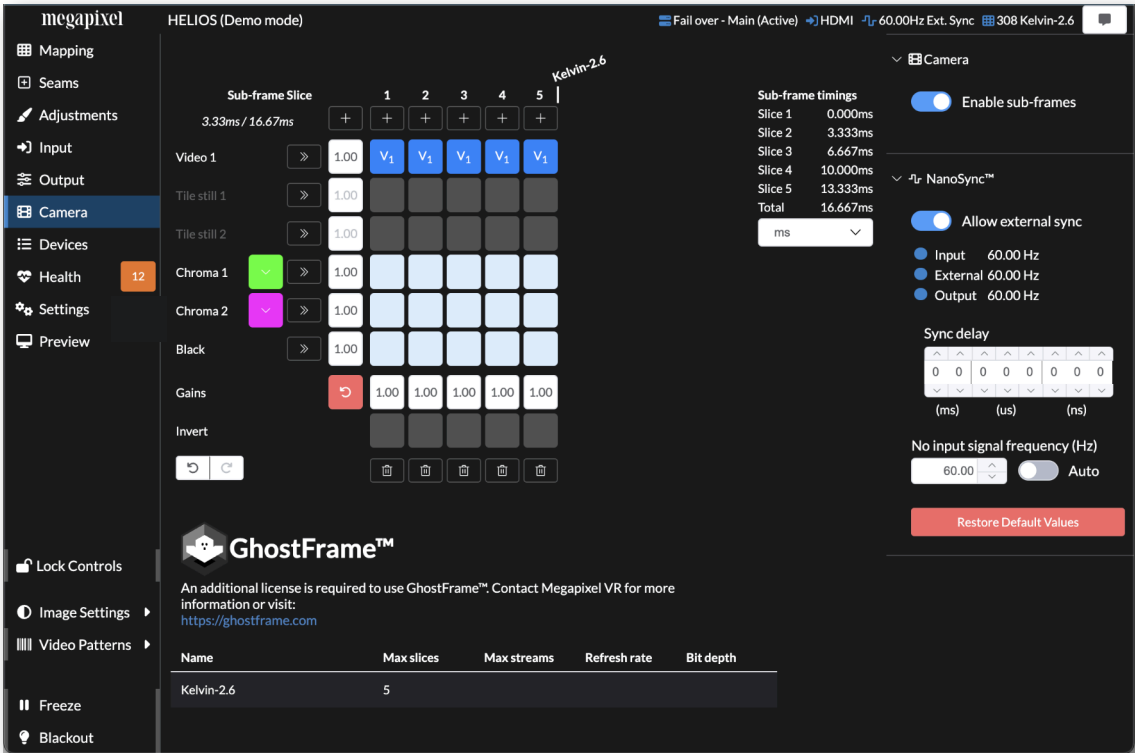


**Figure 99:** Camera interface

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**NOTE:** Tile test patterns disable Camera. Tile test patterns and tile Identify are mutually exclusive to **Camera**.

# Devices Pane

The Devices pane is a dynamic list of all connected system devices. The information is split into two tabs, a **Processing** tab and a **Display Devices** tab. This pane is usually the first place a system technician will check to discover the status of a system.

## Processing Tab

The tab is divided into sections starting at the top with information for the HELIOS **Processor(s)** followed by **Network Switches**.
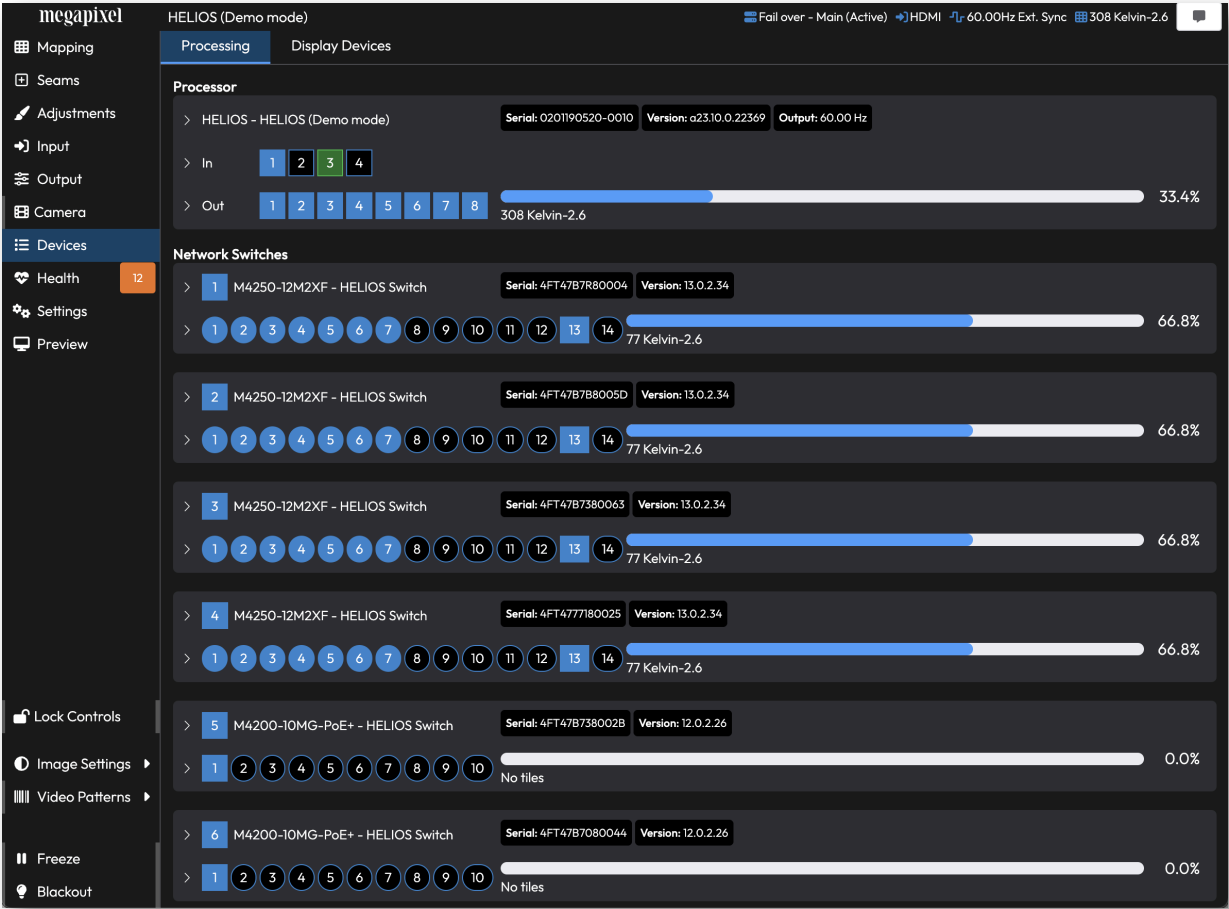


**Figure 100:** Devices pane

## Processor

The main device section of the HELIOS Processor displays the full list of tracked parameters. Use the description field to name the processor as desired. This is the same as changing the name in **Settings > Description**.
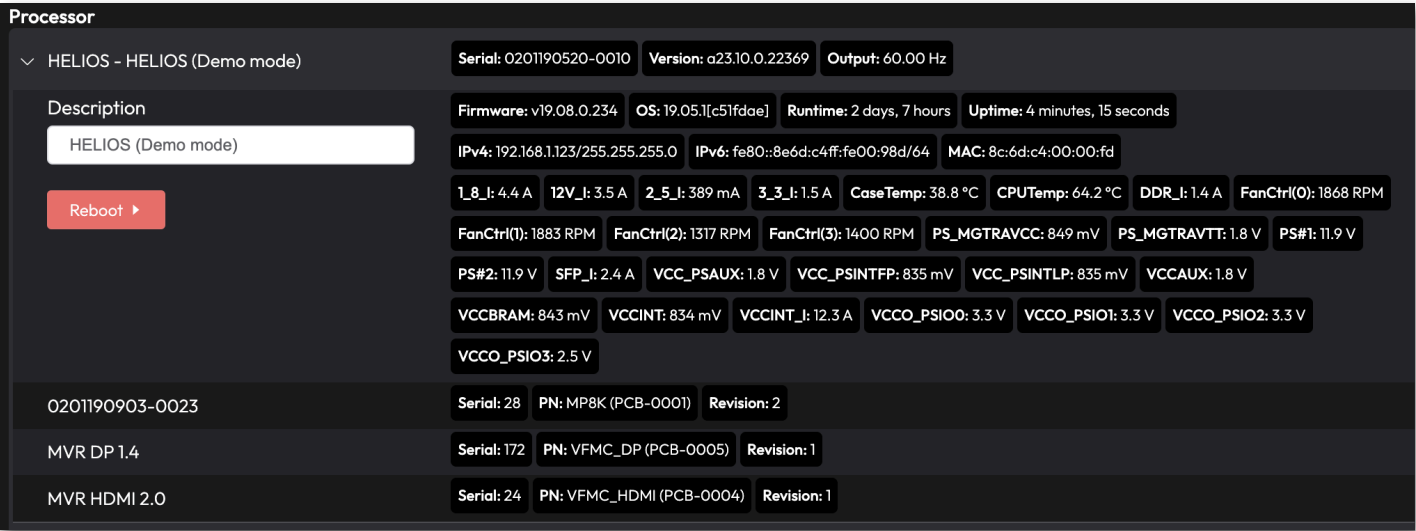


**Figure 101:** Devices Pane - HELIOS Parameters.

The **In** section of the HELIOS Processor displays details about the input SFP+ units. The square icon with the number on it is the input icon. When this icon is a blue square with white text (input 1 in the example below) the unit is receiving video through the SFP+. When the HELIOS recognizes the SFP+ but there is no video, the icon will be a dark green (input 3 in the example below). In both blue and dark green modes the there will be parameters displayed and a label regarding the type of SFP+ that is in the slot. A black with light blue outline icon (ports 2 and 4 in the example below) indicates that the HELIOS unit does not recognize any SFP+ in the slot.
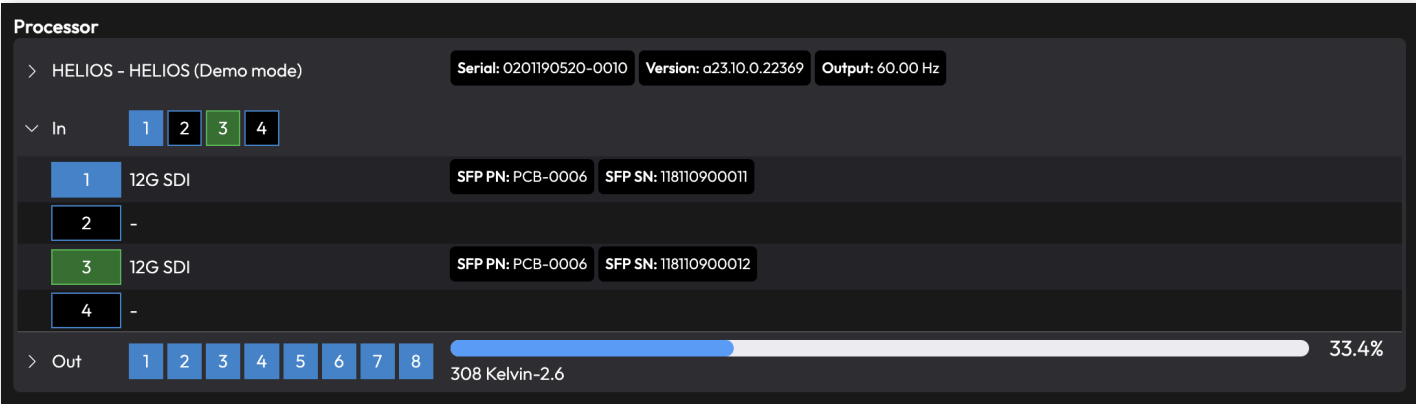


**Figure 102:** Devices Pane - HELIOS Inputs

The **Out** section shows the status of the outputs and a percentage of utilization of the entire HELIOS Processor. Expand the output section of the HELIOS Processor to see details about the outputs. Each port shows a progress style bar showing the port's percent utilization. Underneath the bar is the quantity and type of tiles connected.
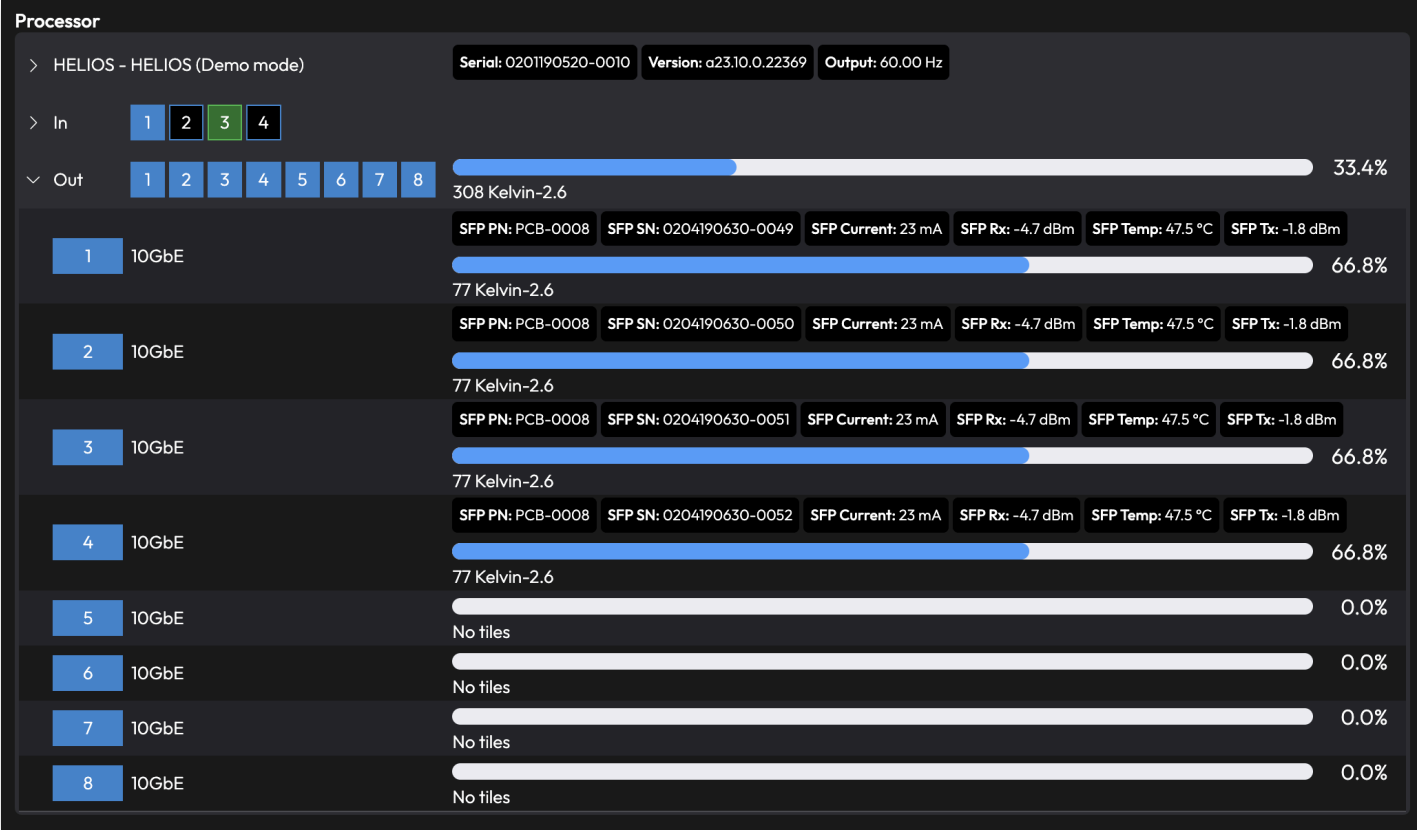


**Figure 103:** Devices pane – HELIOS Outputs

The shape and the color of the port indicators relate to the port connection. See the table below for the detail on what each color means. Links connecting to a processor are square. So all the processor ports are square. The port on the switch connecting to HELIOS will be square (as it's connected to a processor). Similarly the upstream port on the first tile in a chain is also square (as it links back to a processor). Standard HELIOS outputs will always be square since all Standard HELIOS output SFP+ units are 10Gb.

| Indicator Color | Meaning |
| --- | --- |
| Orange | Unsupported SFP |
| Red | < 1GbE link speed |
| Blue | 1 GbE – 2.5 GbE |
| Dark Blue | 10 GbE |
| Dark Green | SFP with no link |
| Inverted Blue | SFP with link |

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# Network Switches

This section displays details for the network switches. Enter a description for the switch if this is helpful for managing the system. This assigned description is persisted within the switch. A remote reboot switch button can also be found here.
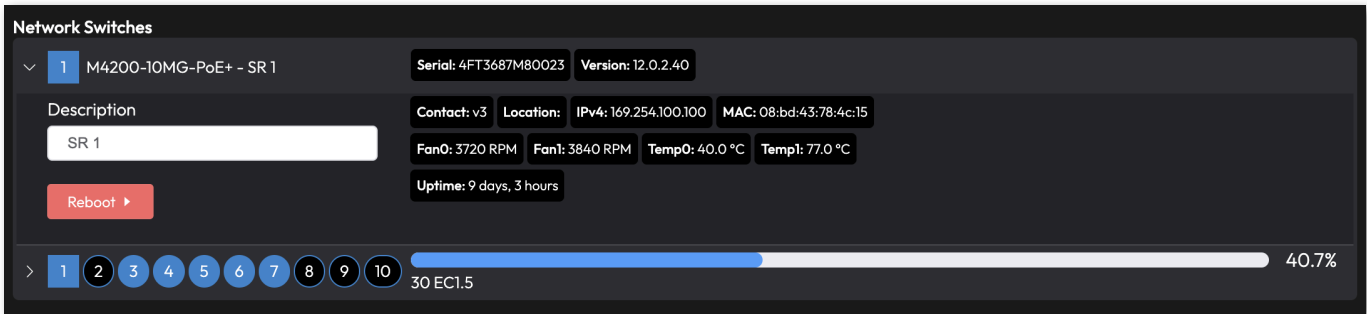


**Figure 104:** Devices pane – Network Switch Parameters

The ports section displays details about the ports. Here again, the square shape icon indicates that **0/1** is connected to a processor. Switch port IDs use slot/port nomenclature. On standard size switches, all ports are considered slot 0; port IDs are numbered 0/1 - 0/9 as shown in the example below. These switches are divided into 12 slots of 8 ports each. Numbering follows the same schema starting with slot 0. When HELIOS is managing a redundant system there is additional information on this pane about the redundant data routes. (See the **Redundancy Appendix** for more information.)

To the right of each port ID is a percent utilization bar with connected tile quantity and type below.



**Figure 105:** Devices pane – Network Switches

## Display Devices Tab

The **Devices > Display Devices** pane contains a list of connected tiles with detailed parameters and status for each. The list can be sorted by any of the column headers. The **Alerts** column (orange rectangle below) can be especially useful to identify all devices with active alerts.



**Figure 106:** Devices pane – Display Devices

# Health Pane

The health pane contains comprehensive network status information about all parts of a connected HELIOS system. This pane contains three tabs; **Alerts**, **Heat map** and **Reports**.

## Alerts

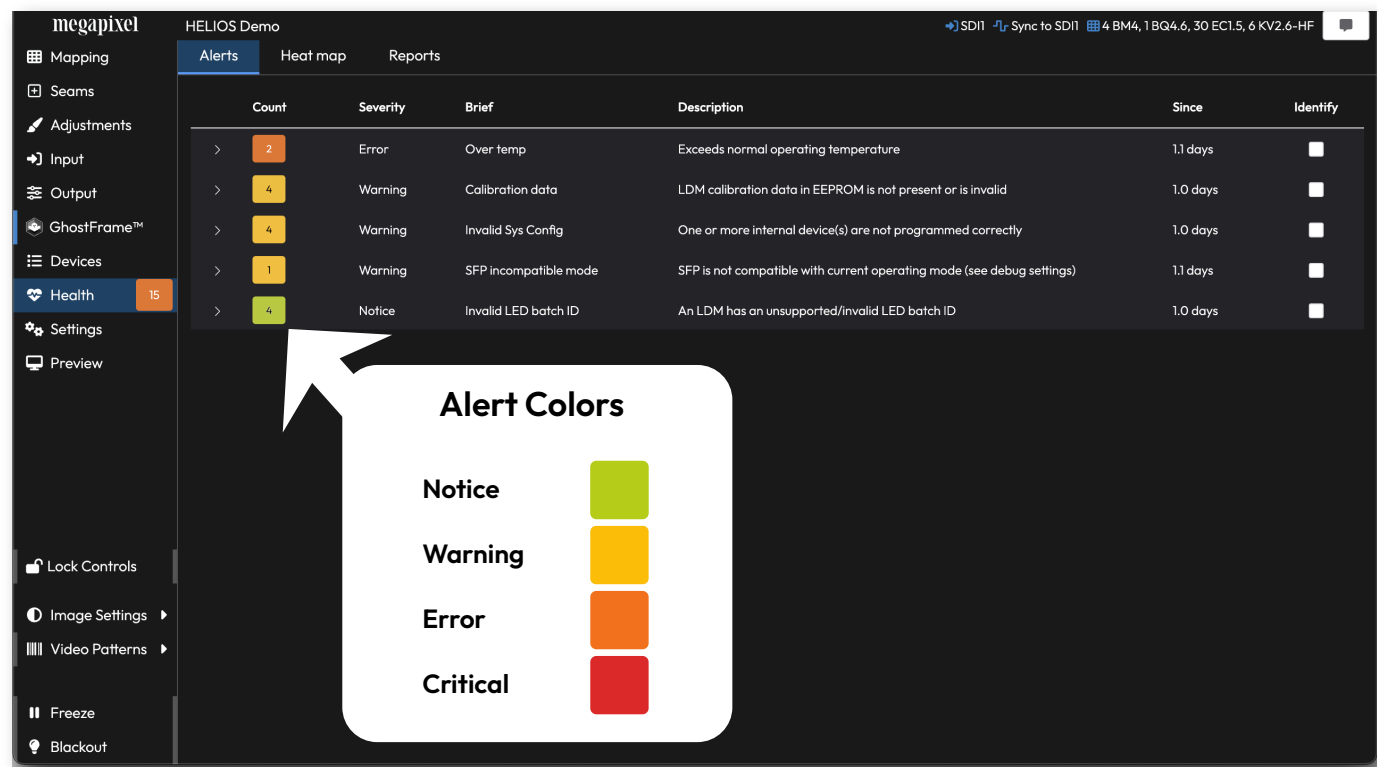To help prioritize alerts, the HELIOS color codes alert badges based on the severity of the condition.



**Figure 107:** Alert Color Codes

The alerts tab provides a list of devices that need attention. Use the disclosure triangle next to the colored alert count (orange rectangle below) to reveal details about the location of each alert within the system.
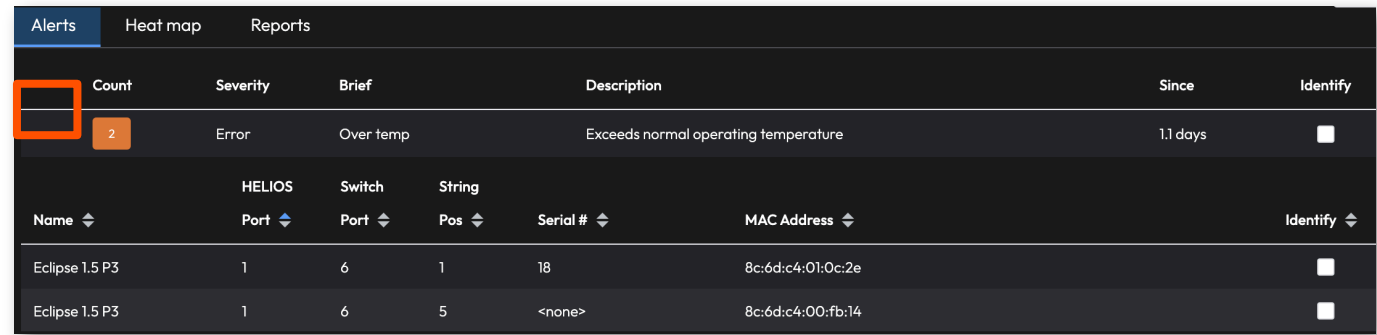


**Figure 108:** Alerts tab

# Heat map

The heat map tab displays thermal information for tiles in the system. Temperatures are indicated in a rainbow palette that shows thermal differences in 5° degree increments.
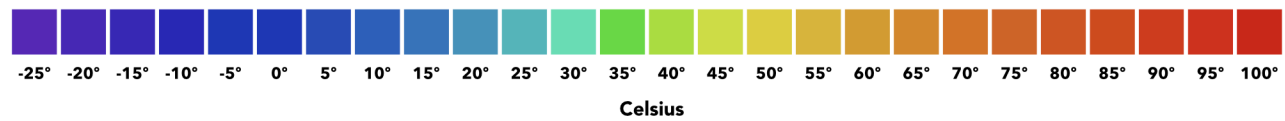


| -25° | -20° | -15° | -10° | -5° | 0° | 5° | 10° | 15° | 20° | 25° | 30° | 35° | 40° | 45° | 50° | 55° | 60° | 65° | 70° | 75° | 80° | 85° | 90° | 95° | 100° |

**Celsius**

**Figure 109:** Color to temperature

In the example below, one tile has raised an alert with a CPU at 89.5°C. Use this view to quickly identify any temperature anomalies in the system. The heat map is not just useful for recognizing hot panels. It is good practice to warm LED panels up prior to being used at full brightness. Use the heat map to monitor progress and to confirm when panels are ready for use.



**Figure 110:** Heat map

# Reports

The reports tab can fetch data from tiles and provide a downloadable (csv file format) report for several data points in the system. This function queries tiles for the information when a selection is made with the drop down menu. The page will be blank until a report type has been selected. In the example below, **Pixel error detection** was selected.

| Function | Description |
|---|---|
| Alerts | A view of devices that need attention. |
| Device serial numbers | A view of all SNs, useful for inventory tracking. |
| Device uptime/runtime | A view of all devices and how long they have been operational. Useful for finding units that reboot more often than others. |
| Device versions | A view of active device software and firmware versions. |
| Fiber sensors | A view of the fiber hardware's health. |
| Pixel error detection | A view of tiles with pixel errors. |
| Tile counters | A view of tile connectivity health. These various diagnostic counters can help with troubleshooting tile health and cable issues. |
| Switch interface counters | A view of switch counters. These diagnostic counters can help diagnose general cable issues. |
| Tile notes | A view of all notes from connected tiles. |



**Figure 111:** Reports tab

## Settings Pane

With **[Advanced mode](#)** enabled the **Settings** Pane contains eight (8) tabs; **Processor Settings**, **Security**, **Still Store**, **Scheduler**, **Saved Configurations**, **Update Center**, **Shortcuts,** and **About**. The following pages describe the functionality found on these tabs.



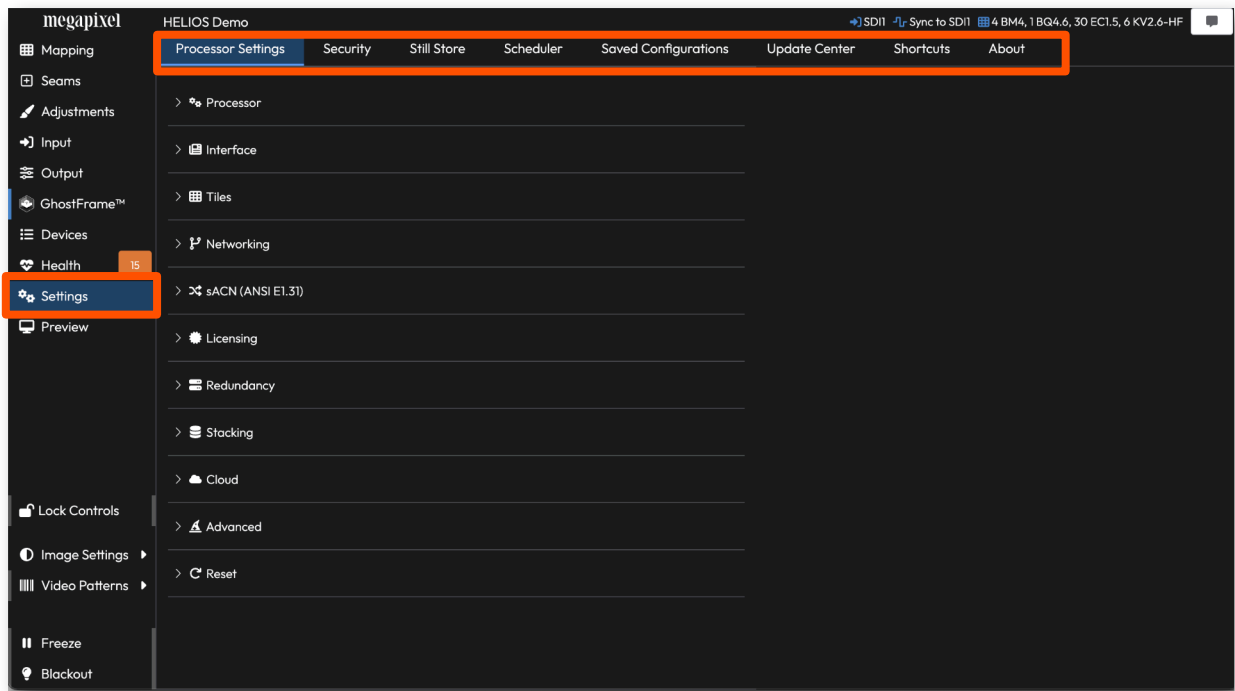**Figure 112:** Processor settings.

## Processor Settings

### Processor

> **Description** – Enter the name of the processor, changes are updated live.

> **Operating Mode** –

>> **Standard license** – HELIOS can use both 10GbE fiber SFP+ modules or 1GbE copper SFP modules.

>> **Junior license** – HELIOS can only use 1GbE copper SFP modules.
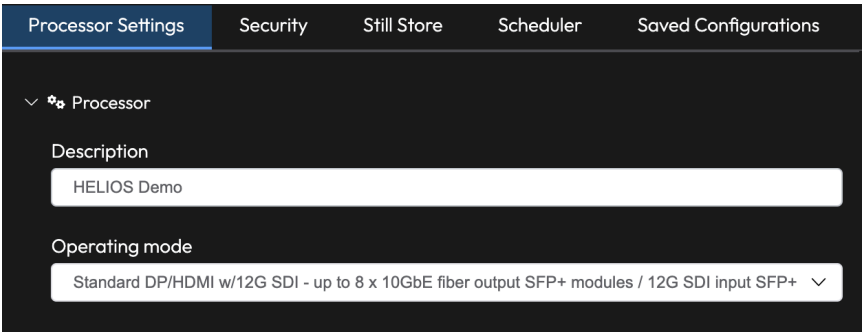


**Figure 113:** Description and Operating mode selection

Changing the operating mode will trigger a pop-up warning asking for confirmation. Select Switch Mode to change and reconfigure the system for the new module type.



**Change processor operating mode?** ✕

Changing the operating mode to 'Junior DP/HDMI' may temporarily disrupt video output and require system reconfiguration.

Are you sure you want to change the operating mode

Cancel    Switch mode
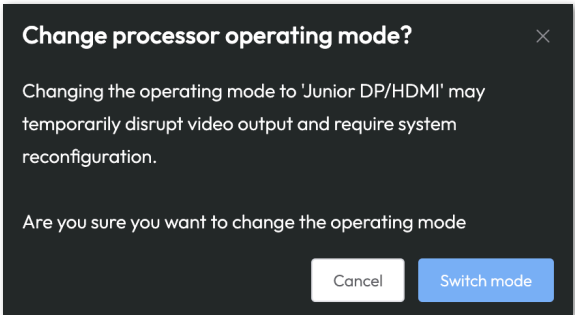
**Figure 114:** Switch mode confirmation

**Interface** - Select a color theme (**Dark** or **Light)** and/or select a language for the user interface.



⌄ ▣ Interface

Theme

Dark    ⌄

Language

(Auto)    ⌄

**Figure 115:** Theme selection

**Tiles**

- **Show Rear Indicators toggle** - See **Tile details** for more information.

- **Identify behavior** – Select how tiles should behave when the tile Identify feature is enabled. Techs usually set this to Rear indicator only once a system is show ready.

- **Fan control** – When supported by tile firmware, select from available tile fan modes.

- **Low power mode** – When supported by tile firmware, set how tiles behave when global blackout is enabled.



⌄ ▦ Tiles

●  Show Rear Indicators

Identify behavior

Front identify & Rear indicator    ⌄

Fan control

Automatic    ⌄

Low power mode

After five minutes of blackout    ⌄

**Figure 116:** Tile setting

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**Networking** - Toggle on/off network discovery protocols (DNS-SD + SSDP) and configure the IP settings of the HELIOS Processor (see **IP Addressing**) for more details on how these controls are used.



**Figure 117:** Networking

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**Networking (Advanced)** - With Advanced mode enabled, the **Networking** accordion will display a **Redirect to HTTPS toggle** at the bottom of the section. Toggle ON to redirect all browser **http://** requests to **https://**.

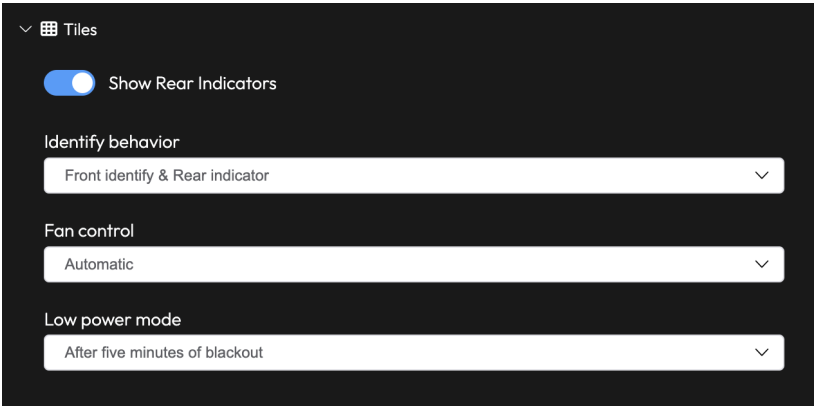HELIOS by default uses a self-signed certificate. HELIOS also supports customer provided HTTPS certificates. This feature allows users in high security conscious applications to be able to load their own signed HTTPS certificates. Certificates must be purchased/requested from an SSL certificate authority. Once obtained, users can upload their own certificate using the **Upload cert + key button** (arrow below). The window offers a button to regenerate the self signed certificate or upload a cert + private key in pem format. Once a certificate has been placed in use, all future https sessions will be secured with that certificate. The advantage of loading a custom certificate is that it can be properly signed. Once signed, the connection can actually be secure and properly validated. Adding a signed certificate will also remove the certificate warning HELIOS gets when using self-signed certificates. See the HELIOS **HTTPS Appendix I** for more technical details.

**Network settings for a HELIOS HTTPS deployment:**

1.  Disable Network discoverable

2.  Redirect to HTTPS

3.  Upload cert + key



---

**NOTE:** An HTTPS connection is required when using gamepad controllers to perform Seam correction. Please see the **Seams** section for more details.

---

## Networking  (Advanced) Continued

**Security settings for a HELIOS HTTPS deployment:**

1.  Add one or more users

2.  Enable user authentication

See the **Security** section for more details.
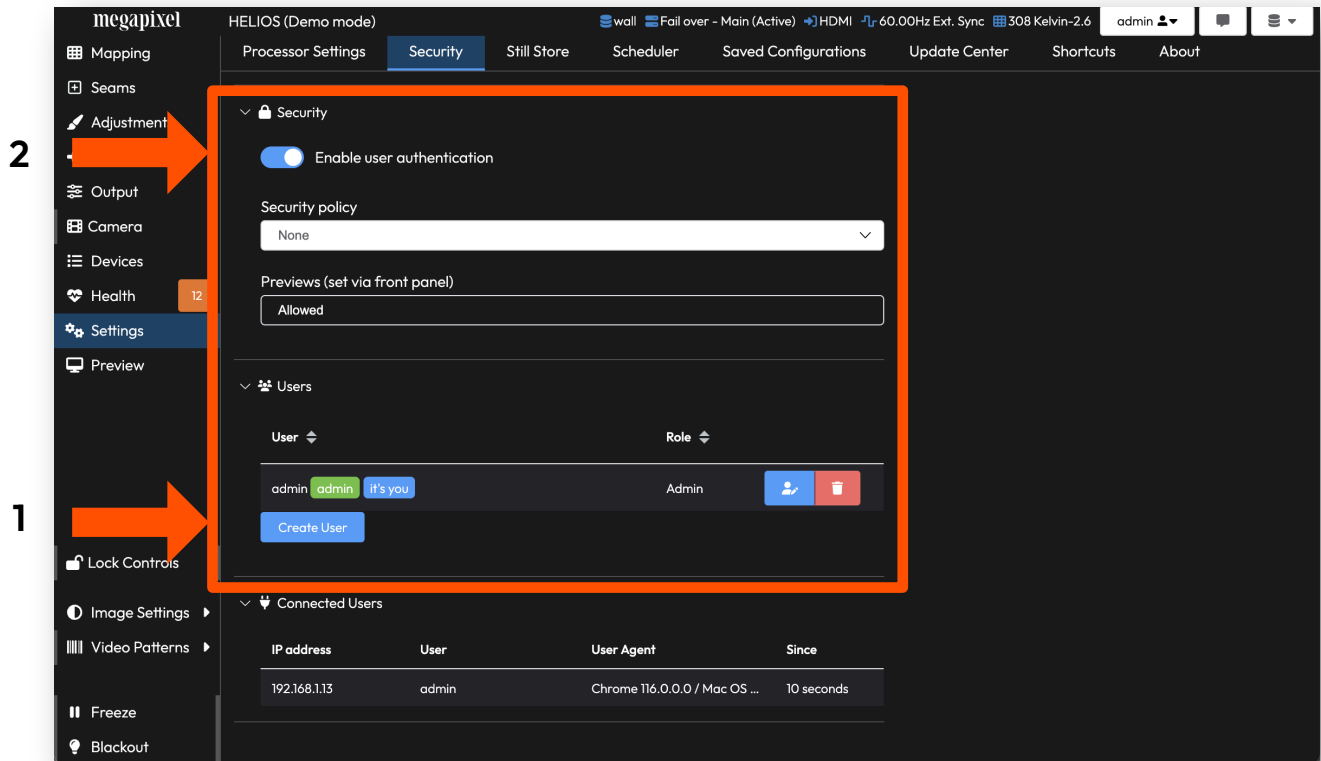


**Figure 118:** Networking Advanced

**sACN (ANSI E1.31)** – Use the sACN or E1.31 protocols to remote control HELIOS. When sACN is valid and active, a green bar with the sACN source name will be shown above the channels.
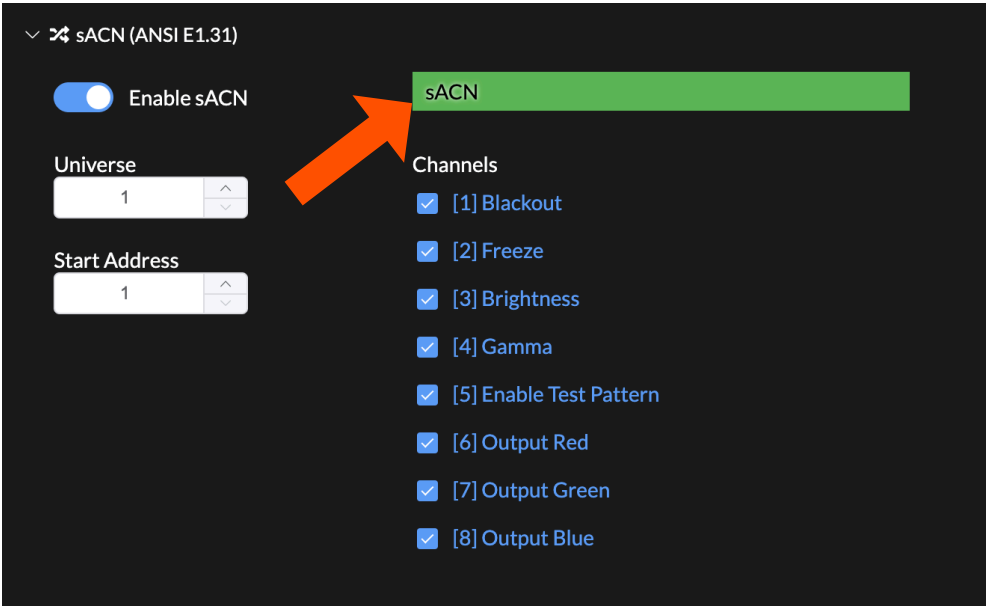


**Figure 119:** sACN enabled

The GUI controls are locked out for sACN controlled functions. Function names will be highlighted in 'bright turquoise'          throughout the interface.
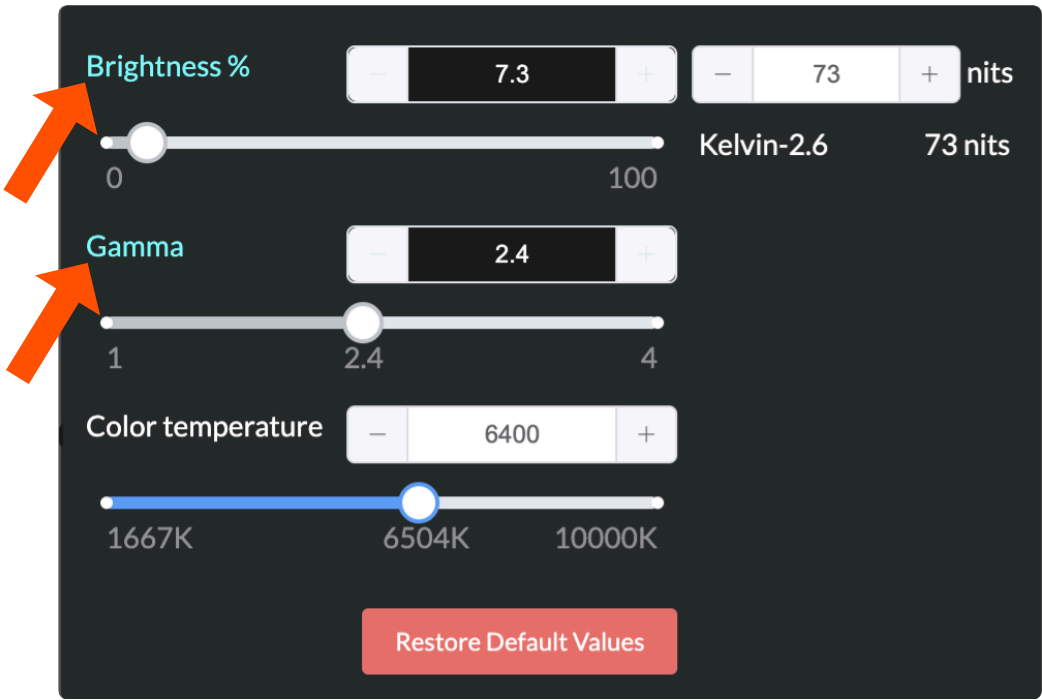


**Figure 120:** Locked out functions

## sACN (ANSI E1.31) - (continued)

When **tile groups** are created, groups are by default assigned channels **10 - 15**. The channel assignments will show up below the primary sACN control channels.
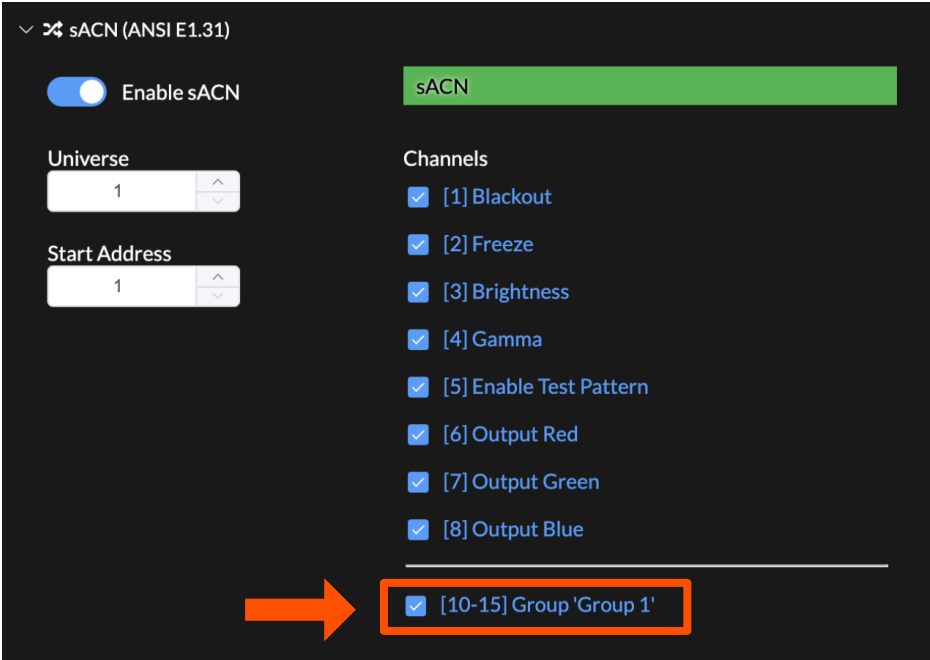


**Figure 121:** Tile group channel assignment

Use the **Tile Group Settings > Start Address** to set the **Start Address** of tile groups.
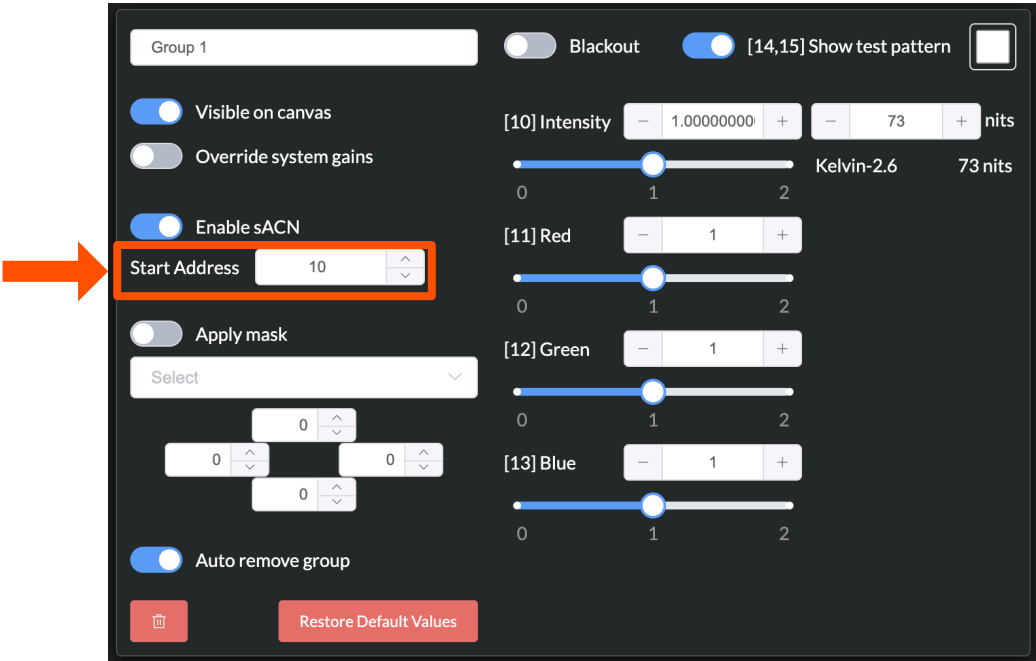


**Figure 122:** Tile group Start Address

## sACN (ANSI E1.31) – (continued)

The table below describes HELIOS behavior for inbound sACN.

| Main Channels | Function | Value |
|:---:|:---:|:---:|
| 1 | Blackout | 0 = Normal operation \| 128 and above = Blackout |
| 2 | Freeze | 0 = Normal operation \| 128 and above = Freeze |
| 3 | Brightness | (0-255) Slider position 0 - 100% mapped to sACN |
| 4 | Gamma | (0-255) Slider position 1.0 - 4.0 (SDR) mapped to sACN  (Gamma 2.4 = 119) |
| 5 | Test Pattern | 0 = Normal operation \| 1 - 255 = Show test pattern |
| 6 | Output Red | (0-200) Slider position 0.0 - 2.0 mapped to sACN |
| 7 | Output Green | (0-200) Slider position 0.0 - 2.0  mapped to sACN |
| 8 | Output Blue | (0-200) Slider position 0.0 - 2.0  mapped to sACN |
| **Tile Group Channels** | | |
| 10* | Intensity | (0-200) Slider position 0.0 - 2.0  mapped to sACN |
| 11 | Red gains | (0-200) Slider position 0.0 - 2.0  mapped to sACN |
| 12 | Green gains | (0-200) Slider position 0.0 - 2.0  mapped to sACN |
| 13 | Blue gains | (0-200) Slider position 0.0 - 2.0  mapped to sACN |
| 14 | Pattern toggle | (0-255) 128 and above = ON |
| 15 | Pattern alpha | (0-255) 0 = full transparent 255 = opaque |

*10=default start address

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**Licensing** - HELIOS units require a license to operate. There are two main types of licenses, HELIOS Standard and HELIOS Junior, other specialized licenses such as the GhostFrame license and the HDCP license are also available. Shown below is a HELIOS Standard license. To enter a license use the **Activate license** button. This button allows license activation via an activation key. The web UI will then communicate with the Megapixel licensing server to generate a license for the system. Alternately, to obtain a license the system ID and serial number will need to be sent to a Megapixel representative. The **About** tab (shown later in this section) has a **Download Support Archive** button. Contact your Megapixel representative with this archive to obtain new or upgrade existing licenses. Once the new license file has been obtained, select the **Upload license** button then, navigate to the license file on the local host machine to load a license into the HELIOS.



**Figure 123:** Licensing

**Redundancy (Advanced)** - Please see the **Data Redundancy** section in Appendix F for details.



**Figure 124:** Redundancy settings

**Stacking (Advanced)** - Stacking allows individual processors that operate sections of a large screen to synchronize functions such as blackout, freeze, and color adjustments. In most cases, stacking should be used with redundancy in the HELIOS system. Enter a Stack name to have the processor join a stack. In the example below, the current HELIOS processor has been assigned to **Stack 1**. Below the Processor stack name field, a table shows that HELIOS is aware of another processor in the system named **A Backup Processor**, assigned to a stack named **wall**.
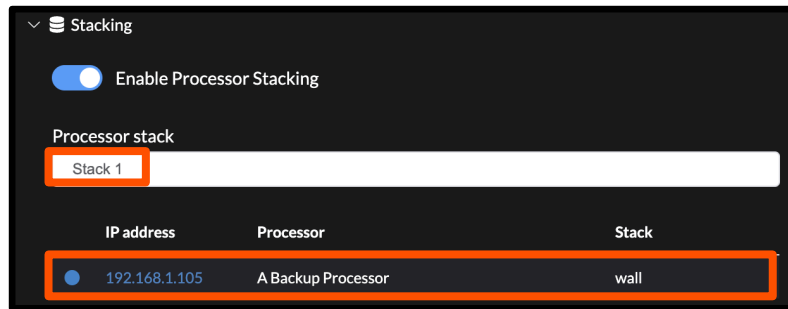


**Figure 125:** Stacking settings

**Cloud** - Enable analytics to be sent to the development team.

**Advanced** - When advanced features are enabled, several features that have not been selected for general release will show up throughout the user interface.

**Reset to factory settings** - Returns a HELIOS unit to factory defaults. This will wipe all HELIOS stored settings, while leaving the tile settings. Mapping position will revert to 0,0 with no rotation, no groups, but LDM seams will be re-retrieved from the tile.
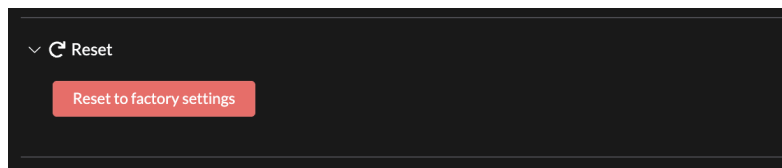


**Figure 126:** Reset to factory defaults

**Data stored on tiles:**

- LDM Configuration
- LDM Seams (user + factory)
- Notes
- Tile Still Store image (volatile memory - cleared on reboot)

**Data stored on HELIOS***:

- Mapping position
- Rotation
- Group assignment
- Other settings are stored within HELIOS by tile MAC. On connecting a tile to HELIOS, the settings are pushed to the tile (cal bypass, LDM gains, tile low latency, etc).

  *Stored on HELIOS by tile position / topology and then falling back on MAC

If there is even a remote possibility the system might need to be returned to its pre-reset state, create a saved configuration and download it prior to factory resetting the HELIOS. See **How to move configuration files** for details. Alternately, a less permanent solution may be to load the HELIOS default factory saved configuration. See the **factory default saved configuration** section for more details.

# Security (Advanced)

In the **Settings** > **Security** tab, HELIOS can be configured to require a user and password for access. HELIOS has selectable complexity requirements. Ensure the selected complexity requirement matches the security requirements of the installation. Press the **Create User** button to open a form window to enter the user info. It is good practice to create an Admin account first. Once security is enabled, standard users will only see a list of logged in users.
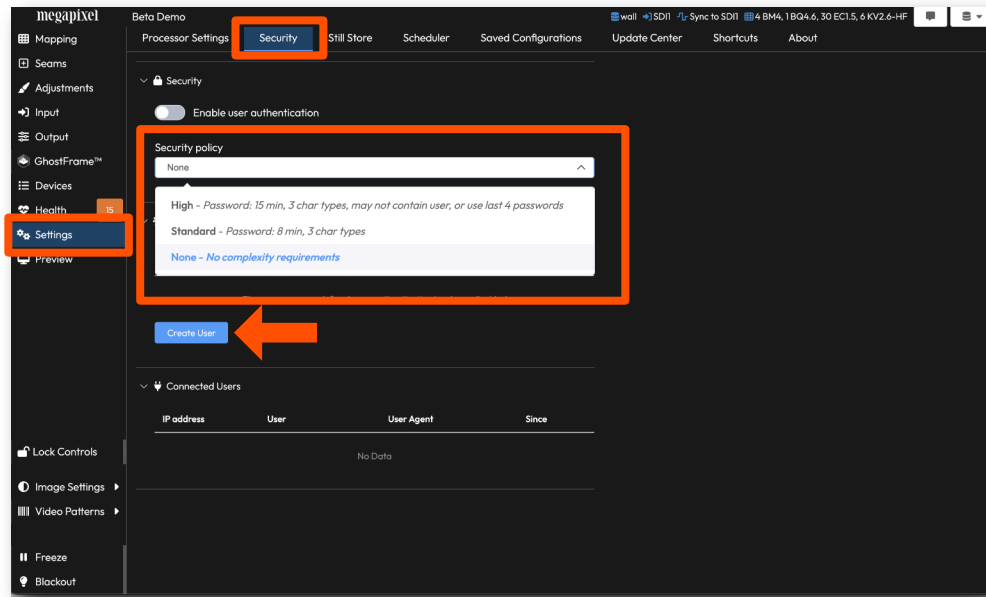


**Figure 127:** Security pane

Complete the fields. When selecting a role (Admin or User) keep in mind that Admin privileges are required to create and edit users. Press **Add User** to create the account.



**Figure 128:** Create user

Google maintains a list of compromised passwords. If a user is created with a simple password such as 'test' or 'password' expect a Chrome warning.
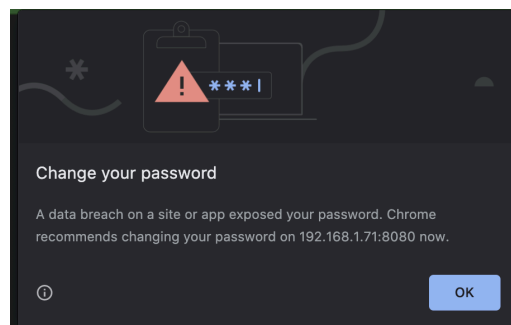


**Figure 129:** Password warning

## Security (Advanced) - (continued)

Use the **Enable user authentication** toggle to turn on security. **Be certain of the user and password prior to enabling security!** If credentials are lost, only a factory default reset will unlock the HELIOS. (See the <u>Unknown User / Password</u> section in Appendix B)
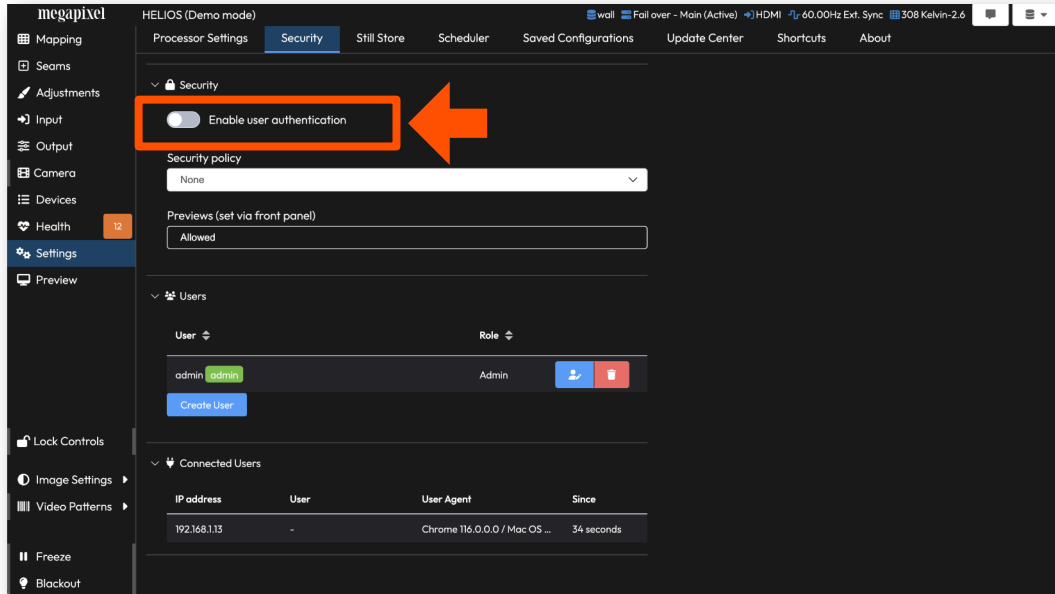


**Figure 130:** Enable User Authentication

Authentication is required immediately after enabling.
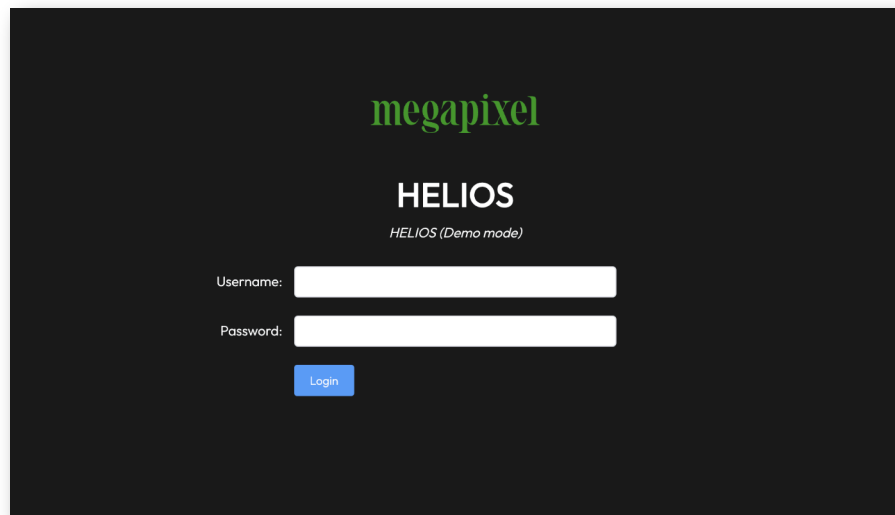


**Figure 131:** Authentication required

# Security (Advanced) – (continued)

When logged on, the user name will appear on the top right.
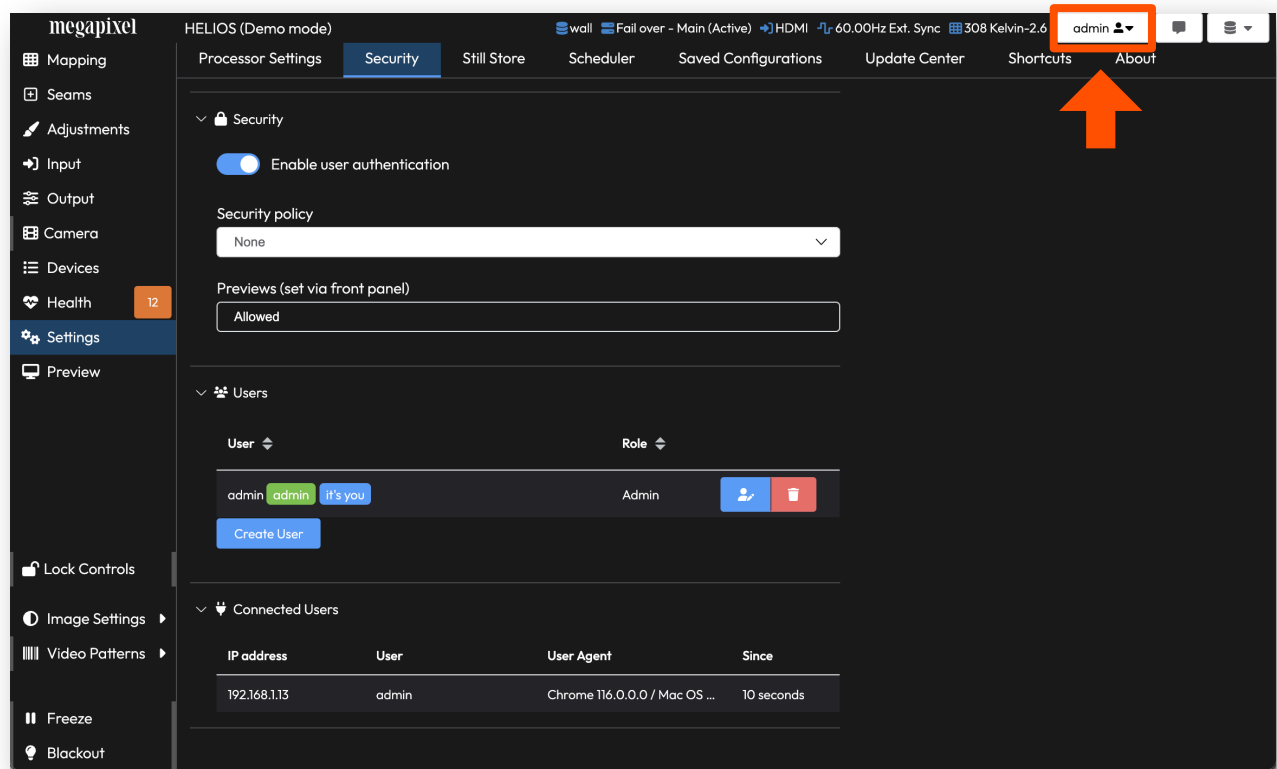


**Figure 132:** User list

Select the user name button to Sign out or change the password.



**Figure 133:** Sign out button

## Security (Advanced) - (continued)

Manage users with the edit and delete buttons. Use the edit icon button to change the password for a user or to block a user. If a name change is required, it must be created as a new user.
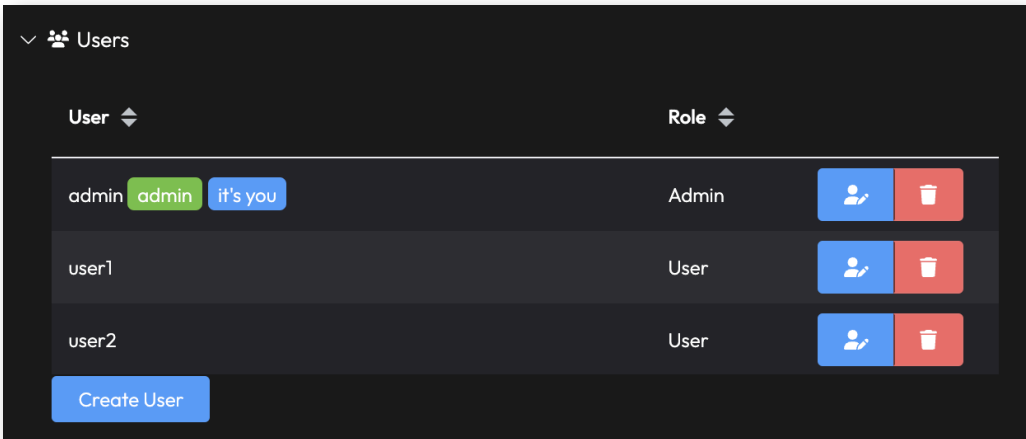


**Figure 134:** User list

If a user has been blocked, an amber notification will appear next to the user name in the user list. Blocked users are not allowed to login.
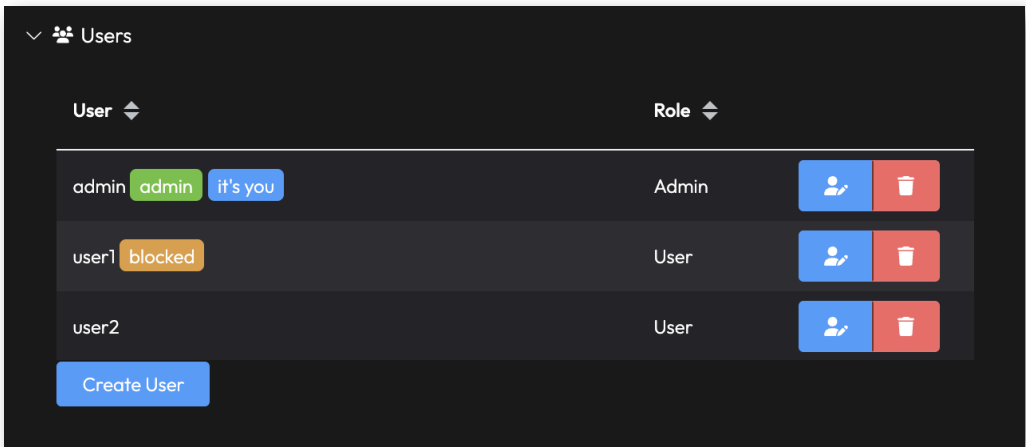


**Figure 135:** Blocked user
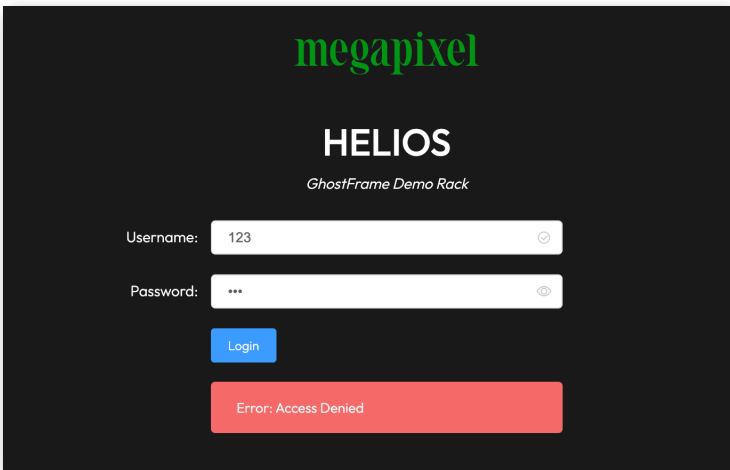


**Figure 136:** Access denied

# Still Store

Use Still store to add still images (jpeg and png) to HELIOS and to display them. The maximum image resolution is 4096 x 2176. This feature works with the Input > **On input failure** feature and the Global **Video Pattern Selection**. By default, HELIOS will show all the loaded images in the carousel. A still can be favorited by clicking on the star icon. Show a still by clicking on the play icon. Remove a still by clicking the trash can icon. Stills can be downloaded by right clicking on them and selecting **Save Image As...** Select favorites to show only favorites in the carousel in the **Video Patterns** window.
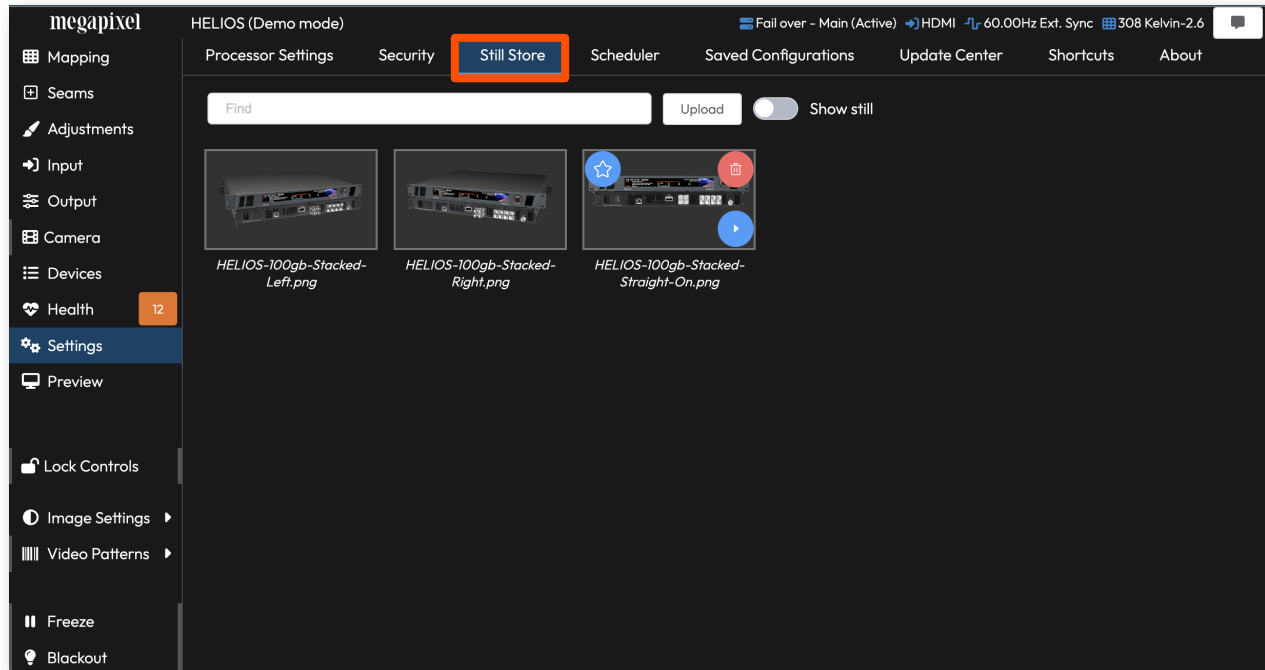


**Figure 137:** Still store

# Scheduler (Advanced)

The HELIOS scheduler can be found on under **Settings > Scheduler**. Use the scheduler to have HELIOS make system changes at a predetermined date and time. The scheduler needs HELIOS to have an internet connection so that it can connect to an NTP server to retrieve the current time and date.

Press the **Add entry** button to add an event.
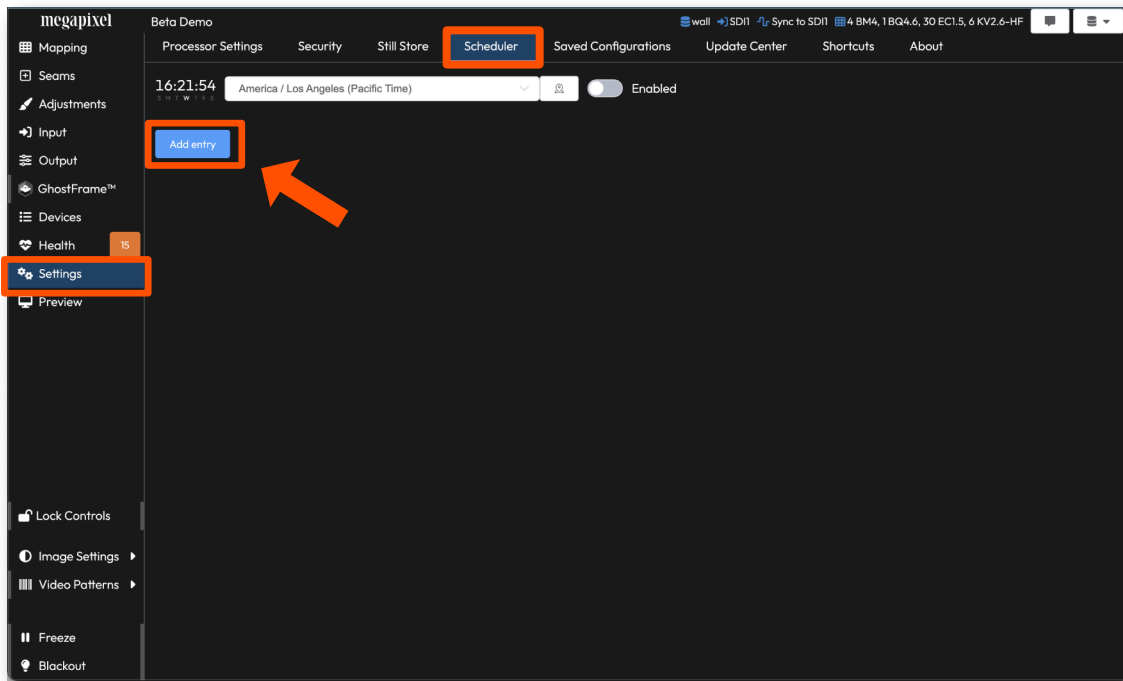


**Figure 138:** Scheduler Add entry

In the scheduler form window set the time and date of the event. The **Weekday** and **Weekend** buttons are shortcuts to manually selecting only weekends or weekdays. Once the time and date are set, enable one (or more) of the listed functions (**Brightness**, **Blackout**, **Input** ) and set the desired value. For more complex configuration changes create a custom configuration on the **Settings > Saved Configurations** tab. Then, return to the **Scheduler**, enable **Apply config** and select the configuration using the **Apply config** drop down (orange rectangle below).
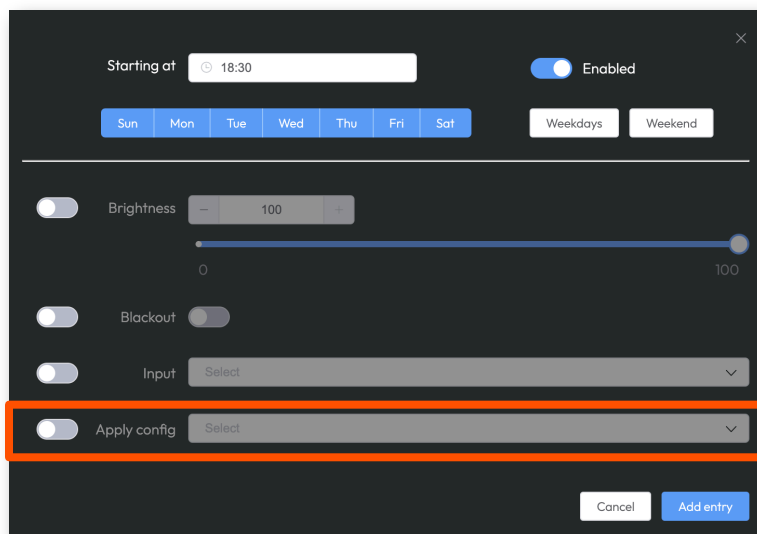


**Figure 139:** Scheduler form

## Scheduler (Advanced) – (Continued)

Scheduled tasks are executed whenever:

- HELIOS starts up
- HELIOS moves into the next scheduled period
- The schedule is changed
- The task is manually triggered

The Scheduler can be quickly enabled/disabled using the top right **Enabled** toggle. HELIOS shows a small clock icon (see arrow in the image below) at the top of the interface when the scheduler is enabled.
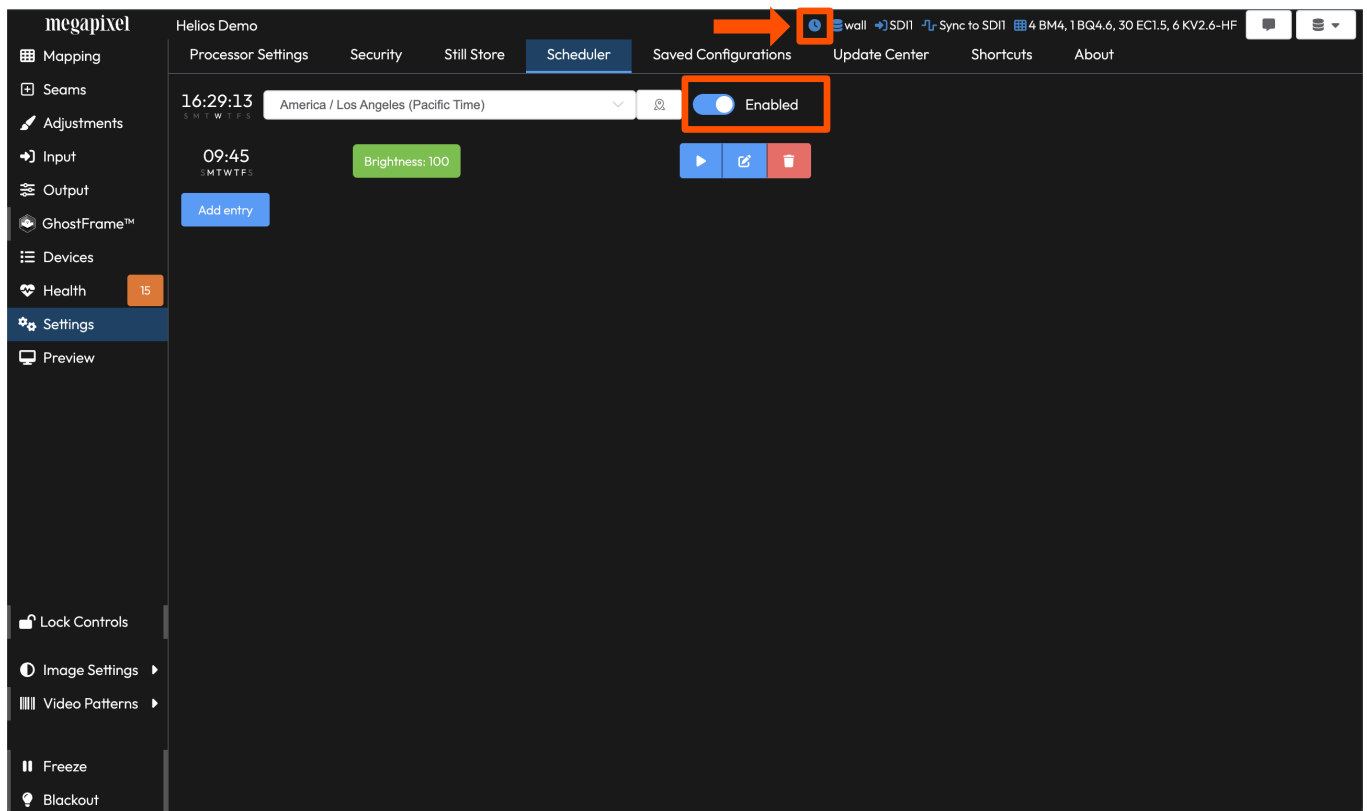


**Figure 140:** Scheduler Enable toggle and indicator

# Saved Configurations

Saved Configurations are used to export a collection of settings. This is useful for configuring a spare unit or to save a progress state while building a new system. It is also the recommended method for documenting and storing full configurations.
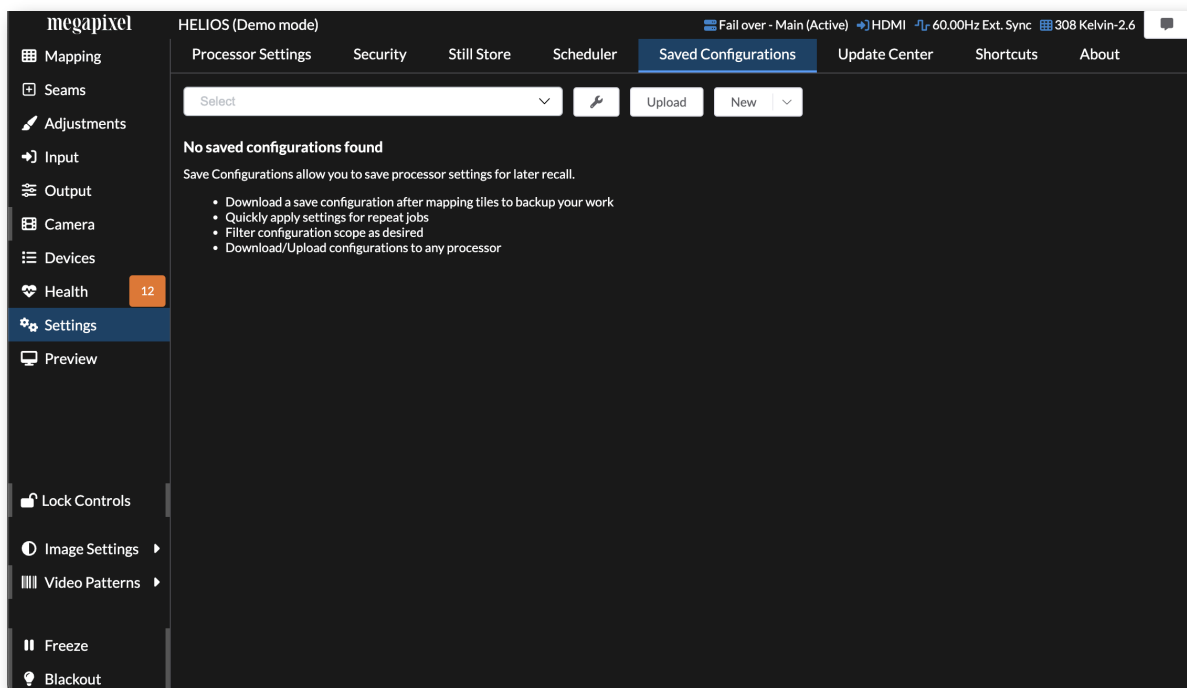


**Figure 141:** Saved configurations

HELIOS has a factory default configuration. Select the **Factory Default** configuration from the dropdown menu to load the file. With this file loaded, and the **Only show changes** toggle switched on, HELIOS displays all the settings that deviate from the factory defaults. In this example, the only change is the creation of one (1) Mapping Group. Press the **Apply Configuration** button to return the HELIOS to factory default settings. In the case of the example below, one **Mapping Group** will be deleted.
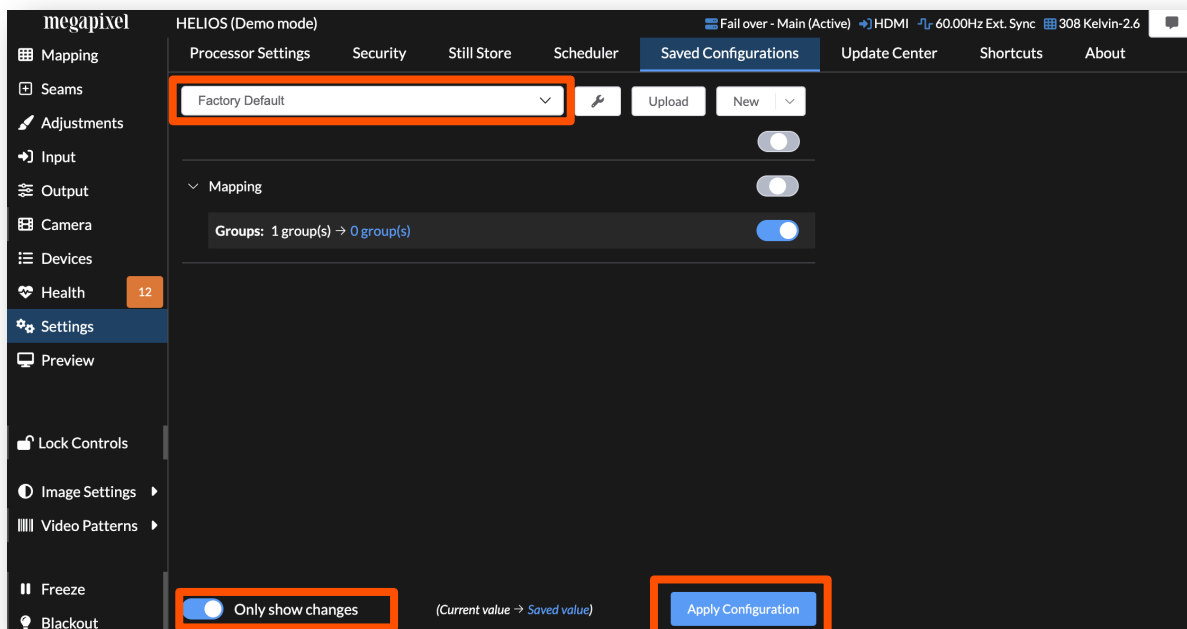


**Figure 142:** Factory Default

## Saved Configurations (continued)

In order to create a new configuration press the **New** button.
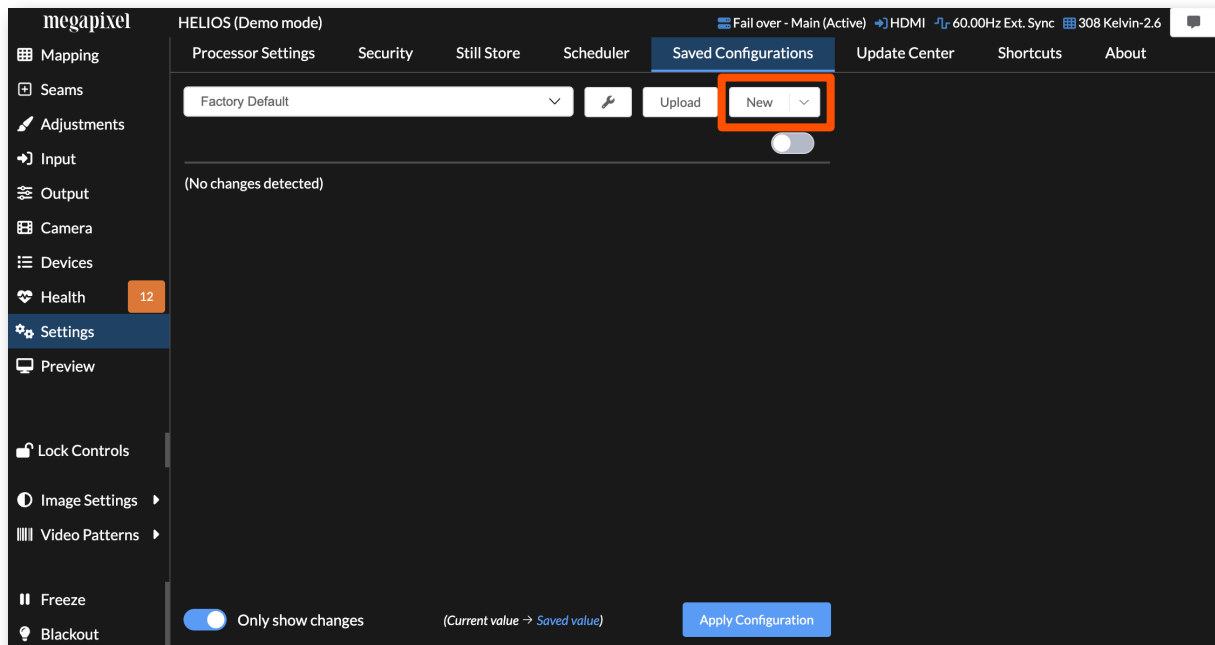


**Figure 143:** New configuration

The system automatically assigns a title based on system time and date, which can be customized by editing the name field. Below the name of the configuration is a list of system parameter filters. If certain parameters are not desired, use the toggle to remove that particular parameter. For example, inputs often have similar color settings across processors in a multi processor system. Rather than manually entering the same input color adjustments to all processors, create a New Saved Configuration with input settings enabled and upload to each processor.
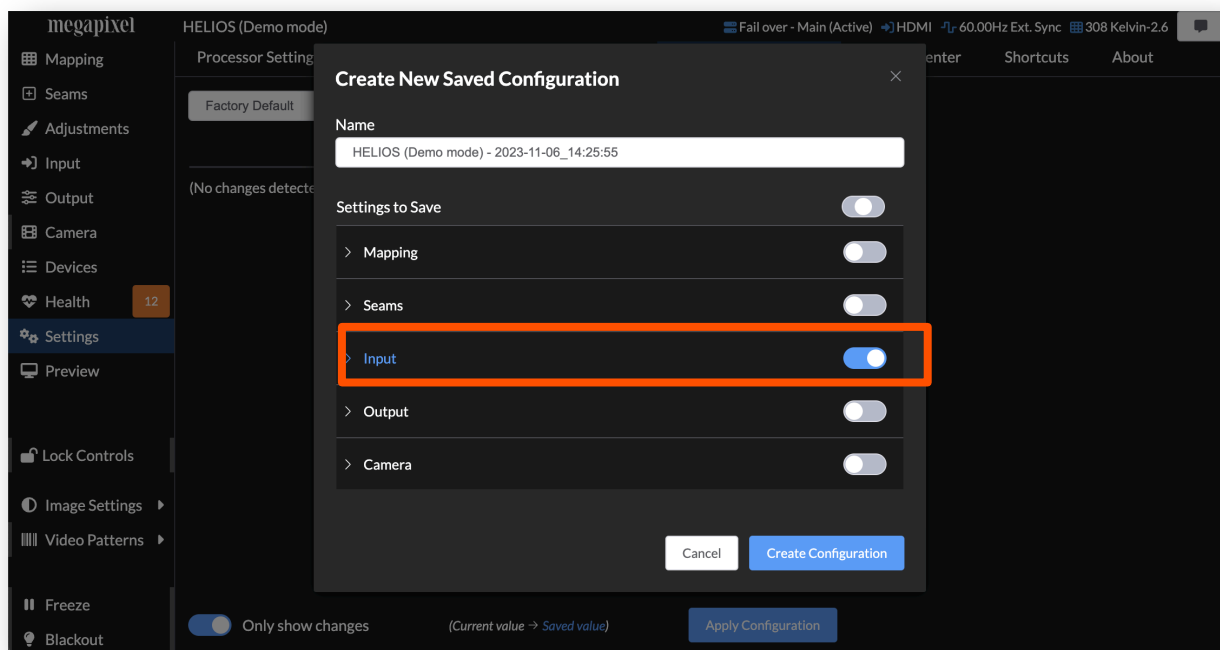


**Figure 144:** Settings filters

## Saved Configurations (continued)

The New button has 'quick access' file management functions under the drop down on the right of the button.

| Function | Description |
|---|---|
| Download | Retrieve the configuration as a file |
| Update | Overwrite the existing configuration with recent changes |
| Rename | Change the name of the file |
| Clone | Duplicate the file |
| Delete | Remove the file |
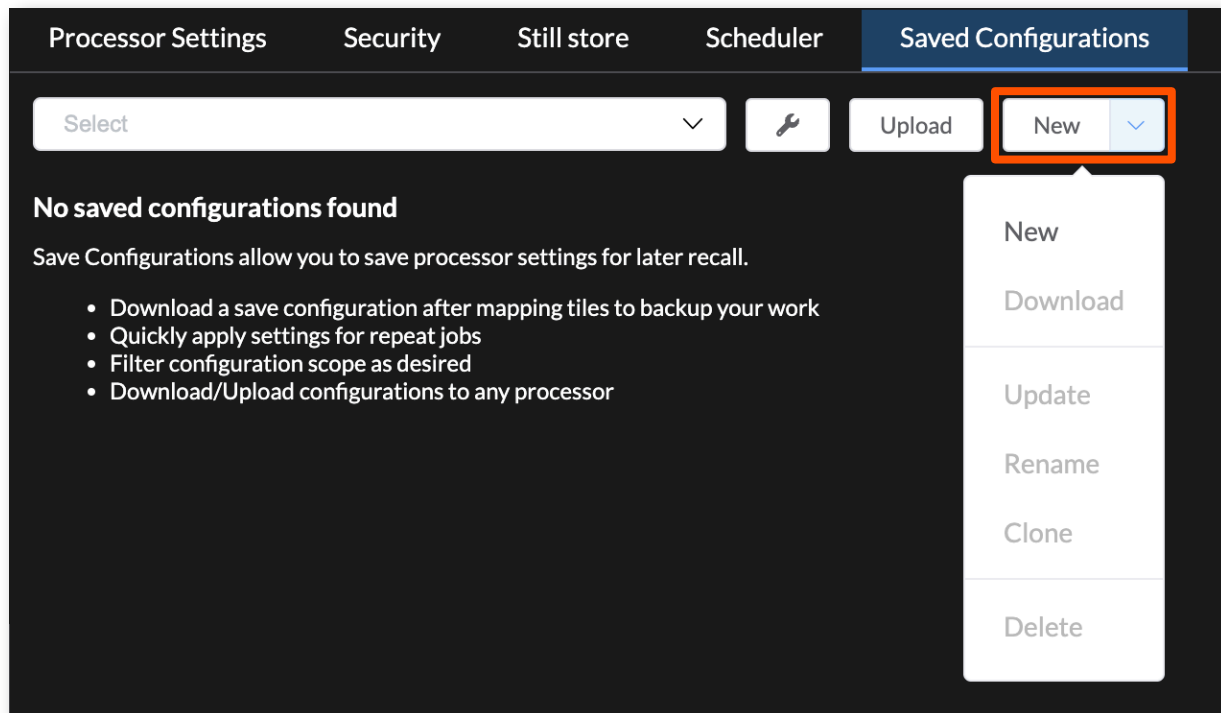


**Figure 145:** Blank 'Saved Configurations' pane

## Saved Configurations (continued)

### How to move configuration files:

The following steps detail how to move a configuration file from one processor to another.

1.  After the configuration file has been created, select the file with the drop down menu. Then use the disclosure triangle on right side of the **New** button to select **Download** from the options.
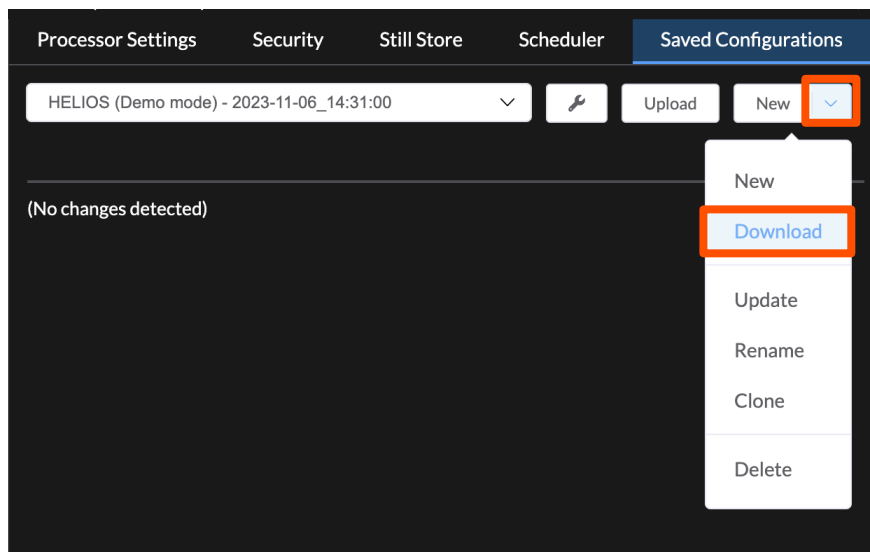


2.  Connect to the target processor, navigate back to the **Saved Configurations** tab and **Upload** the configuration file.
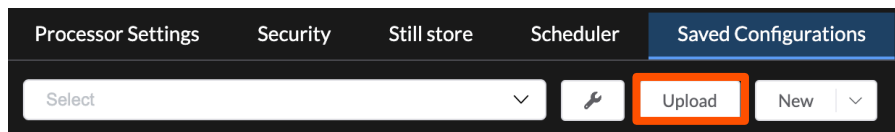


3.  **Apply Configuration** to activate the file.
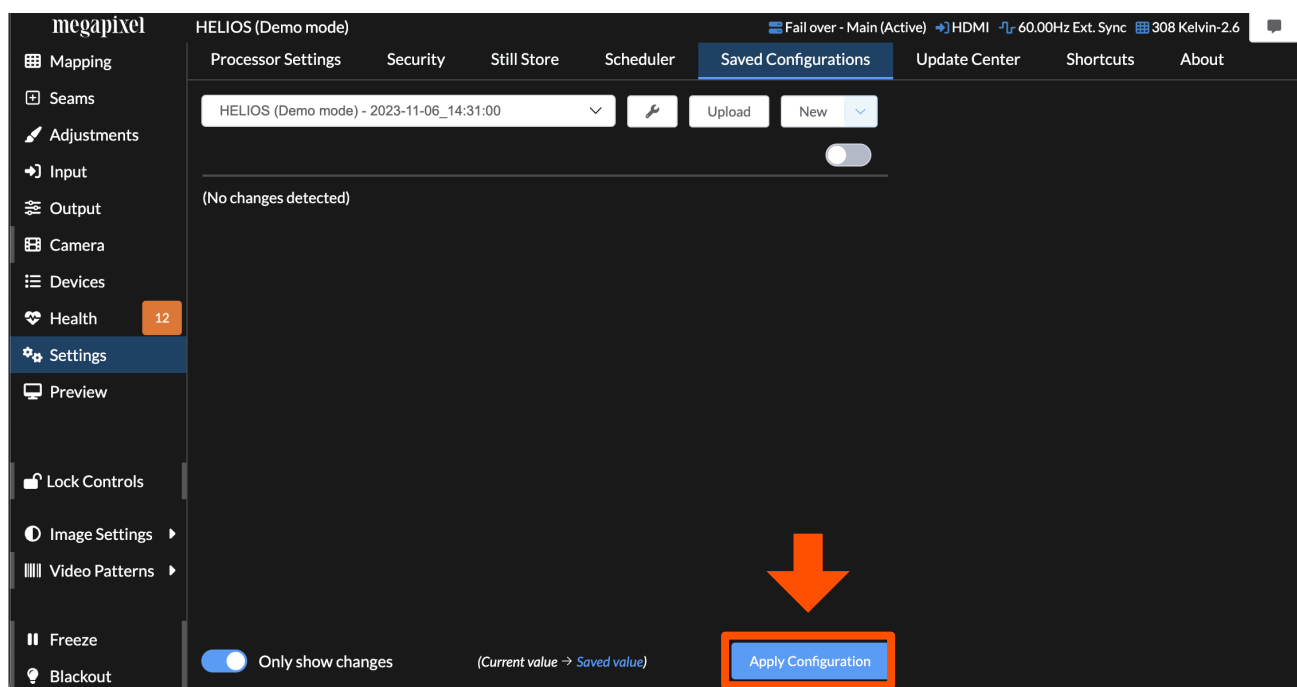
# Update Center

The **Update Center** is used to manage the firmware, software, and operating system updates to the HELIOS system components. Update packages can be retrieved to the HELIOS Processor using the **Check for updates...** button.
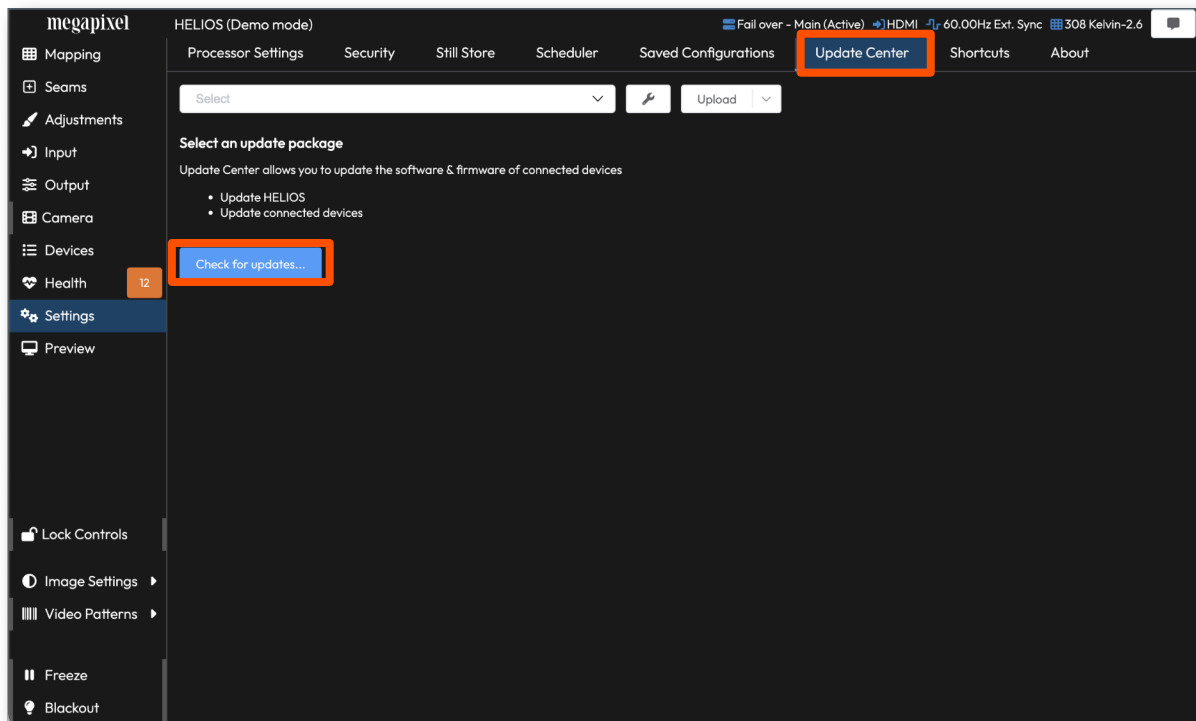


**Figure 146:** Update Center

A small green or yellow arrow indicates whether the package is an upgrade or downgrade to the the existing software. Select either an existing package from the list or add a new one to the HELIOS, with the **Upload** button. All of the Megapixel packages will end with the '.mvrp' extension. The HELIOS packages will be labeled with 'helios' at the beginning of the file name. Tile packages begin with 'px1' (the name of the receiver card). Network Switch packages will begin with 'helios-switches'. Upgrade steps are provided on the following two pages.
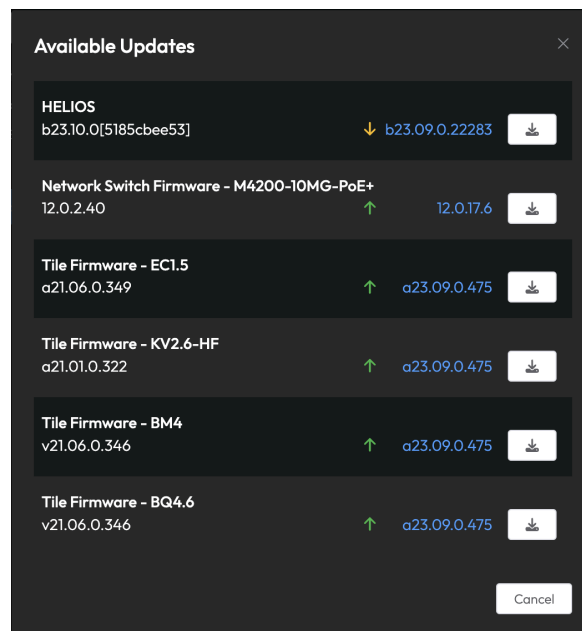


**Figure 147:** Available updates window

## Software upgrade steps

1. Navigate to: **Settings > Update Center** and select the **Upload** button.
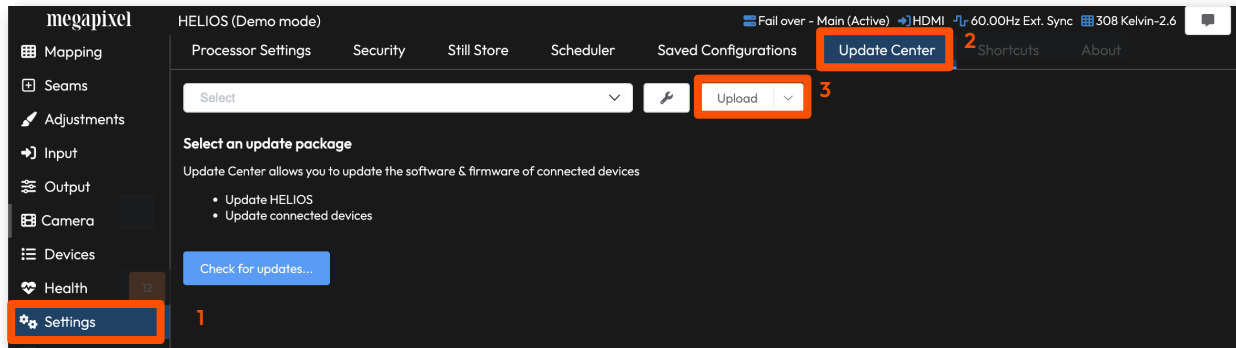


2. Browse to the current software .mvrp file on your computer and upload it. A progress bar will appear during the upload.
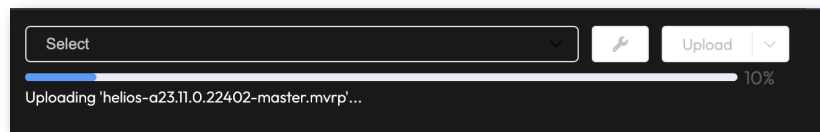


3. After the package has uploaded, select the new .mvrp package from the drop down list, then click **Start**. The upgrade process will show a progress bar.
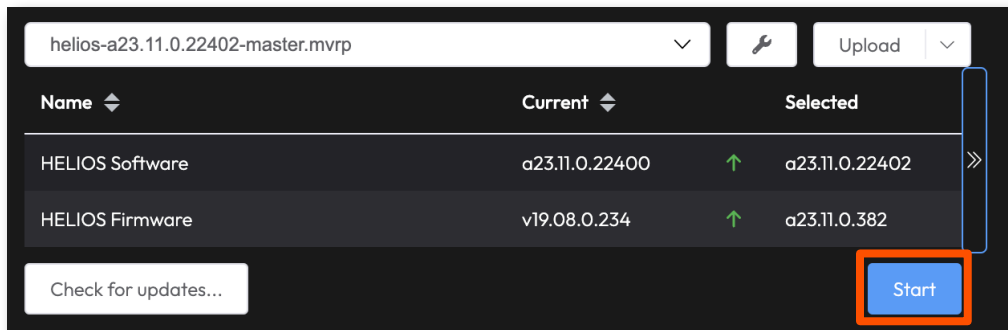
## Software upgrade steps (continued)

4. During the upgrade, a **Connection lost**. message is shown as HELIOS extracts and installs the package.



5. Once the upgrade is complete, the current software version can be confirmed in the table below.

# Shortcuts

The shortcuts menu provides a list of functions that have been assigned keyboard shortcuts. The information here is also available with the press of  SHIFT + ?.
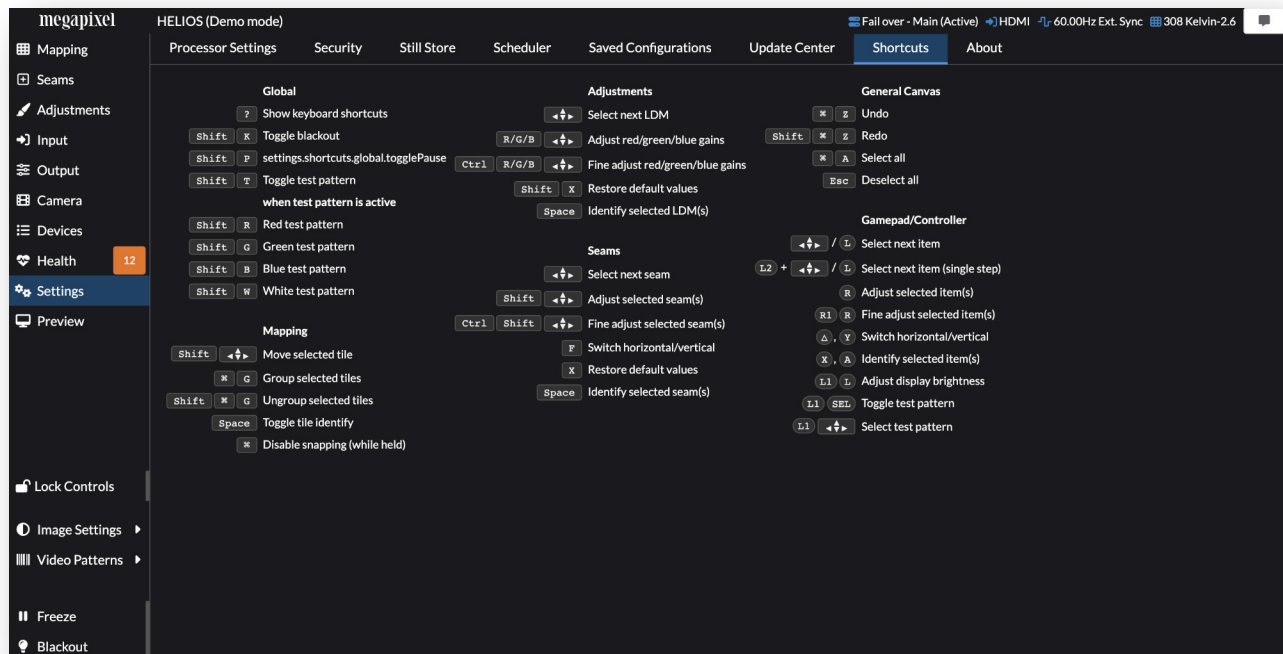


**Figure 148:** Shortcuts tab

# About

The About tab displays the current HELIOS version number along with important links for contacting support. Press the **Download support archive** button to save a zip file containing HELIOS system information files that are essential to obtaining new system licenses and are helpful for troubleshooting.
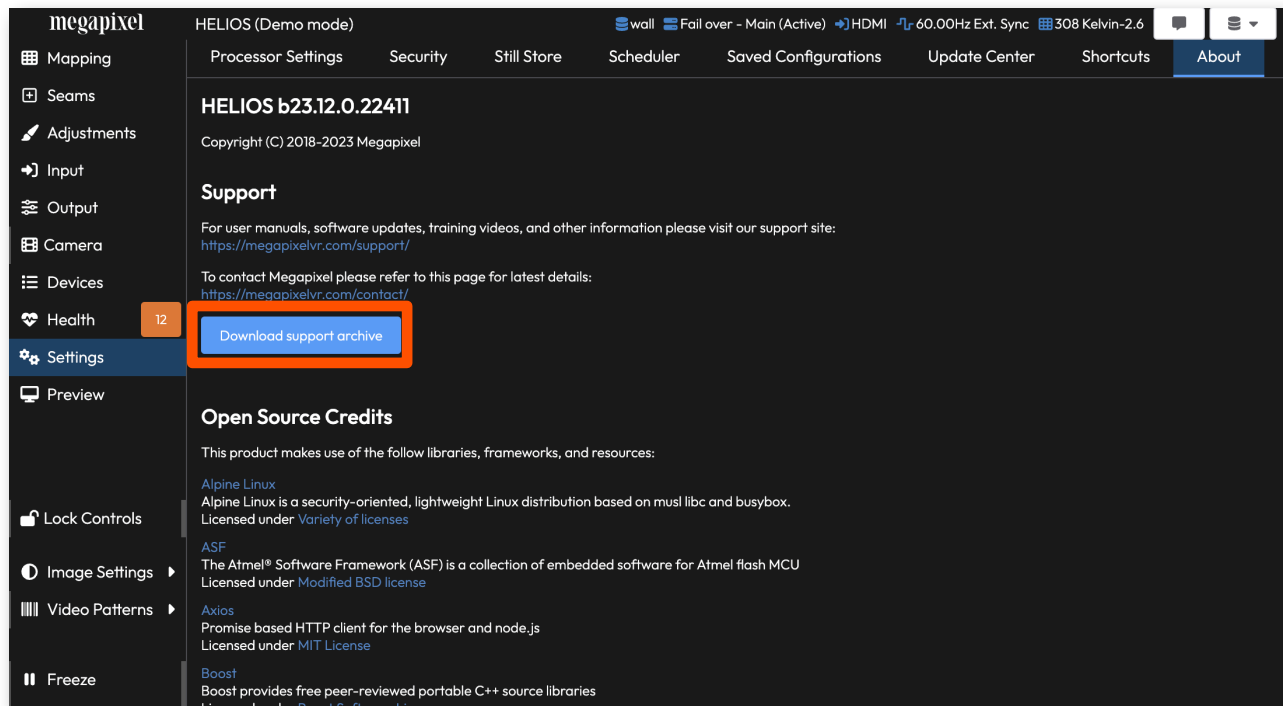


**Figure 149:** About tab

> **NOTE:** Support archives can be uploaded and inspected at the HELIOS demo website About page. Visit **https://demo.megapixelvr.com** and create a login if you don't have one. Once on the **About** page, press the **Upload support** button. Navigate to a support archive saved from a real HELIOS and upload it to the demo site. The demo site will switch from using the the demo backend to the support archive data. Reload the website to return it to using the usual demo backend.
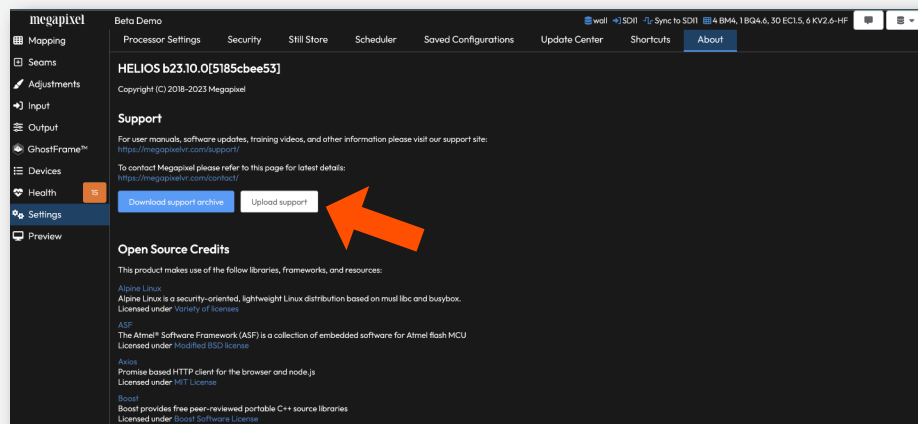
## Preview Pane

The Preview pane displays a low resolution, low frame rate version of actively connected inputs. The layout of the preview window layout will reconfigure based on which inputs are active and which input is selected. In the example below the HELIOS unit is receiving a quad SDI signal, but the unit has HDMI selected as the current input. Four (4) active SDI feeds are visible below a black HDMI preview.
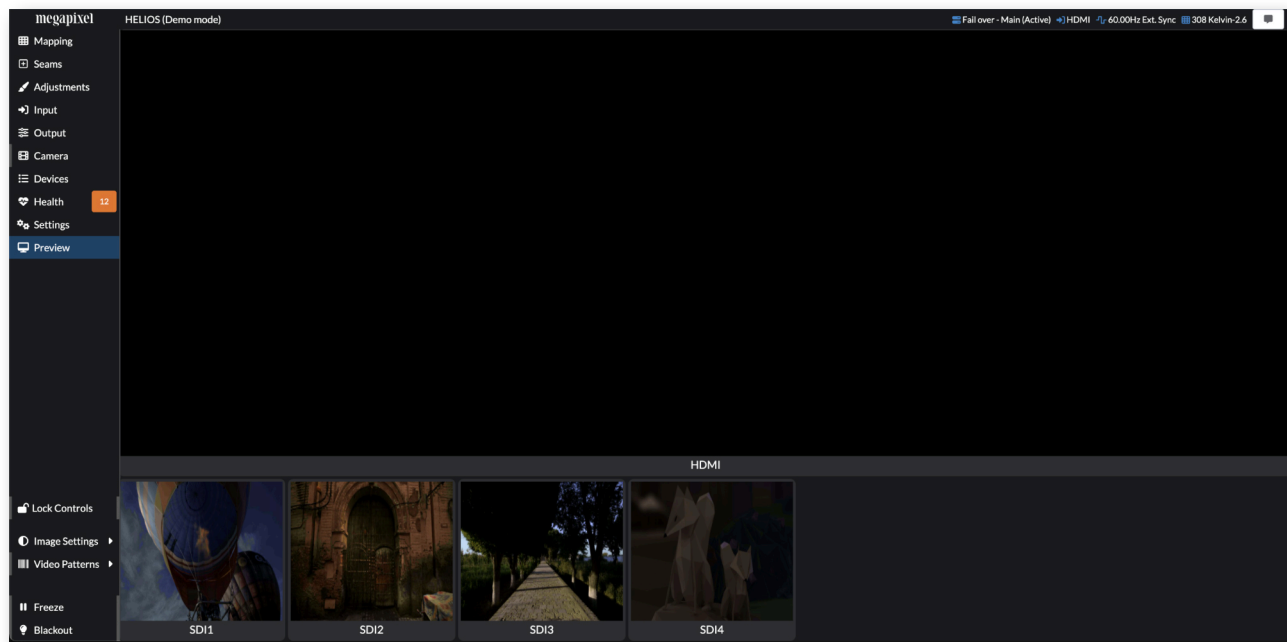


**Figure 150:** Preview pane – No HDMI input

In the example below SDI1 has been selected as the input. The preview pane shows SDI1 maximized at the top. Other active, but not selected inputs are shown as thumbnails at the bottom of the pane.
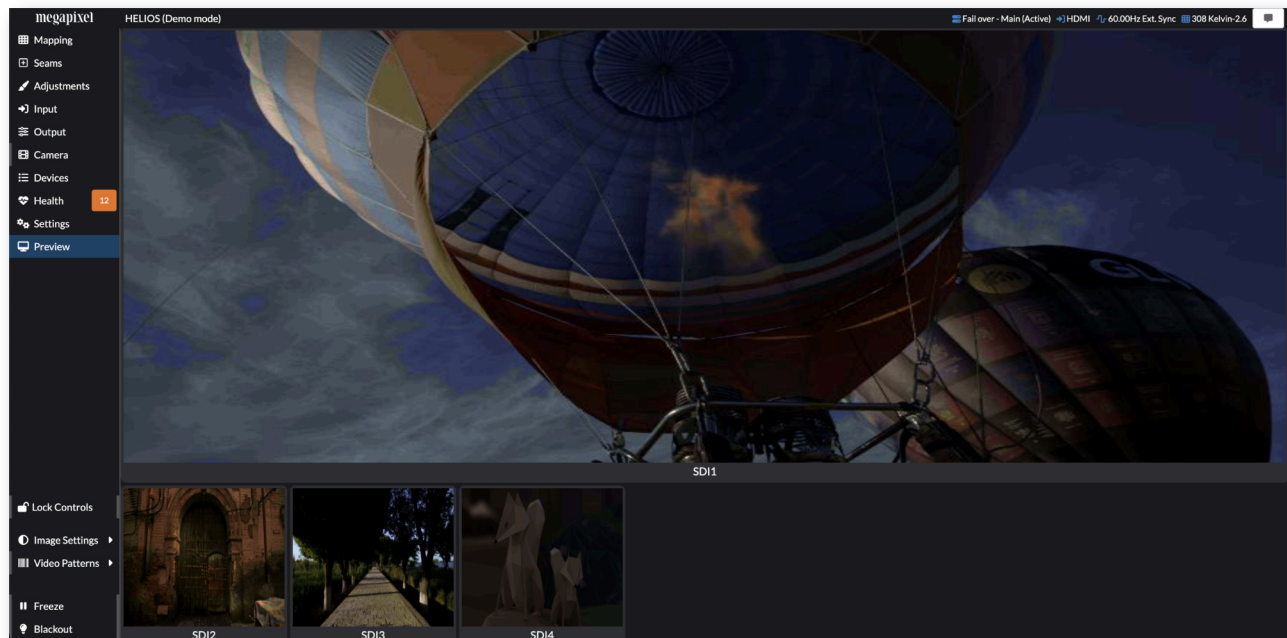


**Figure 151:** Preview pane – SDI1 selected

## Preview Pane (continued)

With either of the Quad SDI (SDI 1x4 or SDI 2x2) input options selected, the Preview pane stitches the four (4) SDI feeds together.
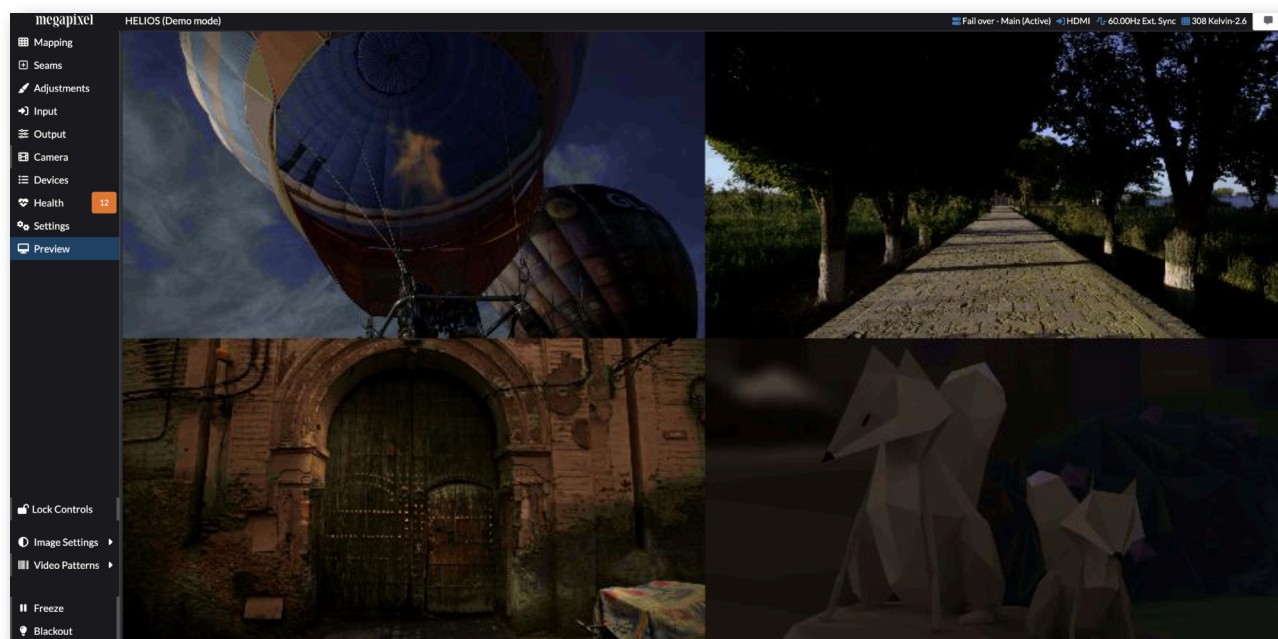


**Figure 152:** Preview pane – Quad SDI

# Seams Pane

Displays occasionally have minor intensity variations at physical tile seams. This is usually caused by inconsistent physical gaps between tiles. Prior to adjusting seams electronically, the installation should be checked for hardware inconsistencies (e.g. latches not engaged, tiles and LDMs not seated properly). The HELIOS Processor provides seam correction by specifically adjusting the intensity of the edge LEDs. Shown below is a selection of horizontal seams highlighted in light blue. When using the **Tile Seams** tab, each selectable region in the user interface is the edge of a tile. When using the **LDM Seams** tab each selectable regions is an LDM (LED module) boundary.

We have found that video game controllers are well suited for the seam correction workflow. The HELIOS UI supports Xbox and Playstation* controllers. The game controller connects via USB or Bluetooth to the laptop or mobile device that is running the HELIOS web UI. Multiple users are supported as each browser connection can have a game controller connected.
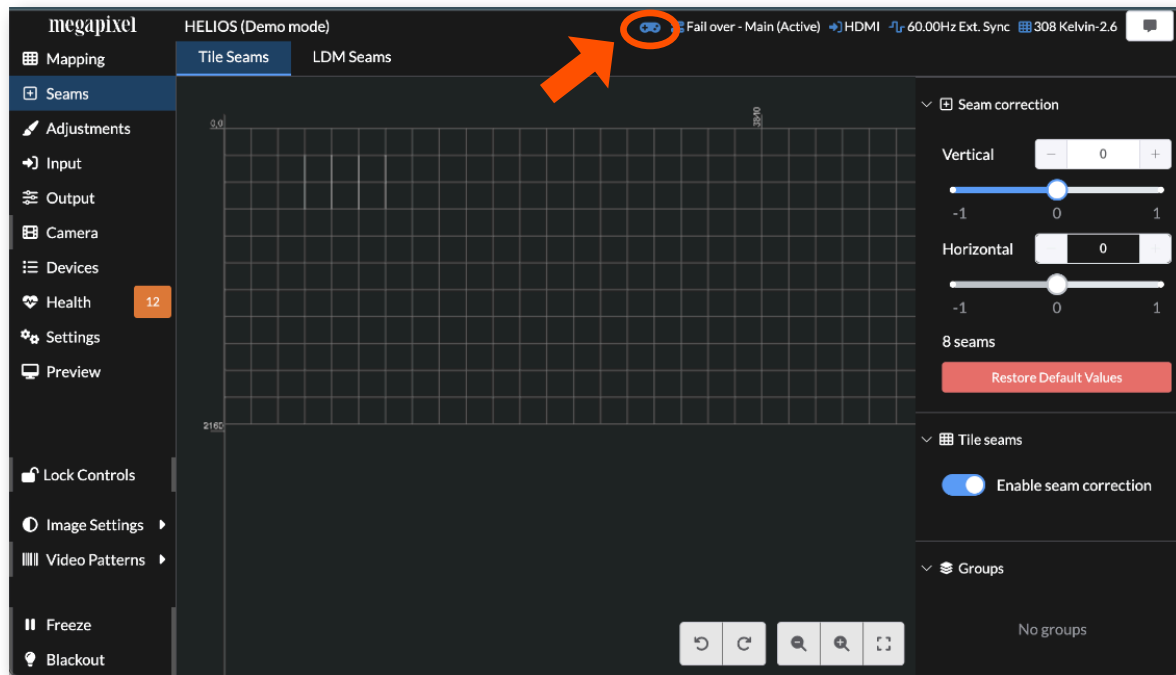


**Figure 153:** Seams pane.

Steps to setup a Bluetooth controller with a mobile host:

1. Begin with the controller turned off. Then, put the controller in pairing mode:

   - Xbox – press the Xbox button to turn on the controller. Then, press and hold the Connect button for a few seconds.
   - PlayStation – press and hold the PS and Share buttons at the same time until the light bar begins to flash.

2. Navigate to the Settings and ensure Bluetooth is turned on.

   - Find the name of the controller under Other Devices. Tap the name to connect.

3. With the web browser in focus and connected to HELIOS press the X button on the controller.

4. A gamepad icon (see image above) should appear on the HELIOS UI confirming the link with the game controller.

* Xbox is a trademark of Microsoft® Corporation. PlayStation is a trademark of Sony Interactive Entertainment Inc.

## Seams Pane (continued)

The warning below is shown when a user connects to HELIOS using the https:// protocol because each HELIOS includes its own self-signed certificate. HELIOS supports loading custom signed HTTPS certificates. See the [Networking (Advanced)](#) section for more information on loading custom HTTPS certificates.

As browsers move to requiring a secure context for gamepad support, users will need to use an https:// connection to enjoy gamepad powered seam correction. Existing http:// (no 's') connection will soon no-longer register that a game controller is even connected.

This change was defined by the W3C who are concerned with protecting the privacy & security of users on the internet. We are actively exploring options, but for now a user has to connect to HELIOS using the https:// protocol to be able to use gamepads on Firefox, and soon the other major browsers

If a warning such as the one below appears when connecting to HELIOS via https://, press the **Advanced…** button on the warning page and **Accept the Risk and Continue** in order to bypass the warning.
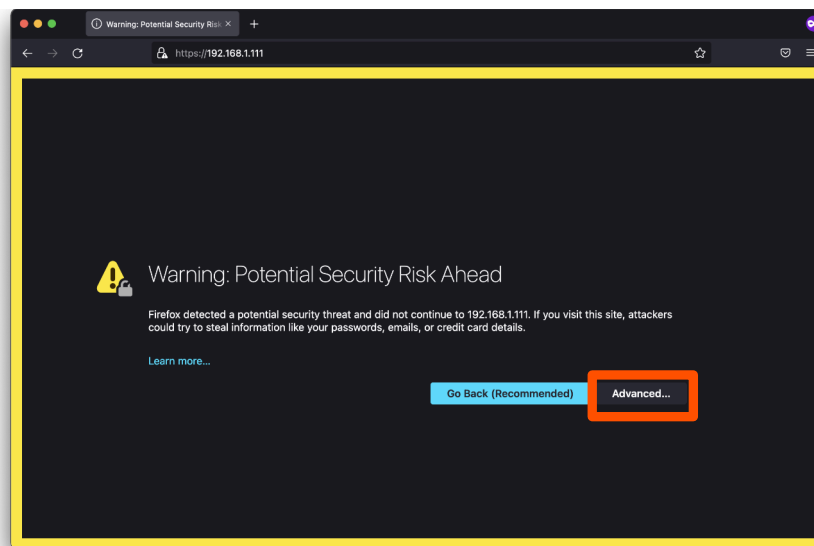


**Figure 154:** https:// warning 'Advanced'
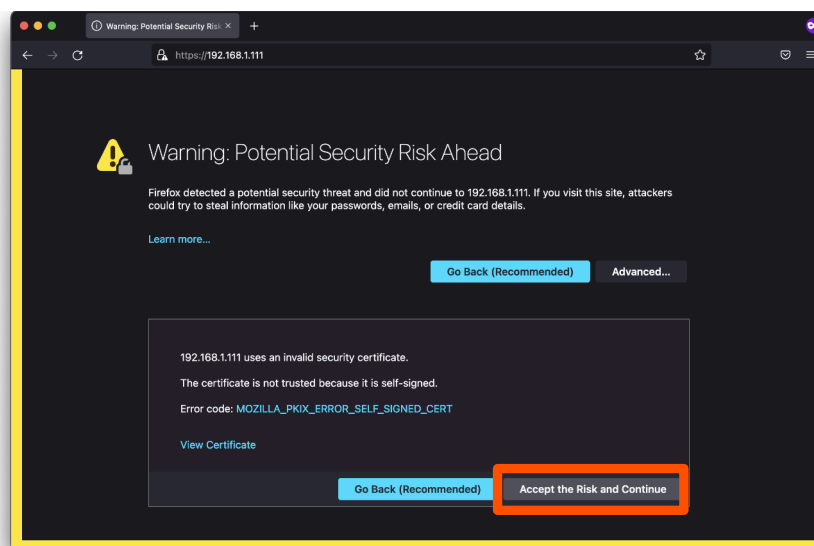


**Figure 155:** Game pad warning 'Accept the Risk and Continue'

**Seam selection** - Both the D-pad and the left stick control seam selection. However, there is a key difference between the two. The D-pad moves the selection one seam per click, whereas the left stick is an analog control. The further the stick is pushed, the faster the selector moves across seams.

**Adjust seam** - Analog control of brightness for the selected seam.

**Toggle H/V adjust** - Toggles between Horizontal or Vertical seams.

**X button** - Flashes the selected seam. Since the seam will not remain highlighted while adjusting, it is easy to lose track of which seam is currently selected. This function helps identify the currently selected seam.

**R1** - For fine control, press and hold the R1 button while using the analog stick.



**Figure 156:** Control assignment

**Tips:**

- Start on one side and work across the screen systematically.
- If multiple users are working, assign regions to each user.
- Check the screen from several view points and distances.

# Adjustments Pane

The HELIOS Processor can adjust the RGB gains on individual LED modules (there is no full tile option). Gain adjustments at the LDM level are available if supported by the tile manufacturer and firmware. Select tiles and use the sliders to make the adjustments. The user interface will tint the tile region to show the color bias assigned to the tile. Shit+click selects multiple tiles. Alt+click selects individual LDMs (if individual LDM adjustment is supported).
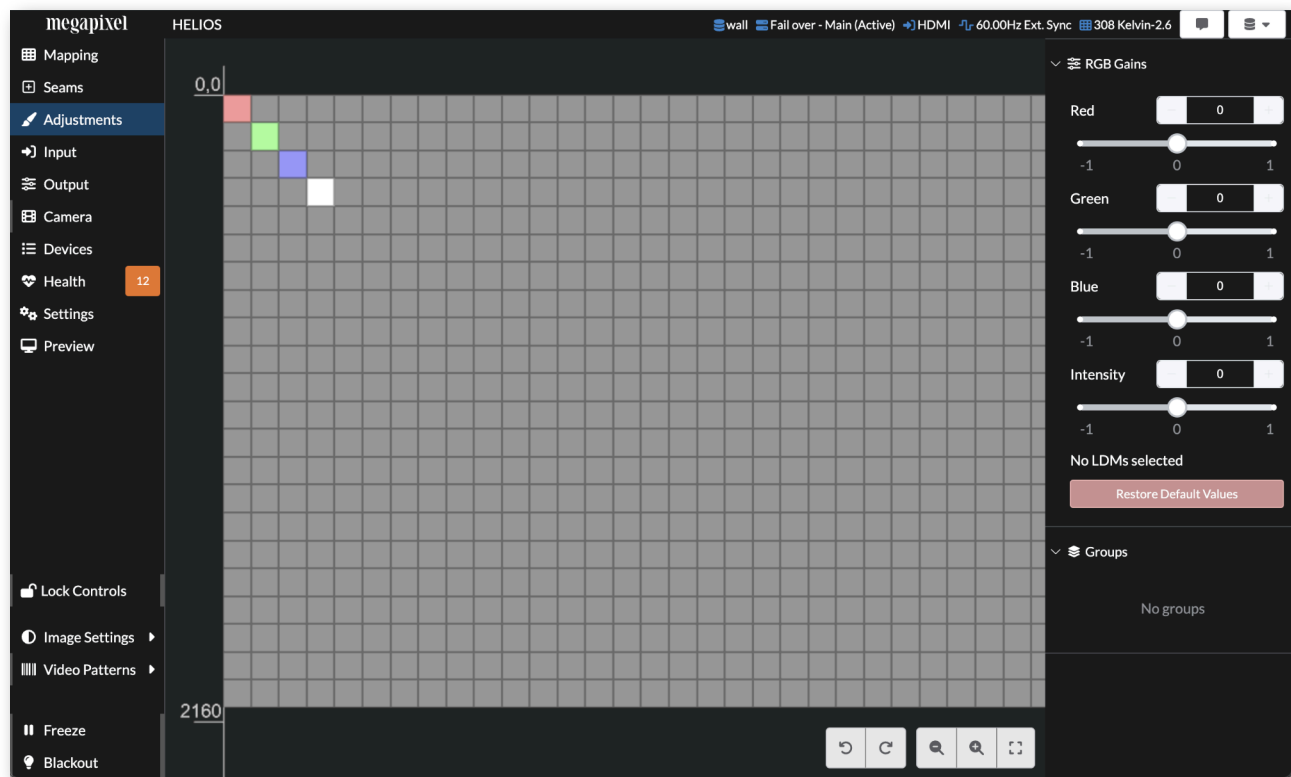


**Figure 157:** RGB gains Adjustments pane

# Maintenance & Accessories

## General Maintenance

Proper maintenance of the HELIOS Processor involves periodically checking the hardware for any parts that are loose or become damaged. Connectors should be checked and the unit replaced if housings are damaged or pins are bent or deformed.

## Processor Filter Maintenance

The front filter on the air intake ducts of the HELIOS Processor should be periodically cleaned. Gently pry the foam filter out and clean or replace the filters.
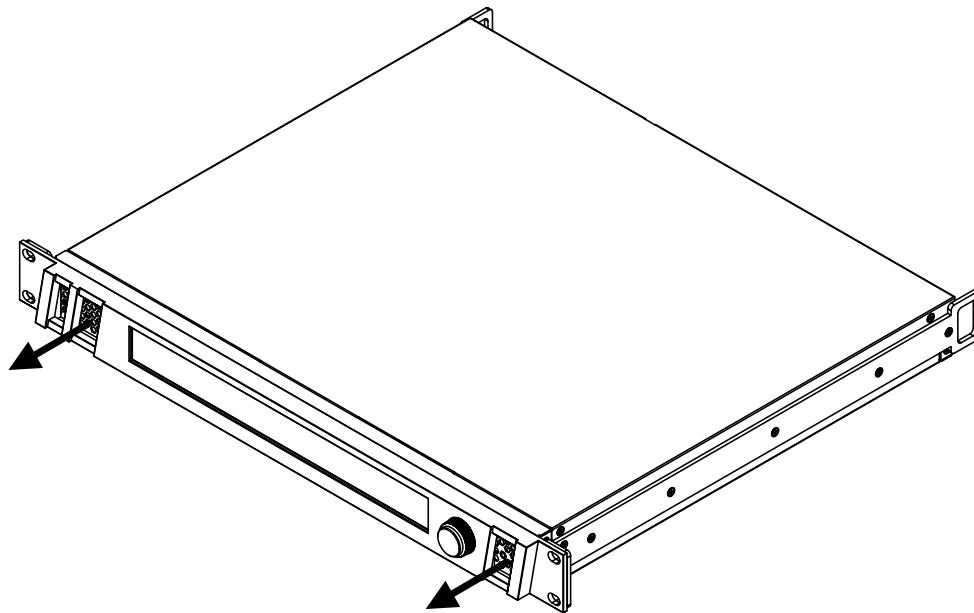
**Figure 158:** Remove air intake fan filters for service.

## Processor Fuse Replacement

The HELIOS Processor has two 6.3A fuses at the power inlet. To replace these, use a small flat head screwdriver to gently pry loose the fuse tray. Slide the tray out to the limit. Examine and replace fuses as necessary. If blown fuses are a persistent issue, return the unit to Megapixel for repair.

**Pry Here**

**Slide Out**

**Bend cap**

**Remove Fuses**
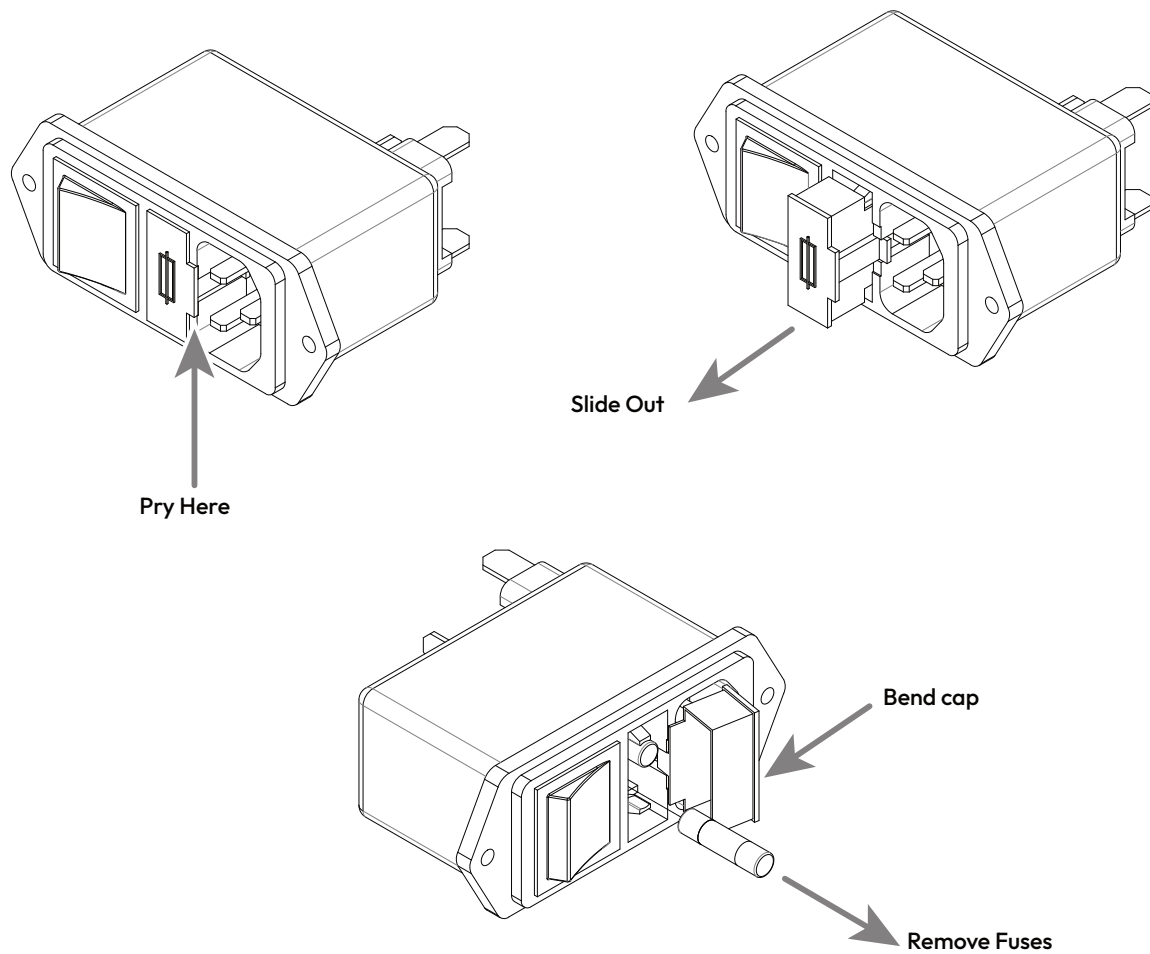
**Figure 159:** Processor fuse replacement.

# Unknown User / Password

## Overview

When user authentication is enabled, the web UI requires a user name and password for access. If the user name and password are lost, the only way to regain access is to restore the HELIOS to factory defaults.

**All current show information will be deleted!**
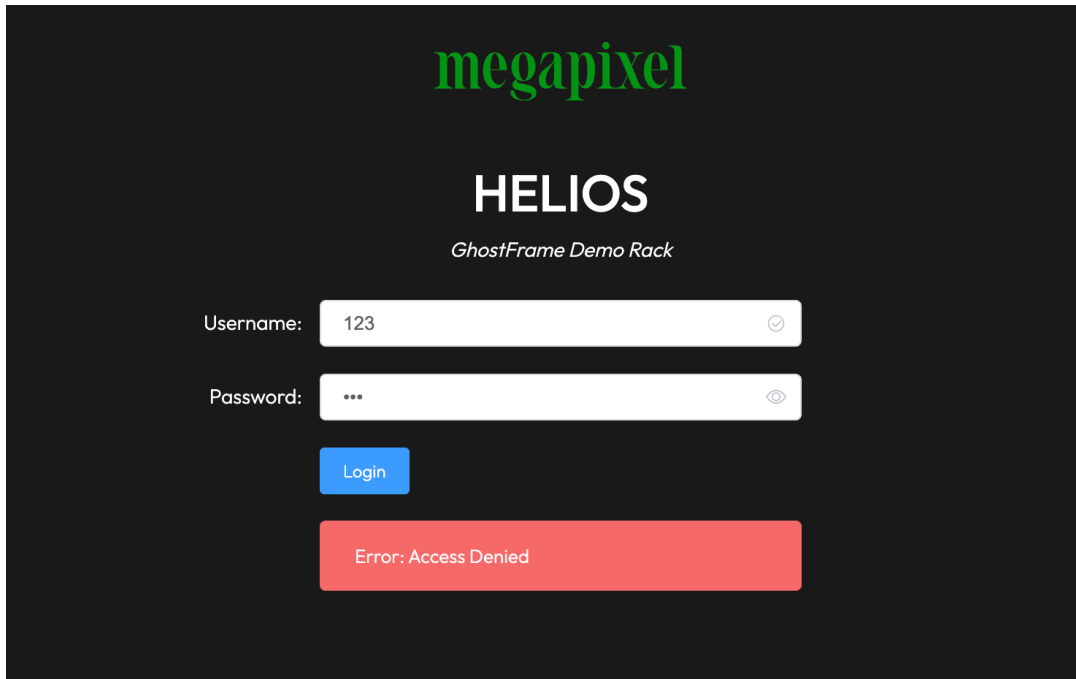


**Figure 160:** HELIOS 'Access Denied'.

## Restoring to Factory Default

1. Press the encoder on the front of the HELIOS unit to access the HELIOS menu.
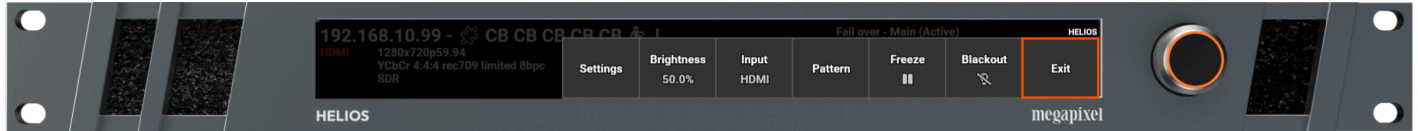


2. Turn the encoder to select Settings.
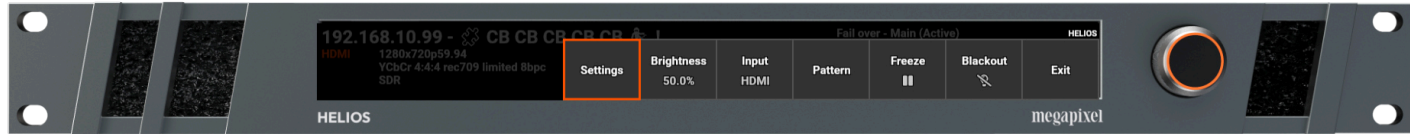


3. Select Factory Default.



4. Confirm the selection reset to factory defaults. The HELIOS will reboot.
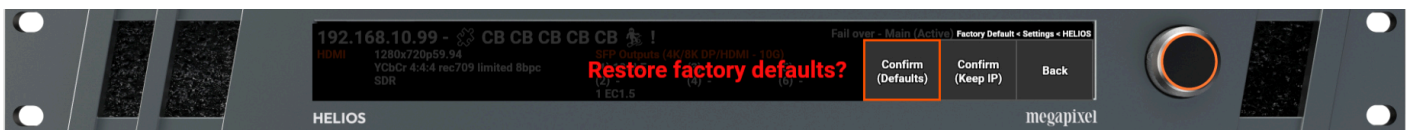


**All current show information will be deleted!**

# Troubleshooting Fiber

## Overview

The root causes of fiber connectivity issues are typically related to the fiber cable or the SFP+ units (sending or receiving).

**Troubleshooting checklist:**

1. Check for fiber link activity lights. HELIOS units have a row of fiber connectivity indicators across the middle of the sending SFP+ group (orange rectangle below). If there is activity on these indicators, the fiber is connected.



2. Check the HELIOS UI for reported signal loss. The SFP **TX** value must be greater than -9 dbm. The example below shows a -11.8 dBm transmit signal. This is below the minimum -9 dbm required. Also check for any network related error messages on the **Health pane**.
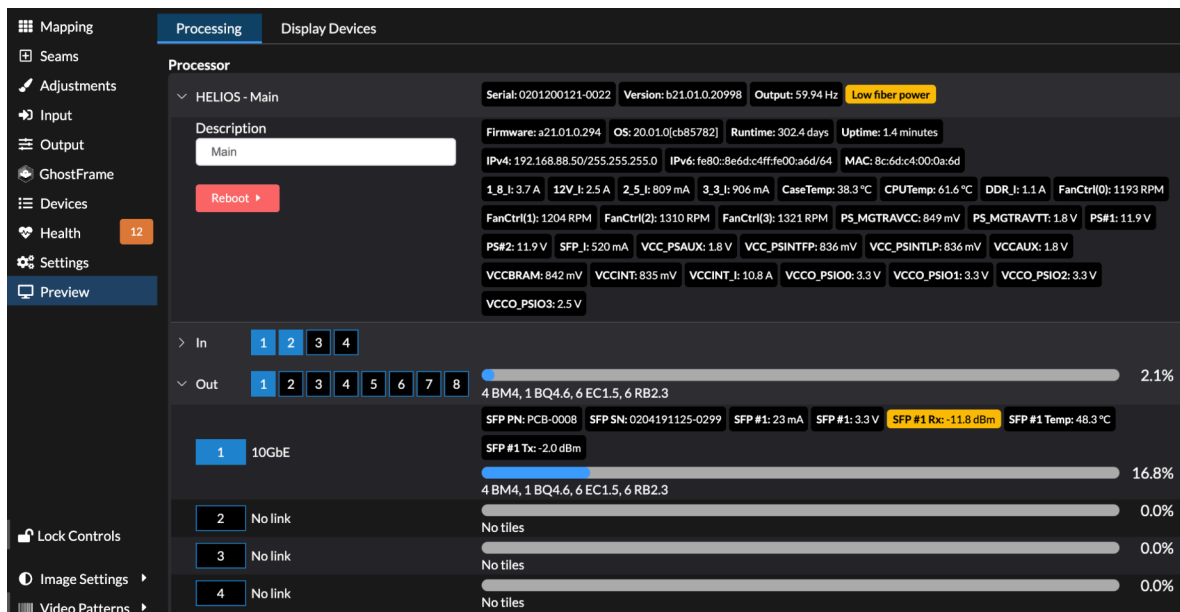


3. Swap the connection for a different fiber strand or cable.

4. Verify fiber type is correct. It should be single mode fiber, 'OS1' or 'OS2'.

5. Confirm correct SFP+ units are being used on each end. Fiber connectivity between the HELIOS and the network switches require unique Megapixel branded SFP+ units.  HELIOS units have sending SFP+ units, network

switches have receiving SFP+ units.

## SFP+ Types

**Sending SFP+** – Blue bale clasp, labeled with arrows pointed away from the HELIOS (top example).

**Receiving SFP+** – Purple bale clasp, labeled with arrows pointed towards the network switch (bottom example).



**Figure 161:** Send and receive SFP+ units.

## Testing SFP+ units

The three strategies below can help diagnose a cable or SFP+ issue.

1.  Setup the network switch near HELIOS, and connect a known good, short fiber cable, and test the link.

2.  Remove the purple SFP+ from a network switch and move it to an available HELIOS SFP+ output slot. Use a known good, short fiber cable to link the purple SFP+ with the blue SFP+. If the SFP+ units link successfully, they are good. The issue is likely related to the fiber cable itself.

3.  Remove a blue SFP+ from a HELIOS output slot and move it to an available SFP slot on a network switch. Connect a known good, short fiber cable between the two SFP+ units and check for link. If the SFP+ units link successfully, the issue is likely related to the fiber cable itself.

4.  If an SFP+ fails this test, it will need to be returned for replacement. Please contact your Megapixel representative for further instructions.

---

**NOTE:** The above can only be done using different models of SFP+ (purple and blue). Fiber systems cannot link two sending units or two receiving units.

## Incompatible SFP Alert

HELIOS units must be properly licensed for the SFP modules in use. The standard license allows 1G copper if set to Junior operating mode **or** 10G fiber if set to standard operating mode. Whereas the junior license only allows 1G copper, and will have standard mode grayed out in the selection drop down. Mismatched licenses and SFP modules will generate system health alerts.
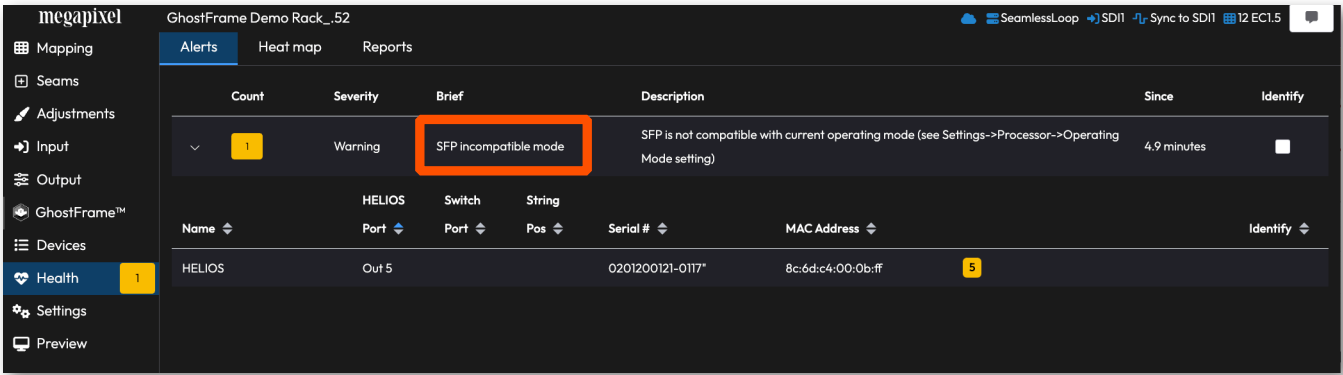


**Figure 162:** Incompatible SFP.

## Troubleshooting License Checklist:

1. Check the system **Settings**> **Processor Settings** > **Licensing** for the license type. A HELIOS Standard license enables both copper and fiber SFP+ modules, whereas a HELIOS Junior license only enables copper SFP modules.
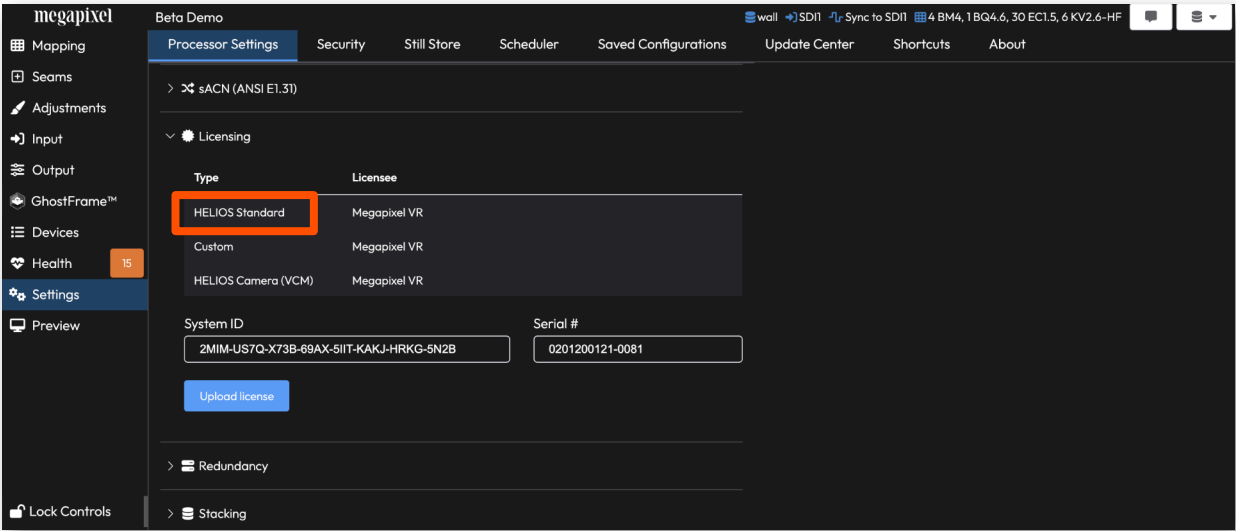


**Figure 163:** HELIOS Standard license.

2. Check the operating mode in system settings. A HELIOS Junior license will only operate Junior mode.
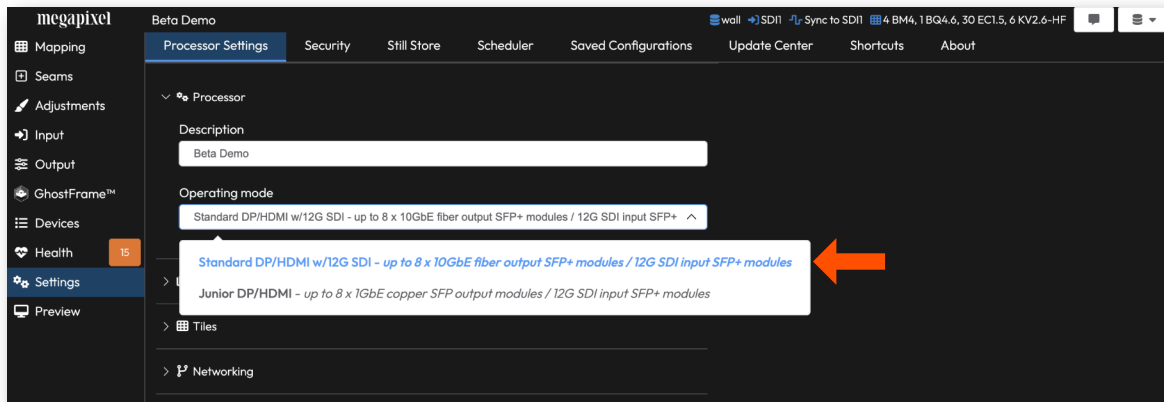


**Figure 164:** Operating mode

3. Check the type of SFP modules and in which ports they are installed in the **Devices** pane. The image below shows the error a HELIOS Standard system will generate in Standard mode with a copper SFP installed in port 7. Copper SFP modules are only compatible with a HELIOS in Junior mode. If copper SFP module(s) are needed, the user should switch the HELIOS to Junior mode (in Processor Settings). A HELIOS Standard can operate in both Junior and Standard modes.
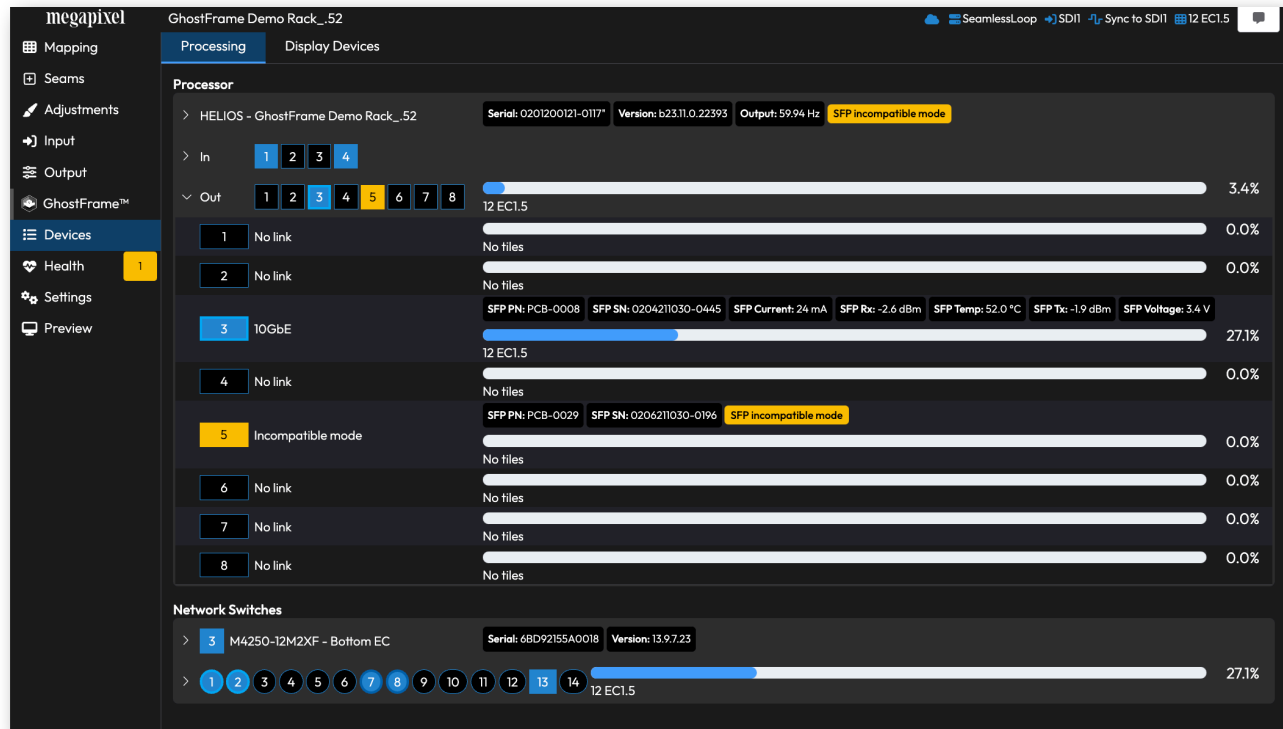


**Figure 165:** Devices Pane Incompatible Copper SFP+ modules

# D

# Low Level Noise Reduction

## Overview

This section describes what Megapixel has found to be the most effective method for reducing low level video noise on LED displays.

Below are two images of an LED display with a dark field next to a person. The image on the left is an example of low level noise that needs to be removed (the errors in black have been exaggerated for illustrative purposes). The black region to the left of the person shows several blocks of different degrees of black. After the adjustments in HELIOS, the image on the right shows fewer irregularities in the black region next to the person.
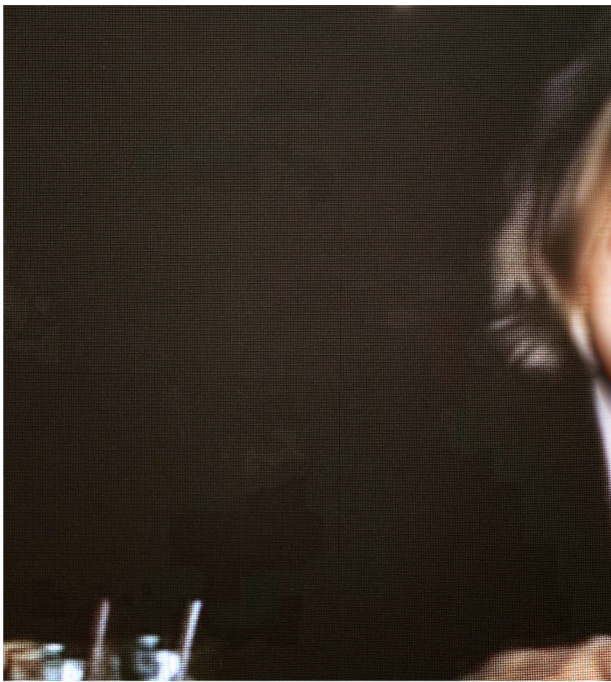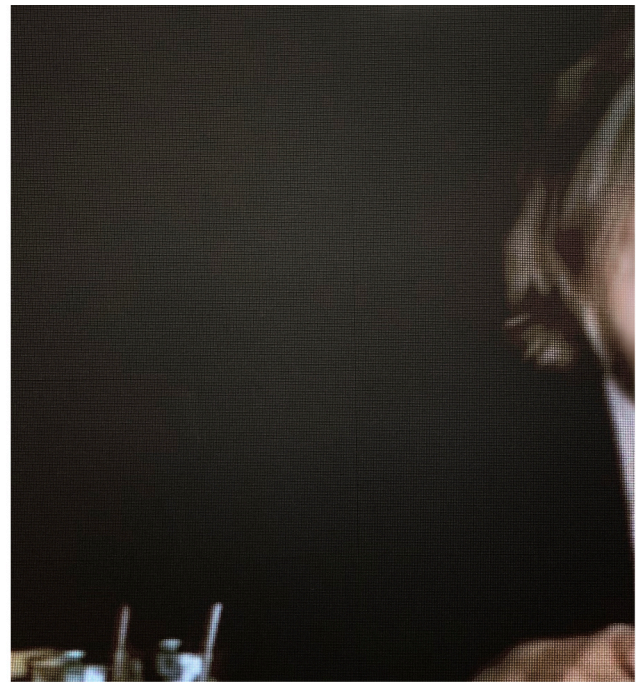


**Before**                    **After**

**Figure 166:** Before and After Correction

## Low Level Noise Reduction Steps

1. Ensure that the content is as noise free as possible before it is sent to HELIOS.

2. Enable Advanced Mode in **Settings > Processor Settings.**
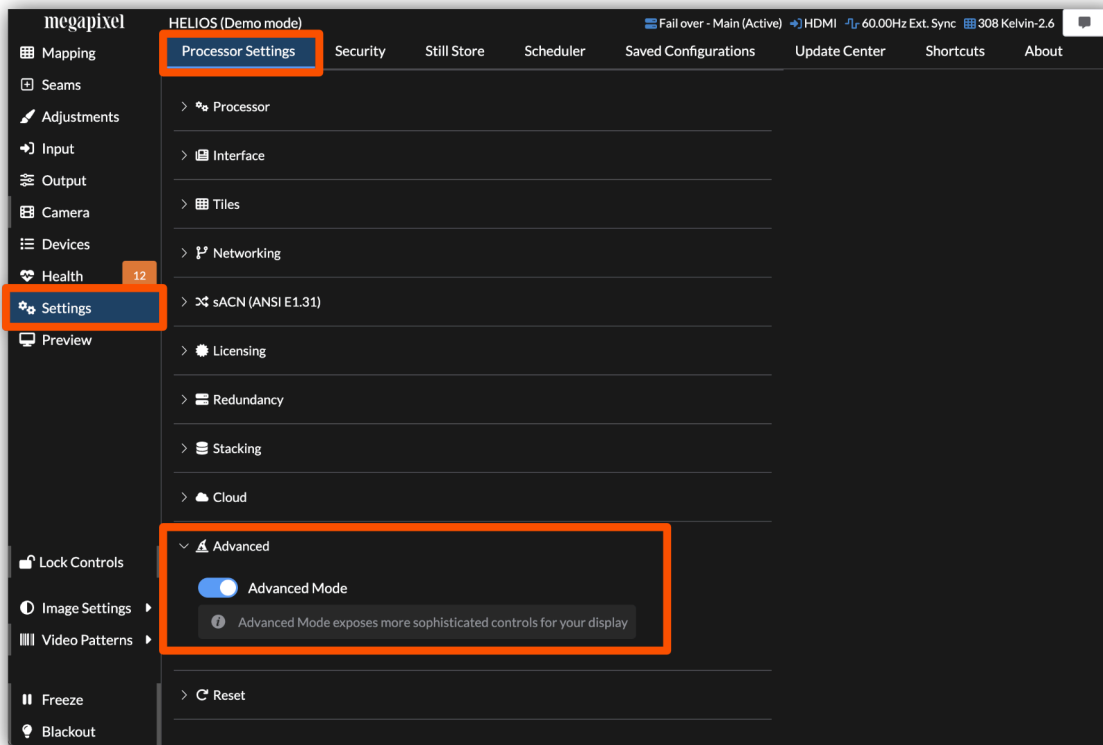


**Figure 167:** Advanced Mode

Navigate to the **Output** pane > **Output adjustments** accordion and increase the **Black clipping** value.

**Black clipping** – raises the floor for the value to be considered black. This causes a loss of detail in shadows and other dark content regions as values below the threshold are not displayed.
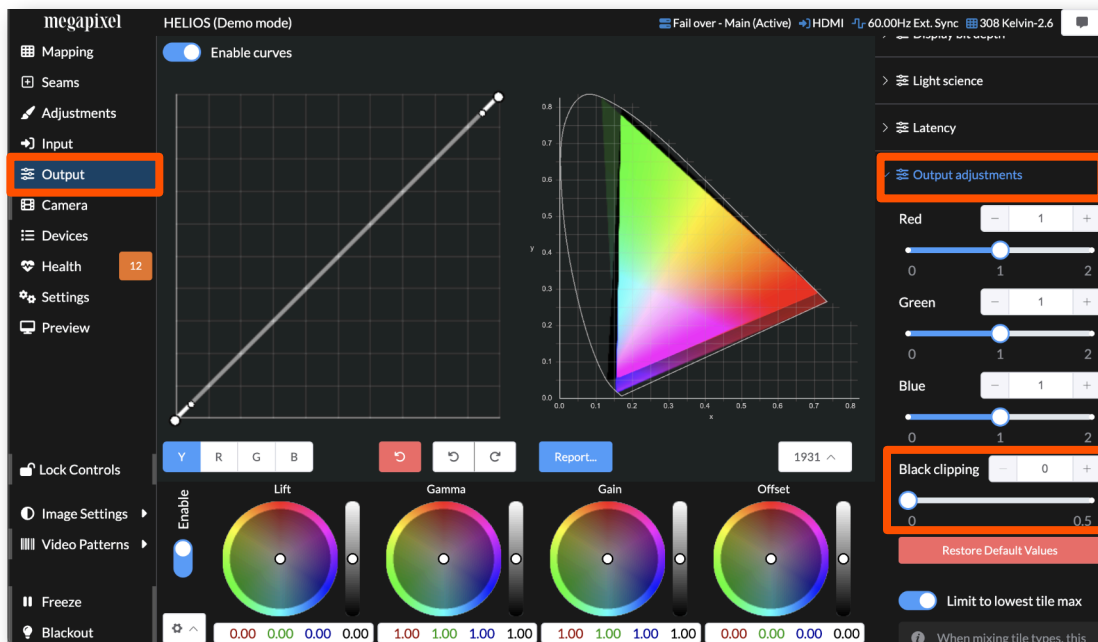


**Figure 168:** Output adjustments

# Low Level Noise Reduction Steps (continued)

4.  Navigate to the **Input** pane > **Input adjustments > Black Level** slider control to reduce the noise coming in by raising the black level.
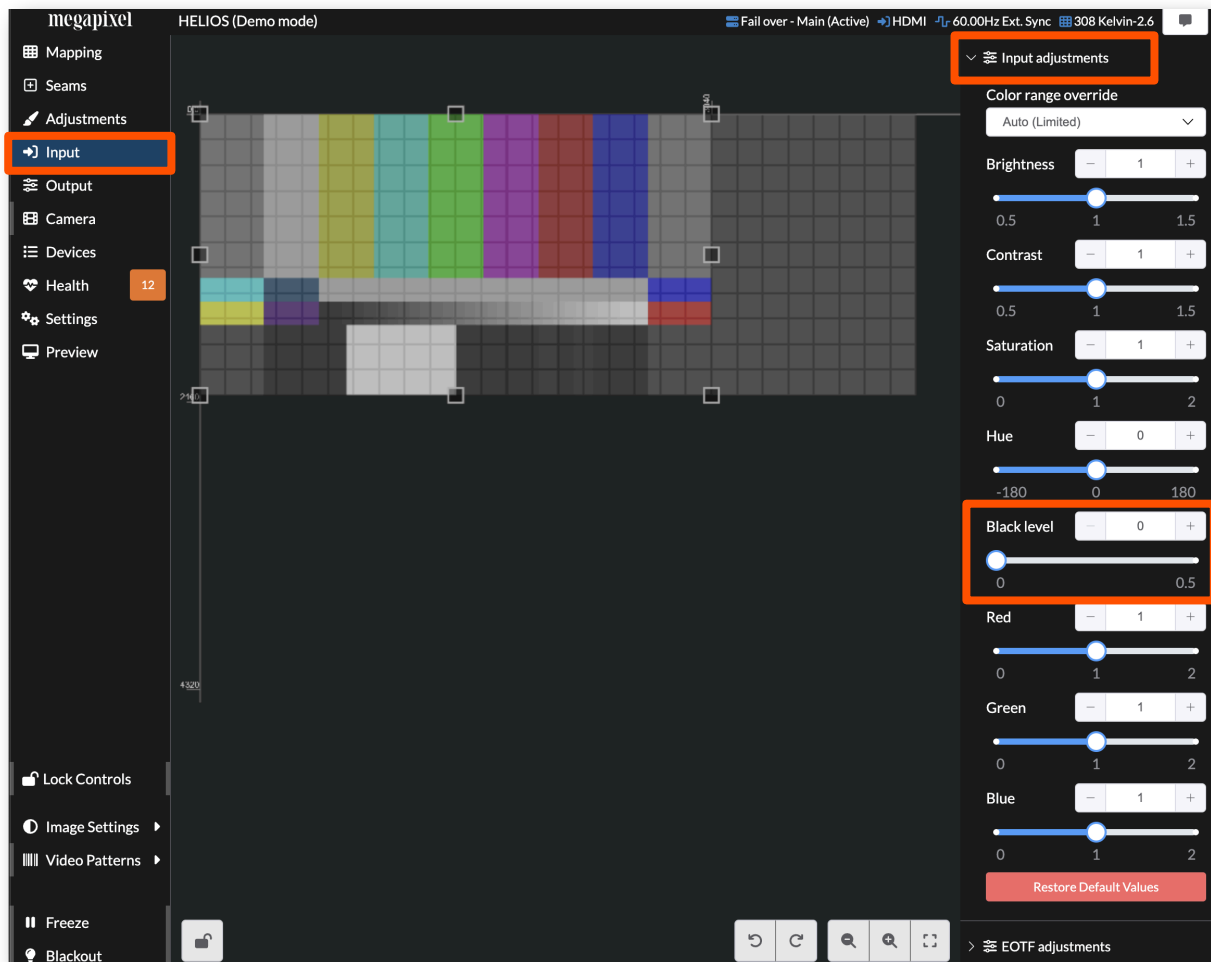


**Figure 169:** Input Black Level

# Content to Panel Luminance Curves

## Overview

PQ encoded HDR content reports a luminance range for the content in the metadata of the HDMI or SDI signal. This section covers how HELIOS handles this luminance data to maximize the capabilities of panels.

The various colored dots on the chart below represent scenarios where panels of different luminance capabilities are matched with content mastered to narrow, medium, and wide range luminance. The far right side cyan dots represent the luminance curve supplied by the PQ content. Each of the 'tile to content' scenarios is mapped against this 0 - 10,000L range.

The blue dot scenario in the graph below shows a panel with a maxL of 100 receiving content mastered with a maxL of 100. The max content level is 100, and the panel is 100. The panel is capable of showing the full range of content (0-100). An image being reproduced in this manner displays the image as artistically intended.

The red dot scenario shows the same 100 maxL panel receiving content mastered to a wider range of 1,000L. The graph shows a more rounded curve as the image loses some of the high level details and the panel is unable to reach the intended brightness levels. The same holds true with the yellow dot scenario, in which a low luminance panel (100L) is given a very wide luminance range. In this case, the slope is even more pronounced as the panel limitations don't allow for the accurate reproduction of the content.
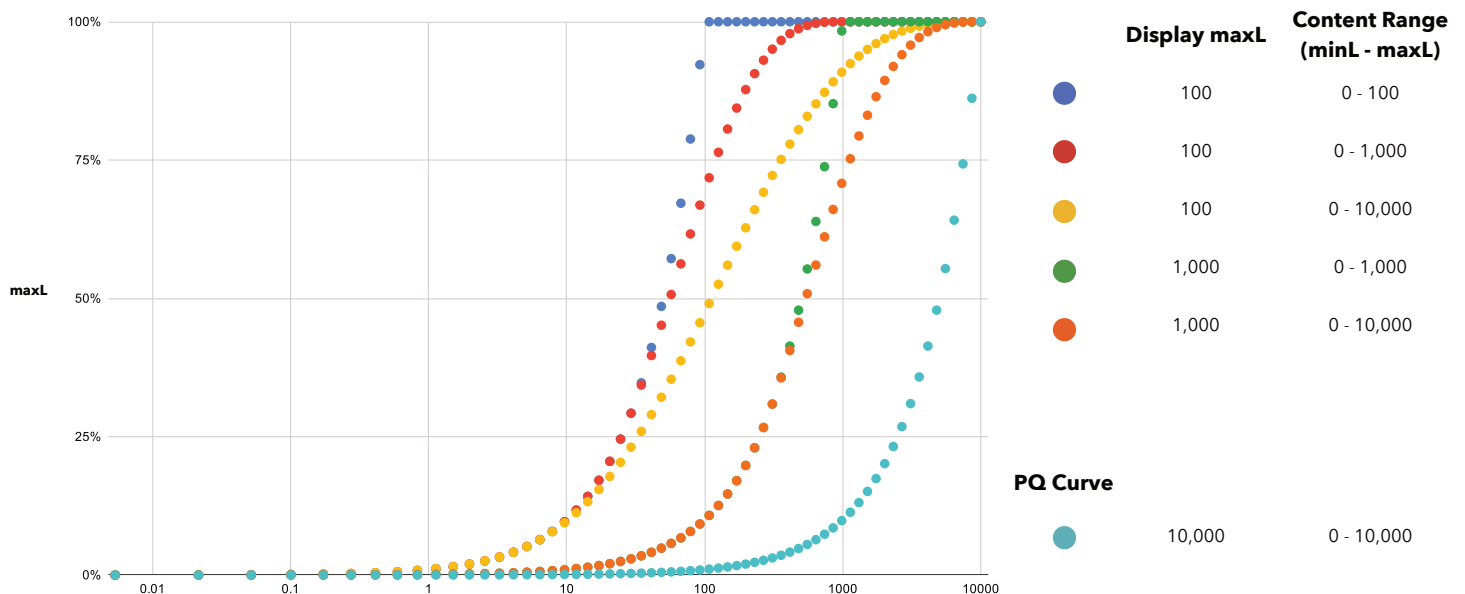


**Figure 170:** HELIOS EOTF Luminance Curves

The image below is a graph of a scenario where 500 nit content is not being displayed correctly on a 100 nit display. As HELIOS has been configured to expect content mastered at 100 nits, while the incoming signal actually has a max content level of 500 nits. Red dots are the content, blue is what actually happens on the display. All of the information above 100% is being clipped by the display.
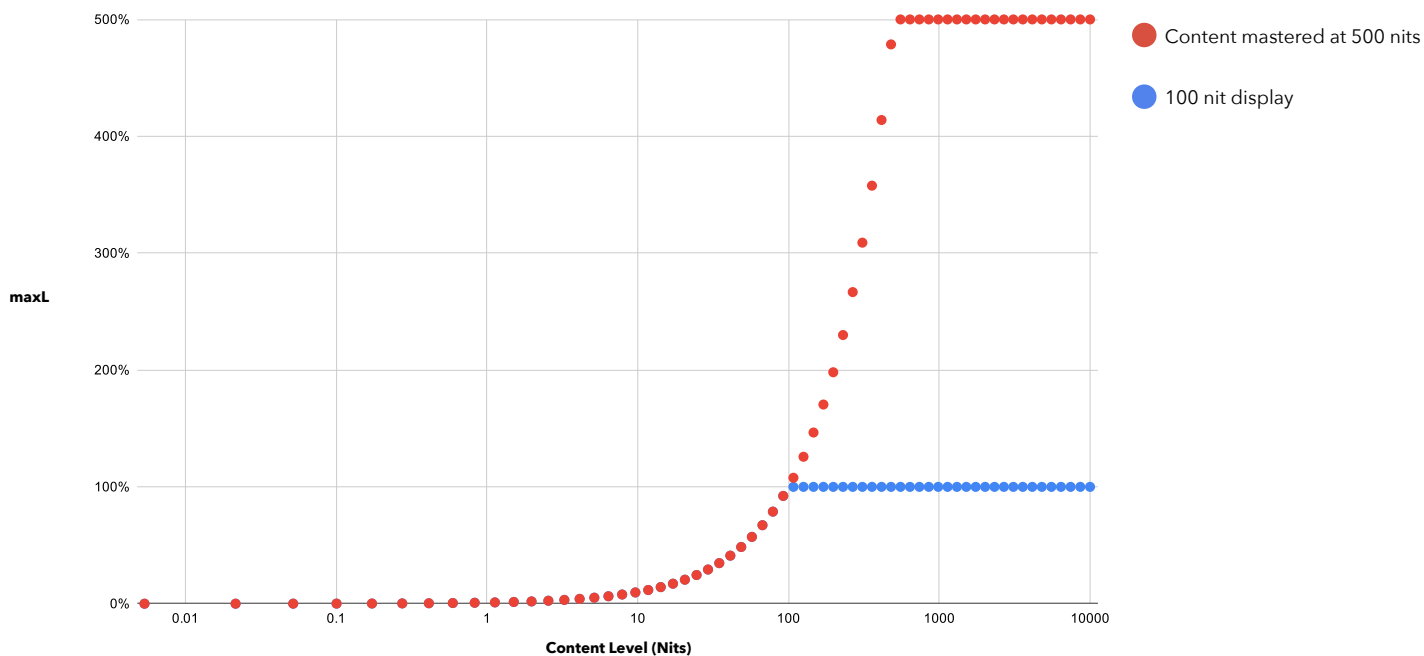


**Figure 171:** *Incorrectly configured content*

It is best practice to align the luminance range of the content to that of the panels. As a workaround for when the content is not mastered for the display, the HELIOS EOTF overrides can be used to "boost" the display's brightness, but will have the side effect of lowering the overall output brightness. An alternative is to adjust the content levels, but that risks clipping content highlights.

**NOTE:** In cases where the content doesn't advertise a content **MaxL**, HELIOS uses the **MaxL** of the display.

megapixel

Content should always be intentionally mastered at a MaxL matching the final display's nit level. In the real world, however, it is quite common for content to be delivered at a default of 1000L. Below are a series of images showing how correct vs incorrect metadata can greatly increase or decrease detail and fidelity. Note the detail of the buildings outside the window are lost. This is due to a Display MaxL of 100 with Content MaxL defaulting to 100L due to a lack of metadata in the video signal. The actual content was mastered for 1000L, so all levels above 100L will lose detail.



**Figure 172:** Detail lost

In the second image, the Content MaxL has been overridden to 1000 nits to match how the actual content file was mastered. Notice the significant increase in detail in the buildings outside the window.



**Figure 173:** Detail retained

# F

# Data Redundancy

## Overview

The HELIOS system supports multiple high availability redundancy modes. Redundancy is accomplished by sending simultaneous, bidirectional video data to each end of tile strings. There are several different system topologies possible with varying degrees of redundancy. The following sections illustrate the supported system topologies.

> **NOTE**: In order to support the latest HELIOS redundancy features, tiles must have software version 23.12 or later before the system is cabled into a redundancy mode. M4250 switches need to be updated to 13.0.4.18+ (TBC) or 13.9.7.23+ See the end of this section for the software upgrade process.

## Seamless Redundancy

Multiple HELIOS feed multiple switches. The most complete type of redundant system.  All of the HELIOS processors must be connected to the same video feed and to an external genlock sync.

| Item | Redundancy |
|------|------------|
| HELIOS | ✓ |
| Fiber Cables | ✓ |
| Network Switches | ✓ |
| Ethernet Cables | ✓ |
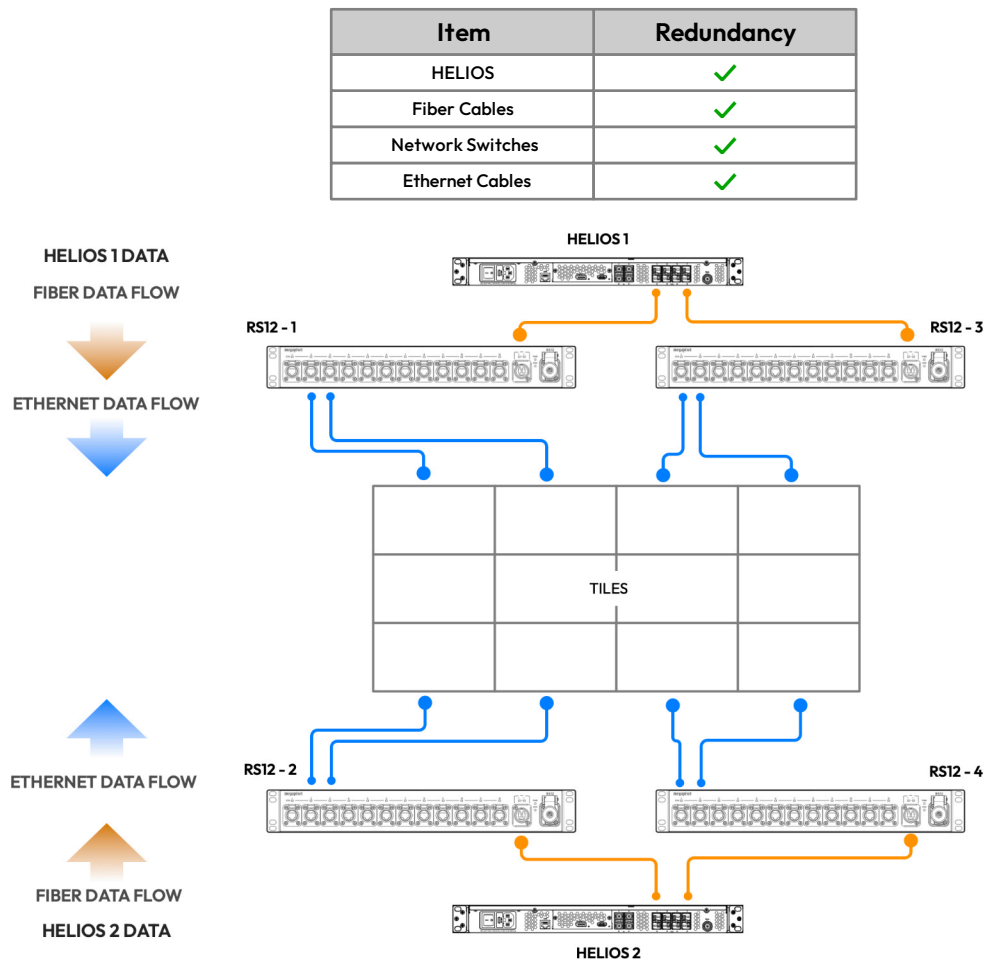


**Figure 174:** Full Redundancy system example

## SeamlessLoop™ – HELIOS Jr. Redundancy

The HELIOS Jr. via copper SFPs sends tile data out of multiple ports. There are no switches used in this type of system.

| Item | Redundancy |
|:---:|:---:|
| HELIOS | ✗ |
| Fiber Cables | N/A* |
| Network Switches | N/A* |
| Ethernet Cables | ✓ |

*Since HELIOS JR. are not fitted with fiber SFPs, switches are not used.

**HELIOS Jr.**

**ETHERNET DATA FLOW**

**TILES**

**ETHERNET DATA FLOW**

*megapixel*
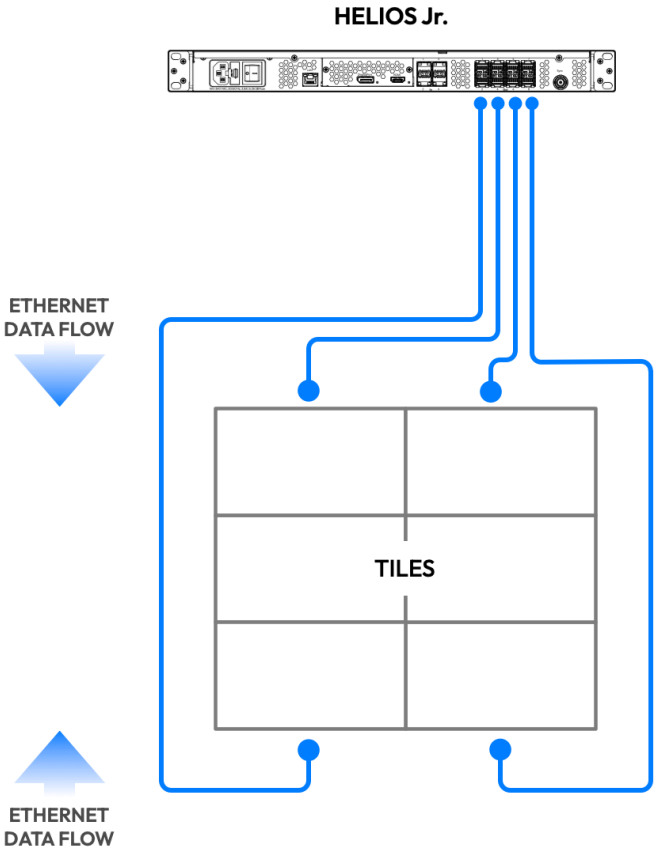
## SeamlessLoop™ – Tile Link Redundancy

Multiple outputs of a switch send bidirectional data to tiles.

| Item | Redundancy |
|---|---|
| HELIOS | ✗ |
| Fiber Cables | ✗ |
| Network Switches | ✗ |
| Ethernet Cables | ✓ |
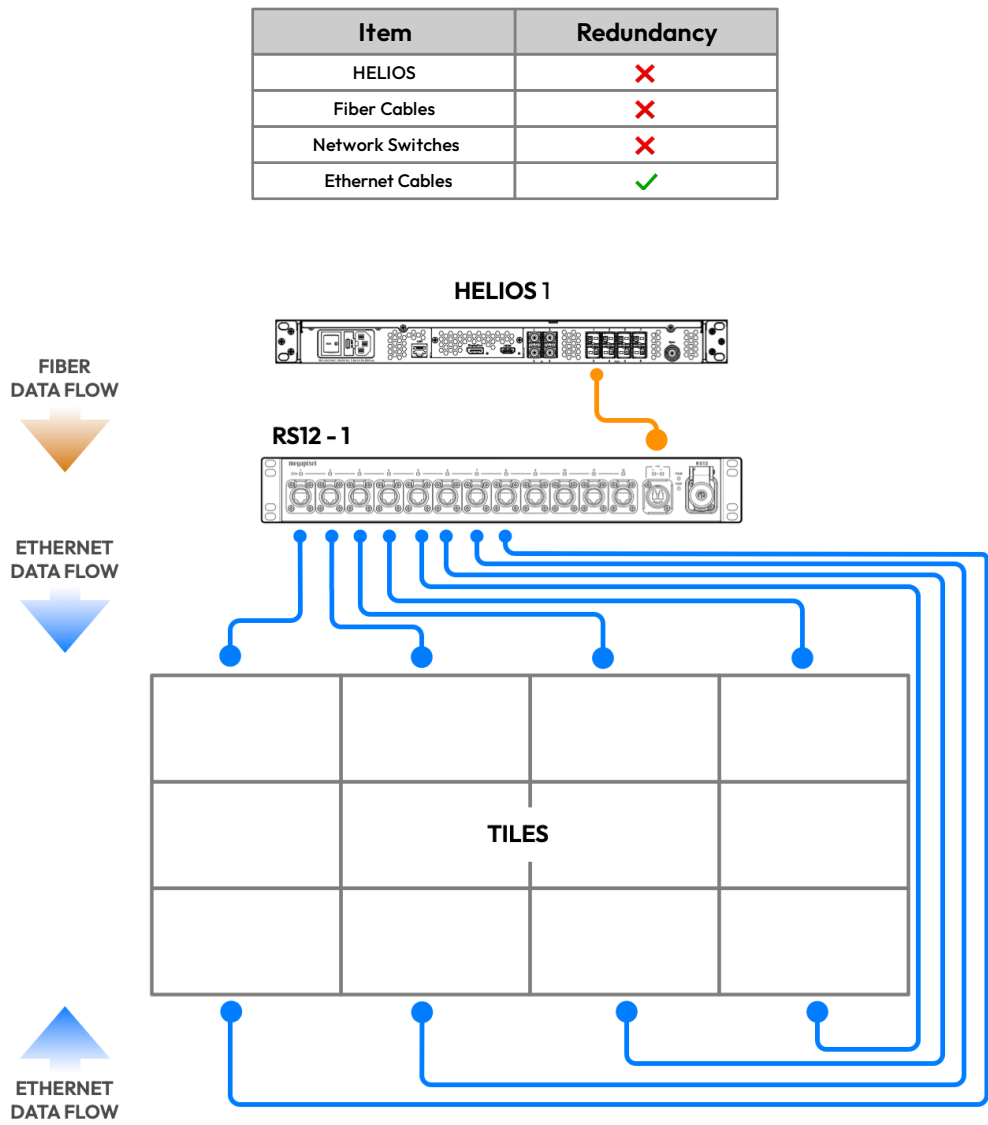
**Figure 176:** Tile Link Redundancy Example

## SeamlessLoop™ – Switch Redundancy

One HELIOS uses multiple fiber ports to feed redundant switches.

| Item | Redundancy |
|---|---|
| HELIOS | ✗ |
| Fiber Cables | ✓ |
| Network Switches | ✓ |
| Ethernet Cables | ✓ |
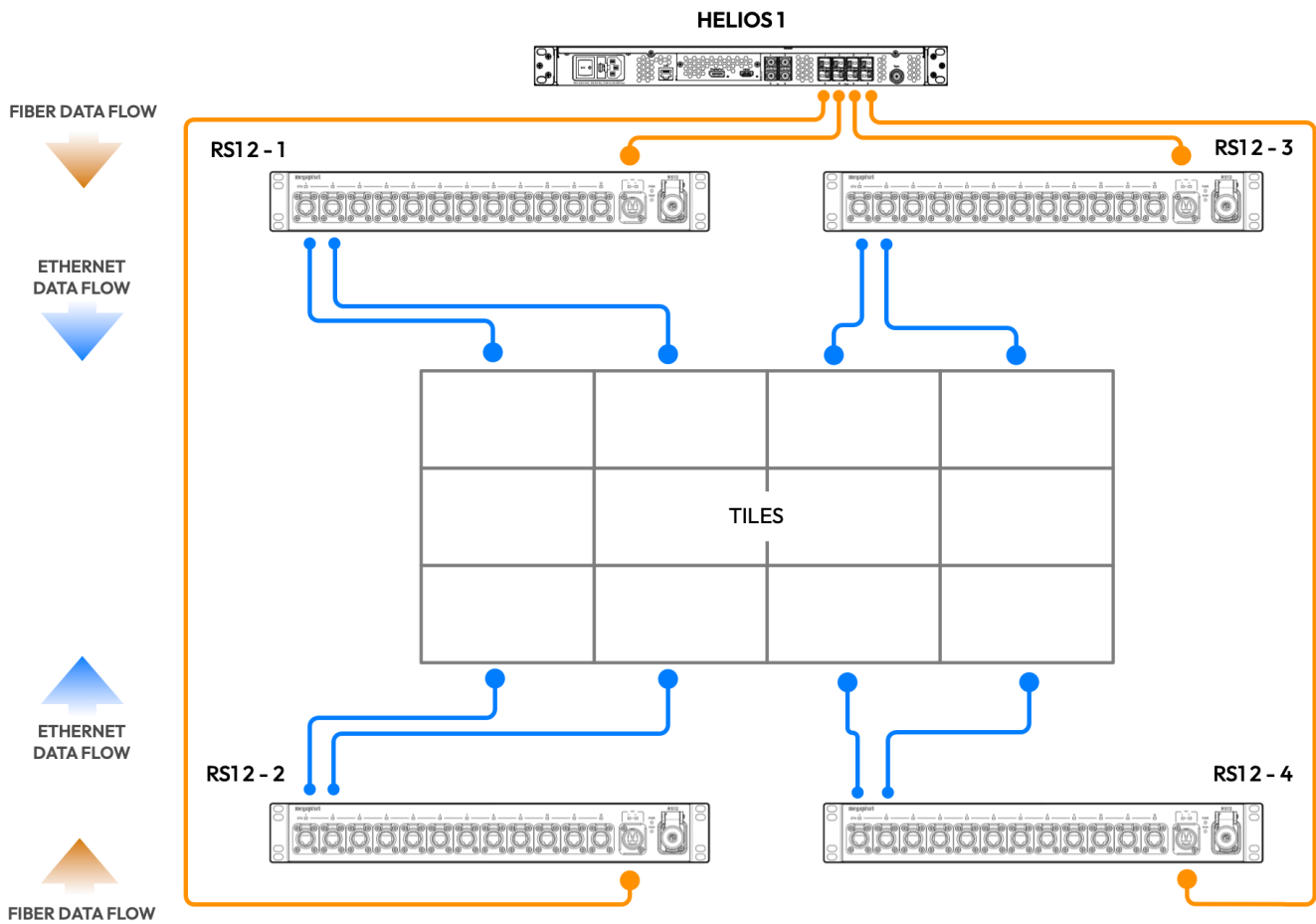


**Figure 177:** Switch Redundancy Example

## Redundancy Settings

Redundancy is enabled by physically configuring the system in any of the supported redundancy schemes as illustrated by the previous figures. In the user interface, ensure the **Advanced** mode is **ON (Settings > Processor Settings > Advanced)**. The redundancy controls are located under **Settings > Processor Settings**.
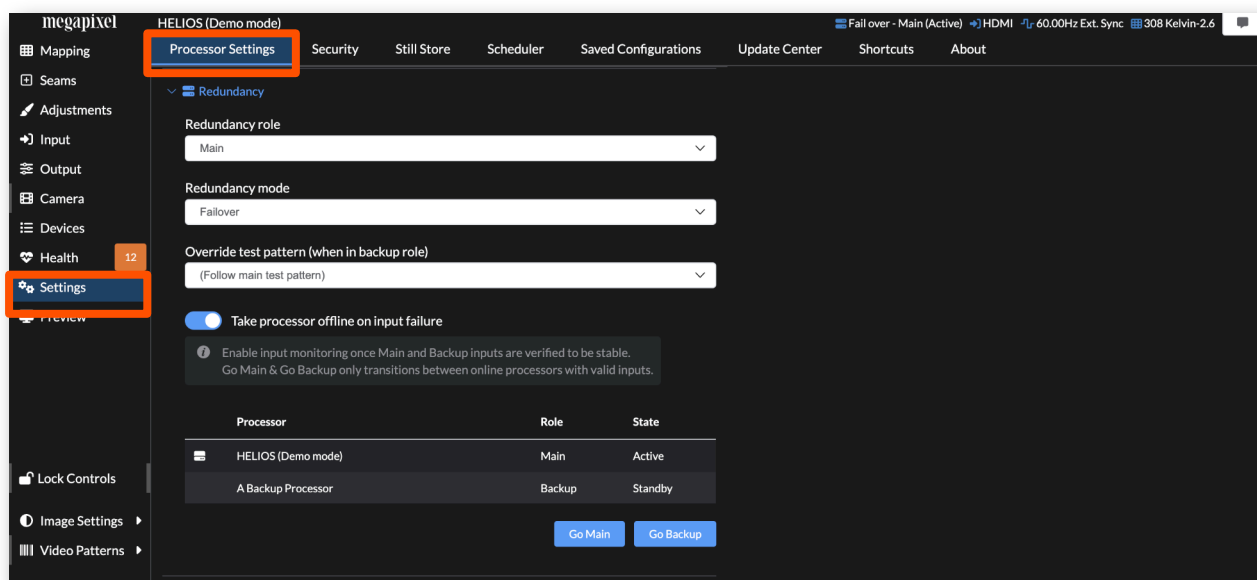


**Figure 178:** Redundancy settings

## Processor Role

The role selection lets the system know how a processor should be prioritized in the system.

HELIOS has three options:

**Main (default)** – Selecting this role identifies the processor as the primary processor in the system.

**Backup** – Identifies the processor as the redundant unit to be used in case of an issue with the Main processor.

**Offline** – Identifies the processor as not available to the system. This is the role to use when a known issue has occurred with a processor. The HELIOS system will ignore a processor in this role.
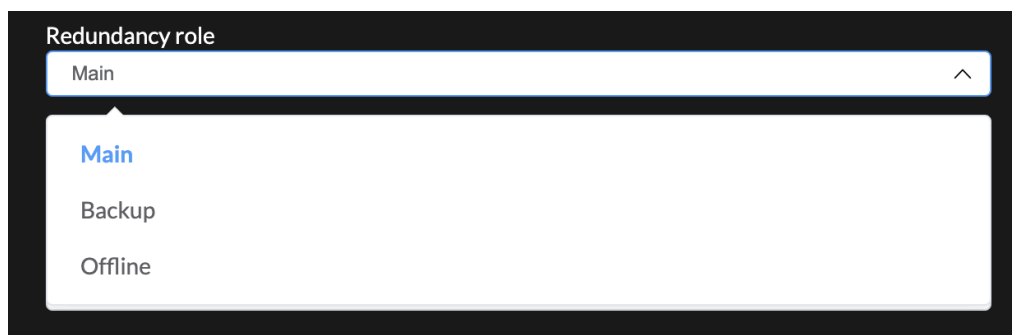


**Figure 179:** Role options

## Redundancy Modes

One of the operating modes must also be selected.
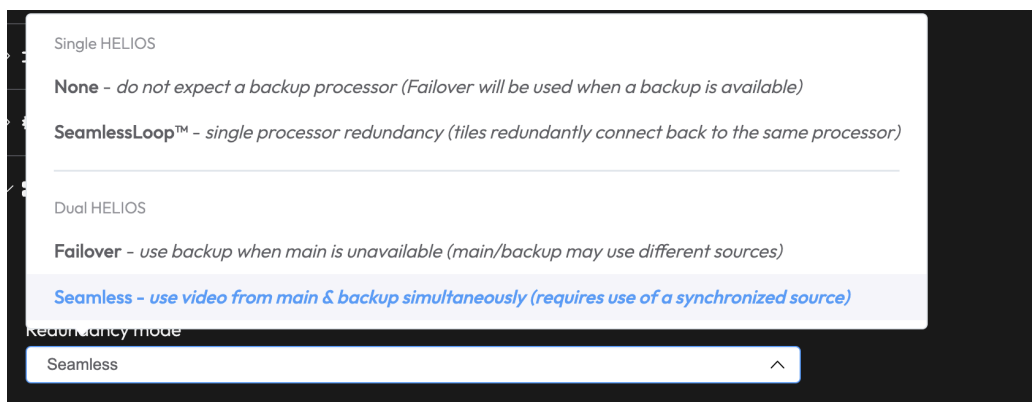


**Figure 180:** Mode selection

### Single HELIOS

**None** -  HELIOS will not be expecting a backup processor.  If the backup processor goes away HELIOS will not throw any errors. If HELIOS detects a backup processor on the network it will still be able to make use of it.

**SeamlessLoop™** - Tiles receive duplicate data from the same HELIOS processor.

### Dual HELIOS

**Failover** - Tiles are set to receive video from one processor only, the main processor. This provides tiles with a predictable signal path. Tiles will re-associate to the backup processor if the main processor stops sending video or the input fails. Since tiles only accept video from one processor, a failure event will have a slight perceptible disruption in the content as the affected tiles associate with the backup processor.

**Seamless** - Tiles are automatically associated with the highest priority processor available to them during startup. In this mode, the tiles in the display are allowed to receive video simultaneously from both processors. The image that a tile displays can be made up of data from both the main and backup processor. When using the Seamless mode, the input video to each of these HELIOS Processors must be identical and frame synced. This is so that there will be no perceptible difference in the image, as tiles use data from both processors. Since the system is using both processors simultaneously, failures have a near imperceptible impact. However, Seamless mode does not do well in situations where a complicated upstream video pipeline can make it difficult to detect input failures.

## Override test pattern (when in backup role)

An alternate processor test pattern can be assigned to backup processors. This feature is primarily designed to help technicians during setup see clearly which processor a tile is currently connected to. The default mode is to follow the main test pattern (the first option in the list). When in SeamlessLoop redundancy mode, override test pattern will still honor the main/backup role, but the system can no longer flip between roles, since there is only one processor.
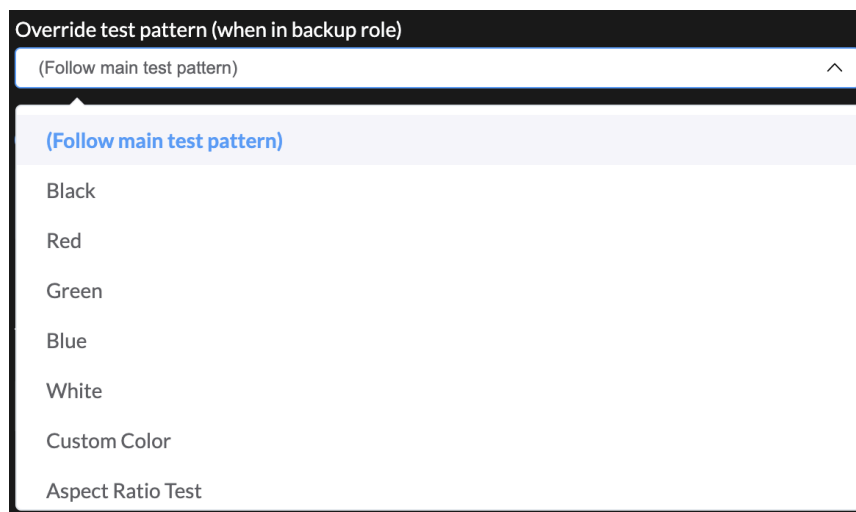


**Figure 181:** Test pattern override

## Take processor offline on input failure

Should the input on the main processor fail to receive frames, the system will switch to a processor with a functional input. In the case of stitched inputs (dual DP/HDMI and quad SDI) losing one of the input links will make that entire input be considered invalid and will trigger a switch. If this toggle is left off, input failure is not used as a criteria to switch processors. Displays will show black until incoming frames are restored to the processor.
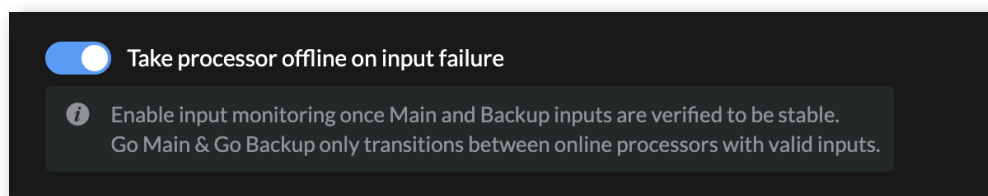


**Figure 182:** 'Take processor offline...' toggle

---

**NOTE:** When **Take processor offline on input failure** is toggled ON HELIOS will not allow the user to Go Main (see below) a processor with no input.

---
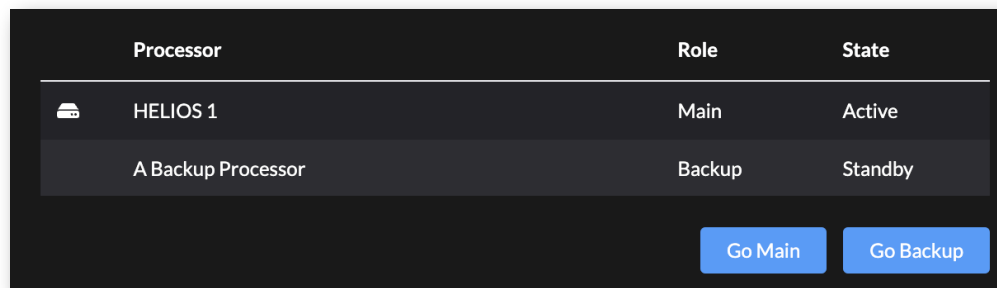
## Redundancy States

**Active** - Processors are Active when panels are connected to only that processor.

**Mixed** - Processors are Mixed when panels are connected to both the main + backup processors.

**Standby** - Processors are Standby when no panels are connected.

**Offline** - A Processor is considered Offline, either via explicit role selection or through input failure



**Figure 183:** Processor Roles and States

## Manual Overrides

If both processors have equal priority on startup, tiles will associate with the first processor they see. If the results of the automatic tile to processor association are not what the display operator needs, a manual Go Main or Go Backup command can be sent to re-associate the tiles to the desired processor. **Go main** / **Go backup** are not available in systems that use only one HELIOS processor.

**Go Main** - A manual override command to tiles. When this command is issued, tiles will associate to the main processor.

**Go Backup** - A manual override command to tiles. When this command is issued, tiles associate to the backup processor.

## Processor Stacking

Stacking should be used when configuring a redundant system. When stacking is enabled, processors share states such as global brightness, tile positions, and redundancy settings (see Appendix J for a **comprehensive list of items tracked by stacking**).  After enabling stacking, enter a stack name to join. If another processor is found with the same stack name, a blue dot icon shows up in the list next to the IP address indicating that the processor has joined the stack.
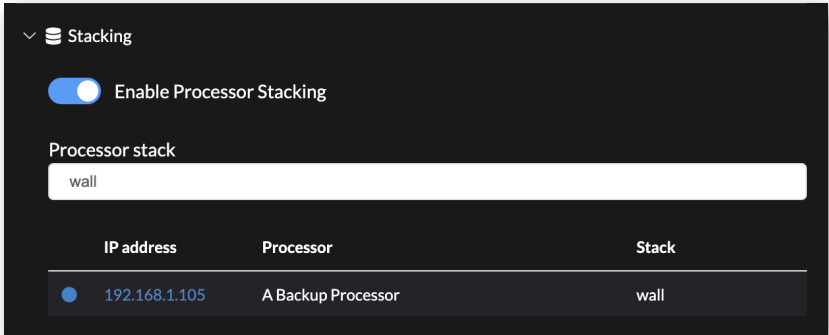


**Figure 184:** Stacking settings

---

**NOTE**: Let stacking take care of sharing data from one processor to another. Do not manually transfer saved configurations from one stacked processor to another. Stack processors before mapping tiles. Alternatively, create the stack with the primary processor first. The order in which processors join a stack matters! Settings are propagated based on how long processors have been part of the stack. Newly added processors will copy the settings from the existing. If stacking is done in the wrong order, without a saved configuration, settings will be lost.

---

## Front Panel Redundancy Info

When redundancy is enabled, the top right of the HELIOS front panel display reports the redundancy **Mode**, **Role**, **State** and **Stack name**. The example below, is set to **Fail over** mode. Possible modes are; **Failover, SeamlessLoop** and **Seamless**. The example below, is set to the **Main** role and **(Active)** state. Possible states are **Active**, **Standby** and **Mixed** (cases where tiles are split between the main and backup processors). Below the **Mode**, **Role**, and **State** info the HELIOS reports the Stack it has joined (as set by the Stacking settings). In the example below, the Stack that the HELIOS has joined is called **MyStackGroup**. When redundancy is not enabled, only the Stack name will be displayed.



**Figure 185:** Front UI Redundancy Info

## Devices Pane Processing Tab

The **Devices** pane **Processing** tab contains important 'behind the scenes' information regarding the redundant data routes. When HELIOS detects a redundant data route it highlights the switch port (**A** arrow example below) and assigns a route number (**B** arrow ). In the example below, both switch port **0/1** and **0/7** carry route **1** data. Switch ports **0/2** and **0/8** carry route **2** data. This is a dynamic system, the HELIOS updates the Devices tab with the latest routing data as it becomes aware of the changes in the system topology.
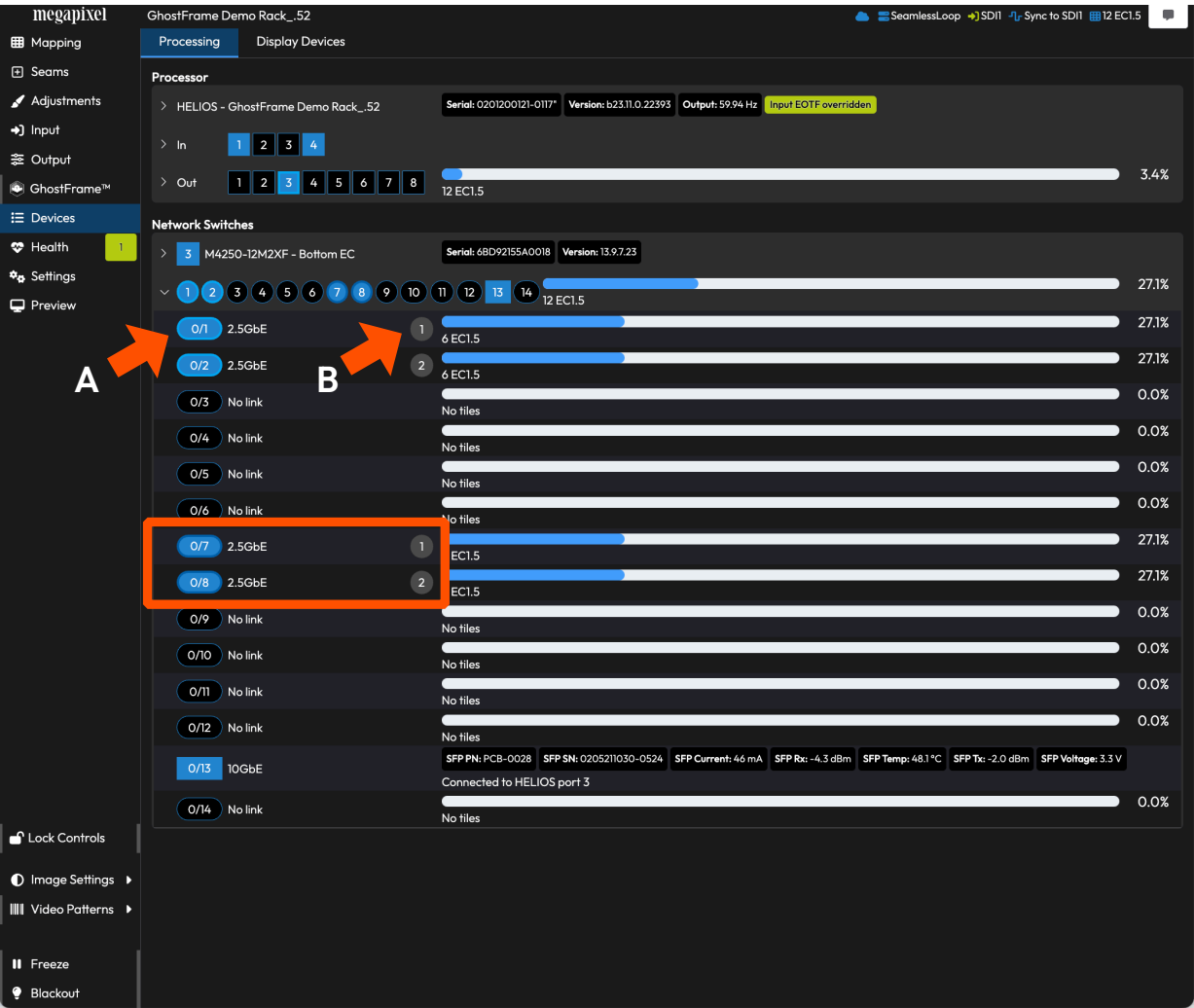


**Figure 186:** Redundant routes

## Devices Pane Link Icon

The devices pane shows a **link** icon ⧉ next to items connected to the same system as the current webUI. In other words, if the operator is currently controlling the **Main** system while browsing the **Display Devices** tab, all of the tiles connected to the **Main** processor show link icons as in the example below.
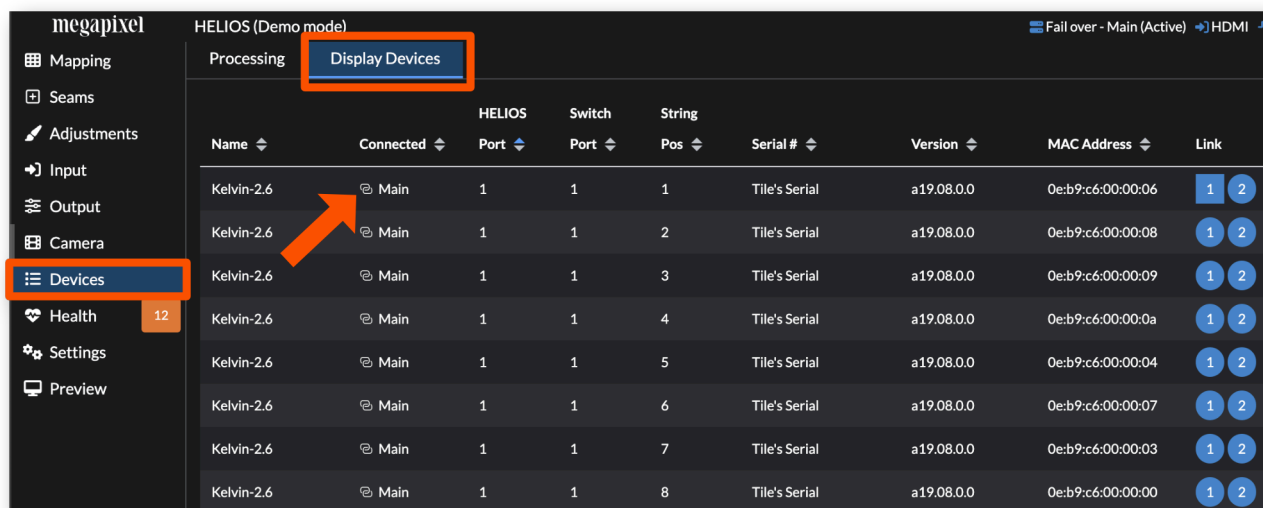


**Figure 187:** Devices Pane link icon

## Software Upgrade Process

Upgrade tiles to version 23.09 or greater using only a single HELIOS processor. Please see the **Update Center** section in Chapter 5 for more details. Tiles need to reply to processors after finishing an upgrade. Having two processors in the system during an upgrade can cause issues with these replies from tiles with earlier firmware versions.

When upgrading a redundant system to a version of HELIOS and tile firmware that supports redundancy it is important to follow a specific sequence:

1. Connect HELIOS MAIN, network switches MAIN, and tiles as normal. Confirm mapping/video as expected.

2. Upgrade the HELIOS MAIN.

3. Upgrade tiles.

4. Boot up HELIOS BACKUP and network switches BACKUP (do not connect tiles yet).

5. Upgrade HELIOS BACKUP.

6. Wait for the network switches BACKUP to appear in devices page.

7. Connect tiles to the network switches BACKUP.

8. Activate stacking and configure redundancy options.

# ST 2110

## Overview

ST 2110 is a suite of standards developed by the Society of Motion Picture and Television Engineers (SMPTE) for transmitting professional media over an IP network. The standards describe how video, audio, and metadata should be packaged and transported over an IP network. ST 2110 is designed to work with existing IP network infrastructure and to be scalable with future advances in IP-based technologies.

In the following examples only the bare minimum components for sending ST 2110 to HELIOS are shown. Actual system implementations usually have additional signal routing equipment.

The example below illustrates an ST 2110 signal being sent to HELIOS from a native SDI camera through an ST 2110 gateway device.
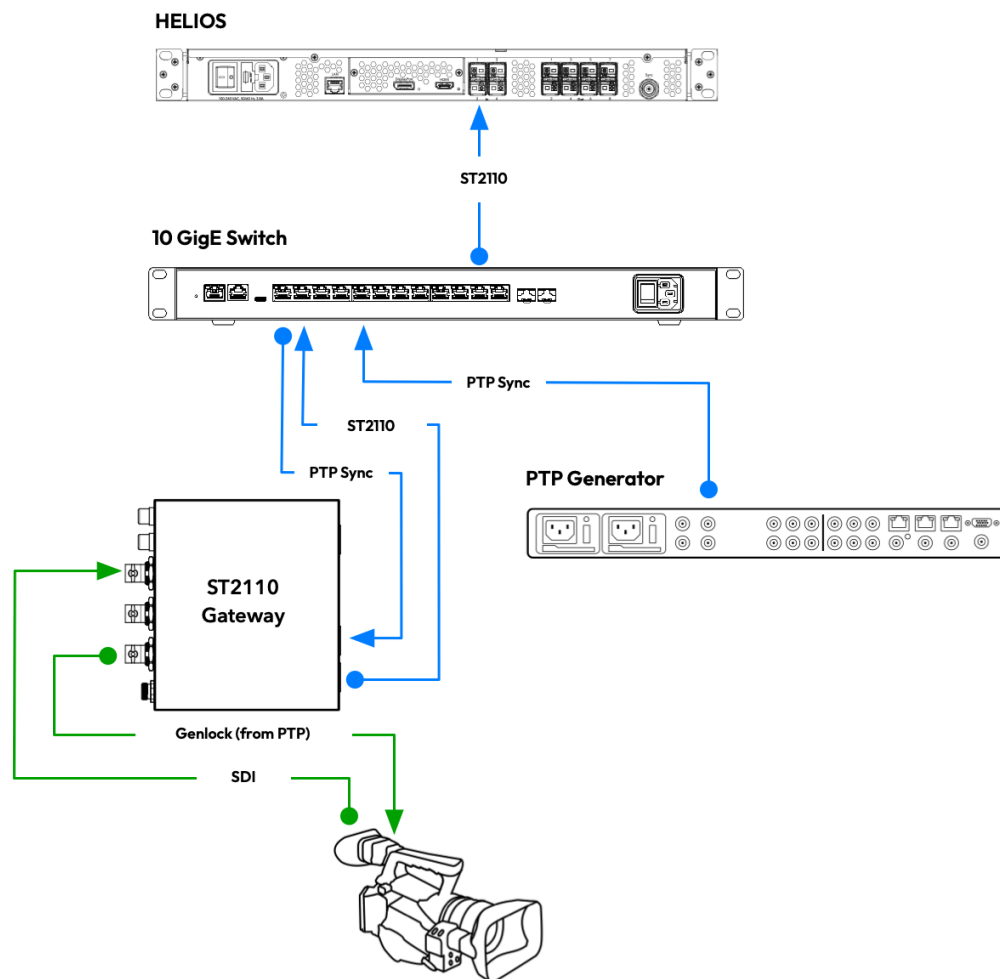


**Figure 188:** A basic ST 2110 system

The example below illustrates an ST 2110 system with a 'device native' ST 2110 signal being sent from a PC equipped with a Rivermax capable GPU. The Rivermax SDK glues together the NIC and GPU to enable interconnect, orchestration, and SMPTE ST 2110 specification compliance.
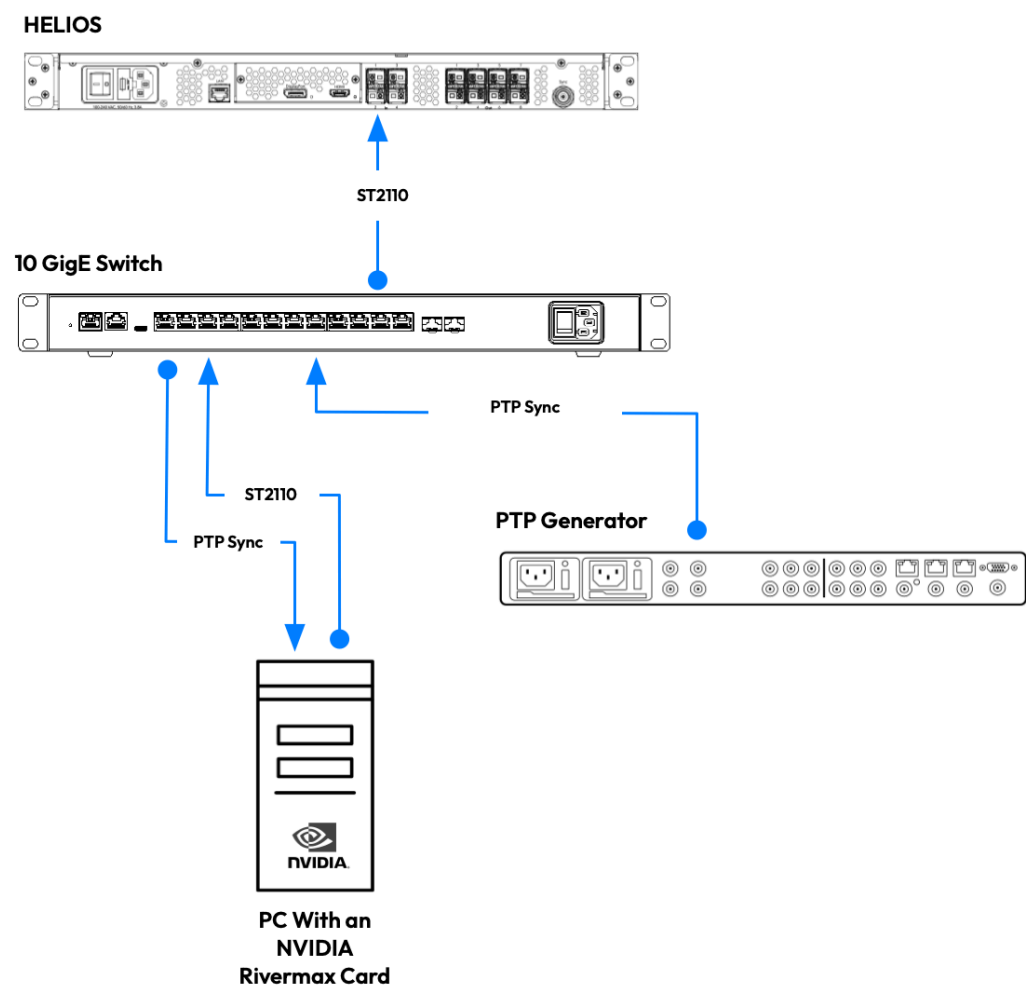


**Figure 189:** A native ST 2110 system

ST 2110 separates the audio, video and metadata into separate synchronized streams. Streams can be be transported independently over an IP link. This separation also allows for more flexibility but it also means that ST 2110 systems need to be configured to locate the streams. SDP (Session Description Protocol) records are small text files that describe the streaming media's parameters to HELIOS.  SDP records are essential for locating and configuring an ST 2110 video signal. The SDP record tells HELIOS which stream to use and what it is. On the following page is an example SDP record. The example can be used as a template for constructing an SDP record. Below the example are tables to help clarify the syntax and purpose of the file sections.

**NOTE:** HELIOS currently requires SDP records to manage ST 2110 streams, but will support the NMOS (Networked Media Open Specifications) protocol in the future. NMOS allows for automatic discovery of devices and streams.

## Example SDP Record

The structure of the file is fairly simple\*. To the left of the equals sign are the parameter types, on the right of the equals sign are the parameter values <type>=<value>. The following text is an example of an SDP record file with the required lines for HELIOS. The file is comprised of several sections. The first section is the Session Level and begins with **v=0**.

```
v=0
o=- 0 0 IN IP4 169.254.165.93
s=rivermax_player
t=0 0
m=video 50000 RTP/AVP 112
c=IN IP4 239.100.9.10/32
a=rtpmap:112 raw/90000
a=mediaclk:direct=0 rate=48000
a=source-filter:incl IN IP4 239.100.9.10 169.254.165.93
a=fmtp:112          sampling=YCbCr-4:2:2;          width=1920;          height=1080;
exactframerate=24000/1001; depth=12; TCS=SDR; colorimetry=BT2020; PM=2110GPM;
TP=2110TPN; SSN=ST2110-20:2017;
```

\* SDP records use the ISO 10646 character set in UTF-8 encoding.  SDP field names and attribute names use only the US-ASCII subset of UTF-8, but textual fields and attribute values MAY use the full ISO 10646 character set.

## Session Level

| Type | Name | Components | Notes |
|------|------|-----------|-------|
| *v* | Protocol version | v=0 | The version of the Session Description Protocol |
| *o* | Originator and session identifier | 0=<username> <sess-id> <sess-version> <nettype> <addrtype> <unicast-address> | "-" Is set for the user name when the originating host does not support user IDs. |
| *s* | Session name | s=<session name> | Must not be empty and should contain ISO 10646 characters. |
| *t* | Time the session is active | t=<start-time> <stop-time> | 0 0 = not time-limited |

## Media Level

| Type | Name | Components | Notes |
|------|------|-----------|-------|
| *m* | Media name and transport | m=<media> <port> <proto> <fmt> | Dynamic payload type 112 is used for uncompressed video.  Payload type must also match attribute lines **a=rtpmsp** and **a=fmtp** |
| *c* | Connection data | c=<nettype> <addrtype> <connection-address> | IN is defined as "Internet" |

## Media Level Attributes

| Type | Name | Components | Notes |
|------|------|-----------|-------|
| **a=rtpmap** | RTP payload format | a=<payload type> <encoding name>/<clock rate> | Dynamic payload type 112 must match the m=line |
| **a=mediaclk** | Clock mapping | direct=0 | Always has a value of zero because no offset is needed between the media clock and the RTP clock. |
| **a=source-filter** | Source Filter | a=<nettype> <address-types> <dest-address> <src-list> | Helps protect receivers from traffic sent from illegitimate source addresses. |
| **a=fmtp** | Format specific parameters | a=<payload type> must match a=rtmap (above)  + other parameters separated by a ';' and a space | Dynamic payload type 112 must match the m=line. Parameters are passed unchanged to the media tool that is creating the stream. |

## Overview

Group masks are primarily intended for blacking out edge pixels, adding rounded corners, and avoiding a physical mask from half covering pixels.

Masks are assigned to tile groups in the group settings. Create a tile group, then open the group settings window with the settings icon button ⚙ in the groups accordion or by right clicking the desired group and selecting **Group Settings...**
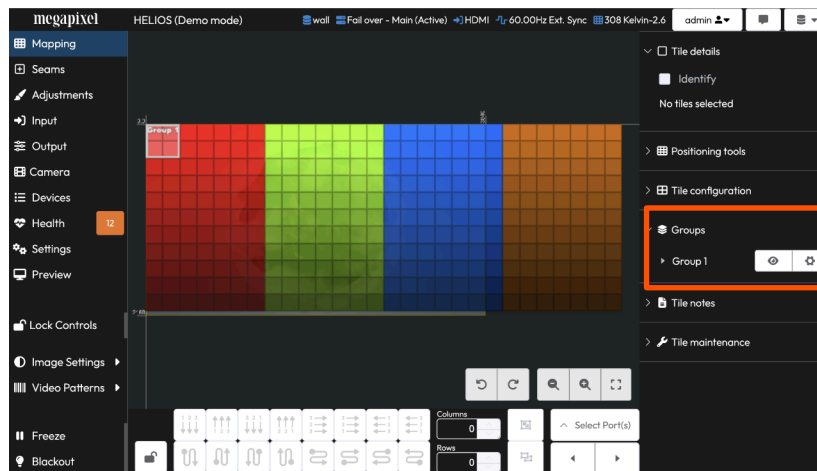


**Figure 190:** Tile group settings button.
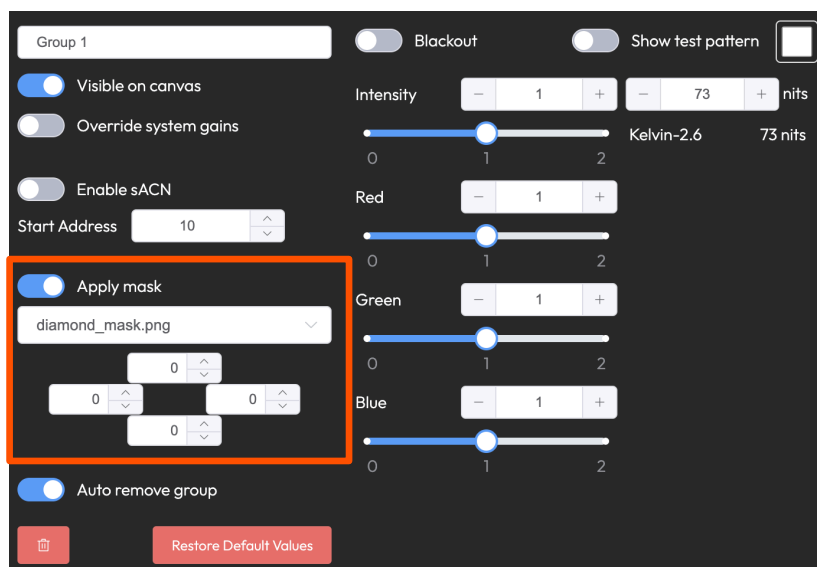


**Figure 191:** Tile group settings window

Masks are uploaded & stored in HELIOS' still store and any image may be used as a mask (JPEG or PNG).

- HELIOS will use the alpha channel when there are non-255 alpha values (only PNG supports an alpha channel)
  - alpha channel - 255 = content (black), 0 = transparent (video) - i.e., transparent = video
  - green channel - 255 = white (video), 0 = black - i.e., black = border
- Different groups can use different masks.
- Masks are algorithmically extended to fit the group's boundaries. HELIOS will process the image, try to figure out how much of the edges are non-repeating, and then repeat the middle section (see below for a illustration)
- If the mask should not be extended, upload a mask image which has the same dimensions as your display group.
- Masks edges may be nudged up to 100 pixels. The smaller the mask the less room there is available to nudge. A positive value will increase that edge (enlarging the mask). Negative will shrink the mask, adding a visible black edge. This is useful for quickly adding black borders, shifting the mask, or lining up repeating patterns such as the diamond teeth.

## Mask Algorithm

Mask pixels are kept the same size. HELIOS does not just stretch/scale to fit the group. Instead HELIOS chops up the mask into sections and truncates or repeats the middle section to fit the group. This is what causes the teeth to repeat and extends the border between the curve regions.



**Figure 192:** Mask algorithm example

Above is the ideal case, where the middle sections perfectly repeat. In other cases the last section will be truncated, which for flat middle masks is not visible, while teeth style masks do requiring nudging.

The advantage of this algorithmic masking approach is more general masks can be used. The example images on the previous page can all be applied to any display, regardless of size. This allows designers to focus on their preferred radius which can then be used with a variety of walls since the middle sections will be repeated.

In the case of more detailed masks, or if the user wants full control, ensure the uploaded mask dimensions match that of the display.

## Mask Mayhem

Note that accidentally inverting the mask colors, or just using a random image, can result in some fun results:

The example below shows an incorrectly inverted mask, which the mask algorithm repeated as best it could.



**Figure 193:** Mask Issues example

## Example Masks

**Two Pixel Border**

The Two Pixel Border mask is a very small mask. It measures only 10 x 10 pixels square. This mask is a great example of how the HELIOS enlarges a mask without stretching it. The example below has been scaled up for the purpose of this guide. Actual dimensions are 10 x 10px with a 2px black border.
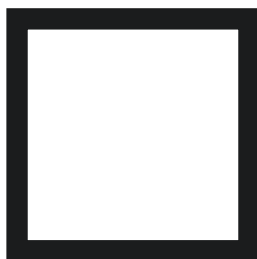


**Figure 194:** Two Pixel Border mask

When the Two Pixel Border mask is applied to a tile group, it forms a two (2) pixel black boundary on the tile group. The example below has the mask applied to two (2) tiles in one group.



**Figure 195:** Two Pixel Border mask applied

## Example Masks (continued)

### Rounded Top
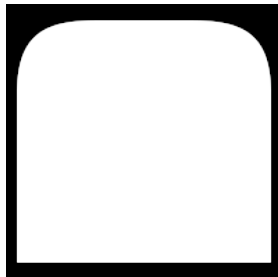


**Figure 196:** Rounded Top mask

The rounded top mask in the example below as applied to a single tile.



**Figure 197:** Rounded Top mask on a single tile

The rounded top mask in the example on the left has been applied to only one (1) tile (the tile group has only one tile). On the right, the lower tile has been added to the tile group so the mask spans both tiles.
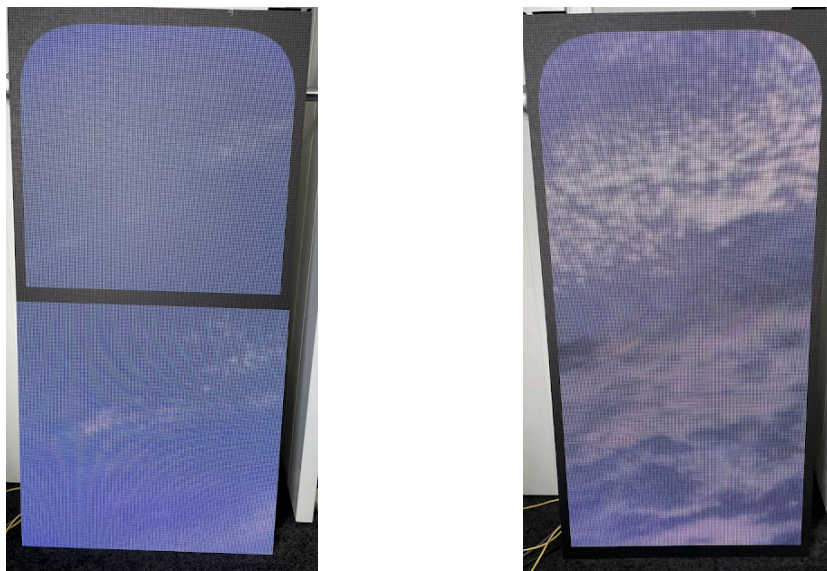


**Figure 198:** Tile group behavior

## Example Masks (continued)

### Diamond Border
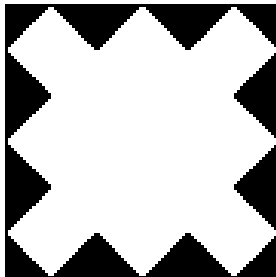


**Figure 199:** Diamond Border mask

In the examples below the Diamond Border Mask has been applied to a two (2) tile group. The example on the left shows the mask without any nudging. On the right, the mask has been nudged with the values (-8, -4, -8, -4). Due to the negative nudge values being used, a slightly thicker black perimeter is visible on the right tile.



Increased black perimeter due to nudging
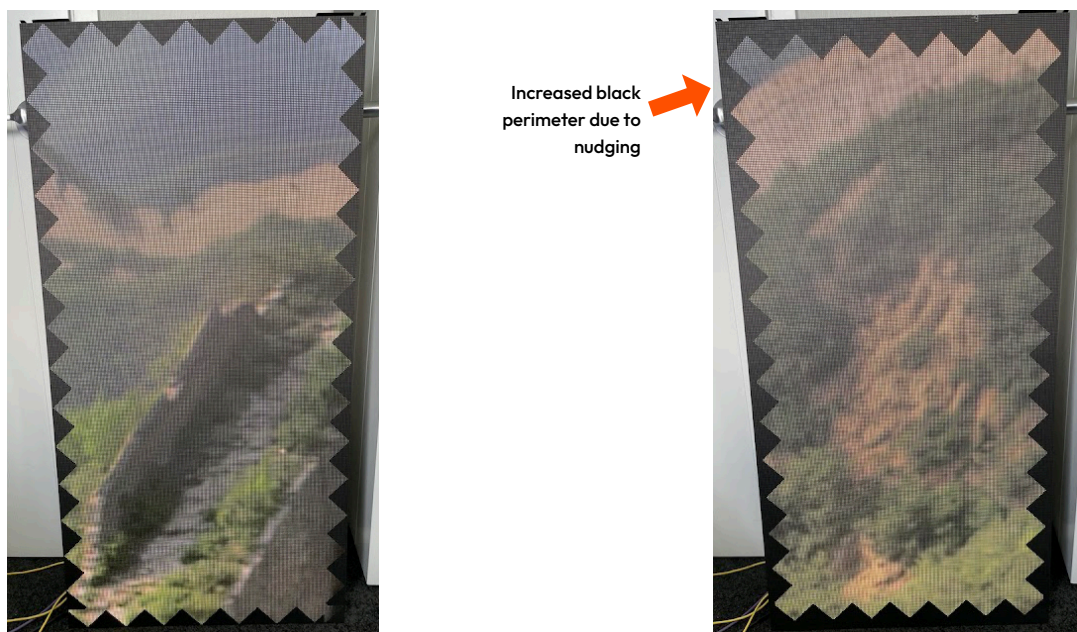
**Figure 200:** Nudge example

## Example Masks (continued)

### Asymmetric



**Figure 201:** Asymmetric mask

The mask algorithm is aware of asymmetric masks. The mask does not need to be the same size as the group, the mask algorithm is able to handle the size difference and in the case of this example will repeat the seats.



**Figure 202:** Asymmetric mask applied

# HELIOS HTTPS

## Overview

HELIOS supports both HTTP and HTTPS ("secure") connections. By default HELIOS will generate a self-signed certificate, which is not secure. Since anyone can generate a self-signed certificate and put whatever they want in it.

For an HTTPS connection to be secure, and not show a browser warning, it needs to be verifiable by a certificate authority (CA). Certificates can only refer to fully qualified domain names (FQDN).

**Requirements:**

- HELIOS must be resolvable via DNS (e.g., https://my-helios.com)
- HELIOS must have a certificate signed by a trusted CA

Most enterprises have their own internal trusted CA and internal DNS which can fulfill these requirements. While others may end up placing HELIOS on the internet (not recommend).

For testing, it is possible to generate and trust a self signed certificate, and use the hosts file to provide DNS resolution.

## Workflow

1. Determine FQDN and ensure HELIOS is reachable via that FQDN

2. Generate a private key pair that meets the CA's requirements (e.g., RSA 4096, ECC 256)

3. Generate a CSR (Certificate Signing Request) for that FQDN

4. CA takes the CSR and generates a signed certificate

5. Include required intermediary certificates with the signed certificate (chain of trust)

6. Upload bundled certificate + private key to HELIOS

## Including intermediary certificates

Often the CA generating the certificate is using an intermediary certificate, which is trusted by one or more other intermediary certificates, before being ultimately trusted by a root certificate. As most devices only have knowledge/trust of the root certificates, often the intermediaries need to be included to complete the chain of trust.

To complicate matters, most modern browsers include many of these intermediary certificates or know how to retrieve them. Which results in the site appearing secure from some systems but not others. A good example of this is where Chrome says the site is secure, while OMNIS does not.

In OMNIS' case; it is only aware of the root certificates, so without knowledge of the intermediaries, HELIOS' certificate cannot be verified.

To resolve this, we can include the intermediaries in the certificate file that we upload to HELIOS. A pem file is a plain text file, which contains a base64 encoded x509 certificate between two tags. We can just concatenate additional certificate entries to this file. Convention is to have the least authoritative certificate first.

```
-----BEGIN CERTIFICATE-----
... Device cert ...
-----END CERTIFICATE-----
-----BEGIN CERTIFICATE-----
... Intermediary CA ...
-----END CERTIFICATE-----
-----BEGIN CERTIFICATE-----
... Intermediary CA 2 ...
-----END CERTIFICATE-----
```

## Verifying uploaded certificate

Here we haven't included the intermediaries, so it is failing:

```
% openssl s_client -showcerts -connect my-helios.com:443

CONNECTED(00000003)

depth=0 CN = my-helios.com

verify error:num=20:unable to get local issuer certificate

verify return:1

depth=0 CN = my-helios.com

verify error:num=21:unable to verify the first certificate

verify return:1

write W BLOCK

---
```

While in this case we have included the intermediaries, so it can resolve that it was issued by Let's Encrypt:

( **my-helios.com** has been substituted in the example below)

```
% openssl s_client -showcerts -connect my-helios.com:443

CONNECTED(00000003)

depth=2 C = US, O = Internet Security Research Group, CN = ISRG Root X1

verify return:1

depth=1 C = US, O = Let's Encrypt, CN = R3

verify return:1

depth=0 CN = my-helios.com

verify return:1

write W BLOCK

---
```

## HSTS

HTTP Strict Transport Security is a way for a site to advertise that all connections must be via https. Which prevents downgrade attacks, as browsers default to trying http:// first, before https://.

- HSTS is a flag set in the response by the web server when a user visits the site. After which the browser will remember this flag, so future connections will always be via https. Browsers will also then straight out refuse to connect via plain http unless this behavior is overridden .
- HSTS only applies to FQDN connections. So connections by IP will ignore this flag.
- HELIOS will only only set the HSTS flag if Redirect to HTTPS when enabled.
- HELIOS must be resolvable via FQDN
- HELIOS must have Redirect to HTTPS enabled

To verify:

```
% curl -i https://my-helios.com
HTTP/1.1 200 OK
Strict-Transport-Security: max-age=31536000; includeSubDomains
...
```

## Generating a self signed certificate

The command below will provide a private key (key.pem) and certificate (cert.pem). Which can then be uploaded to HELIOS via network settings.

**Mac:**

```
openssl req -x509 -newkey rsa:4096 -nodes -keyout key.pem -out cert.pem -sha256 -days 365 -extensions ext
-config <(cat /System/Library/OpenSSL/openssl.cnf \
  <(printf '[ext]\nextendedKeyUsage=serverAuth\n'))
```

**NOTE:** The **serverauth** extension is required to prevent browsers complaining about an invalid key.

## Supported ciphers

Supported SSL ciphers can be checked by using nmap with the following script (stackoverflow).

With HELIOS 23.12:

```
% nmap -p 443 --script './ssl-enum-ciphers.nse.txt' 192.168.10.99
Starting Nmap 7.94 ( https://nmap.org ) at 2023-11-11 11:51 NZDT
Host is up (0.00012s latency).

PORT STATE SERVICE
1338/tcp open  wmc-log-svc
| ssl-enum-ciphers.nse:
|   TLSv1.2:
|     ciphers:
|       TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 (ecdh_x25519) - A
|       TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384 (ecdh_x25519) - A
|       TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA256 (ecdh_x25519) - A
|       TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA384 (ecdh_x25519) - A
|       TLS_ECDHE_RSA_WITH_CHACHA20_POLY1305_SHA256 (ecdh_x25519) - A
|       TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA (ecdh_x25519) - A
|       TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA (ecdh_x25519) - A
|     compressors:
|       NULL
|     cipher preference: server
|   TLSv1.3:
|     ciphers:
|       TLS_AKE_WITH_AES_256_GCM_SHA384 (ecdh_x25519) - A
|       TLS_AKE_WITH_CHACHA20_POLY1305_SHA256 (ecdh_x25519) - A
|       TLS_AKE_WITH_AES_128_GCM_SHA256 (ecdh_x25519) - A
|     cipher preference: server
|_  least strength: A

Nmap done: 1 IP address (1 host up) scanned in 0.74 seconds
```

# Technical Specifications

## M4200-10MG-PoE+ (GSM4210P) Network Switch - Specifications Table

| | |
|---|---|
| **Dimensions (W x H x D)** | 440mm (17.32") x 43.21mm (1.70") x 100mm (3.93") |
| **Power Requirements** | 100 - 240V AC, 50Hz/60Hz, 1A (IEC C14 Connector) |
| **Weight** | 2.1 kg (4.62 lb)  shipping dimensions and weights below |
| **IP Rating** | Indoor only |
| **Ambient Operating Temperature** | 10° to 40°C (50° to 104°F) |
| **Certifications** | UL, FCC (Class A), CE, WEEE, C-TPAT |
| **Fiber Optic Input from HELIOS Processor** | 1 x 10Gb SFP+ Single Mode Fiber Input (LC) |
| **Copper Output Ports** | 8 x 1Gb / 2.5Gb Ethernet (Video Output ports)<br>1 x 1Gb Ethernet (OOB management port) |
| **Maximum pixels per port** | 425,000 pixels (12-bit, 60Hz) = 918Mb/s per port |
| **Maximum pixels per 10 port network switch** | 4,250,000 pixels (12-bit) = 9.18Gb/s per network switch |

## Network Switch - Shipping Info.

| | |
|---|---|
| **Shipping box dimensions (W x H x D)** | 533mm (21") x 279mm (11") x 305mm (12") |
| **4K Kit - 2 switches** | 1 full box |
| **8K Kit - 8 switches** | 3 boxes (2 full + 1 partial) |
| **Full box (3 switches)** | 12.2 kg | 27 lb |
| **Partial box (2 switches)** | 8.5 kg | 19 lb |

# HELIOS Processor - Specifications Table

| | |
|---|---|
| **Dimensions (W x H x D)** | 481.5mm (19.0") x 44.2mm (1.7") x 414.5mm (16.3") |
| **Power Requirements** | 100 - 240V AC, 50Hz/60Hz, 3A (IEC C14 Connector) |
| **Fuses** | 2 x 6.3A 250V Glass Tube Slow Blow, Ø 5 x 20mm |
| **Weight** | 5.7kg \| 12.6lb shipping dimensions and weights next page |
| **IP Rating** | Indoor |
| **Ambient Operating Temperature** | 10° to 40°C (50° to 104°F) |
| **Certifications** | UL, FCC (Class A), CE, RoHS, CQC, UKCA, EAC, NOM, BIS, KCC, RCM |
| **Maximum pixels per Processor** | 35M pixels |
| **Heat Load** | 256 BTU/hr thermal dissipation |
| **HELIOS web UI** | 1 x Gb Ethernet |
| **System Latency *** | 3 frames ( @ 60Hz = 50ms \| @ 120Hz = 25 ms) |
| **Inputs** | |
| **HDMI** | 1 x Input – HDMI 2.0b |
| **DisplayPort** | 1 x Input – DP 1.4 HBR3 |
| **SDI**  4 x Inputs: | SD and HD-SDI (Progressive only) |
| | 3G and 6G SDI (level A and B) |
| | 2SI on 12G-SDI ** |
| **10G ST 2110** | 4 x Inputs, 4 x Streams up to 4K @50Hz ea. |
| **100G ST 2110** | 1 x Input, 4 x Streams \| Input 'A' 8K @60Hz \| Inputs 'B/C/D' 6K @60Hz \| for a total of 8K @60Hz |
| **Sync** | 1 x  –  Analog Tri-level Sync † |
| **Outputs to Display Devices** | |
| **HELIOS Standard**  8 x 10Gb SFP+ Outputs: | 9/125 Single mode (SMF) OS1 (<=1000m) or OS2 |
| | LC-LC terminated UPC Polish |
| | Riser / plenum rated |
| | Maximum / port @12-bit, 60Hz: 4,250,000 pixels‡ = 9.18Gb per output |
| **HELIOS Junior**  8 x 1Gb  SFP Outputs: | RJ-45 |
| | Cat 6/Cat 6a |
| | Maximum / port @12-bit, 60Hz: 425,000 pixels = 918Mb per output SFP |

* Input to eyeball including network switches.

** Square Division is supported, but it can not be scaled. Stitched inputs also can not be scaled.

† Tested to work with: Evertz MSC5601, AJA GEN-10, BlackMagic Design CONVMSYNC

‡ A lower bit depth and/or frame rate allow for more pixels. Regardless of frame rate or bit depth, the maximum pixels per HELIOS output port is 8.5 million.

# HELIOS Processor - Shipping Info.

| | |
|---|---|
| **Shipping box dimensions (W x H x D)** | 533mm (21") x 597mm (23.5") x 184mm (7.25") |
| **HELIOS – JR** | 8.2 kg \| 18.1 lb |
| **HELIOS Standard – 4K** | 8.2 kg \| 18.1 lb |
| **HELIOS Standard – 8K** | 8.7 kg \| 19.1 lb |

# Each HELIOS box contains:

- HELIOS Processor
- Power cord (North American, NEMA 5-15P )
- Ethernet cable (5ft)
- Rack mount screws
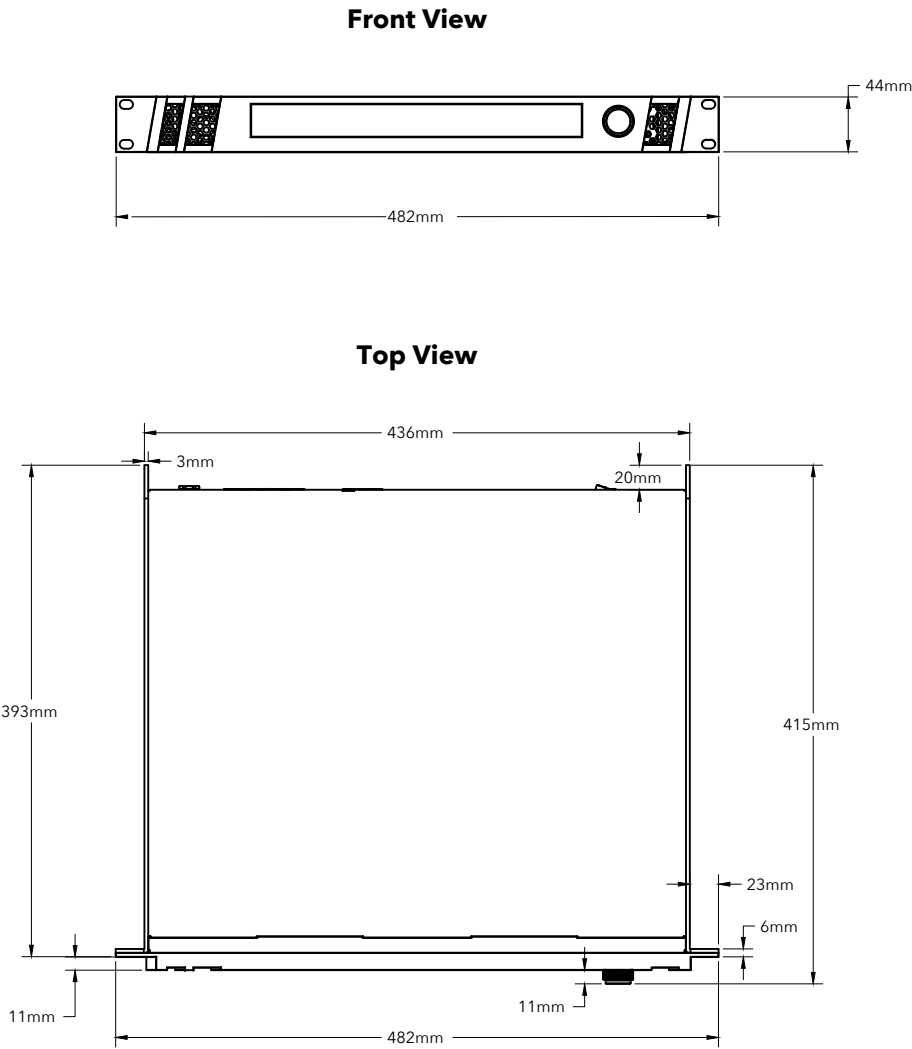- Quickstart guide

# HELIOS Processor Dimensions

### Front View

**Figure 203:** HELIOS dimensions

# HELIOS Processor - Input Capability Matrix

The charts below show three common refresh rates. HELIOS supports any frequency between 15Hz and 120Hz. When capacity planning, use the rate in the table that is closest to the actual frequency that will be used. See the System Planning section for the bandwidth calculation formula that can be used for HDMI, DisplayPort and ST 2110.

| | 720p (1280 x 720) | 1080p (1920 x 1080) | UHD (3840 x 2160) | DCI 4K (4096 x 2160) | 5K (5120 x 2880) | 6K (6016 x 3384) | 8K (7680 x 4320) | DCI 8K (8192 x 4320) |
|---|---|---|---|---|---|---|---|---|
| **120 Hz** | | | | | | | | |
| RGB 12-bit | DP/HDMI/ST 2110 | DP/HDMI/ST 2110 | No | No | No | No | No | No |
| RGB 10-bit | DP/HDMI/ST 2110 | DP/HDMI/ST 2110 | No | No | No | No | No | No |
| RGB 8-bit | DP/HDMI/ST 2110 | DP/HDMI/ST 2110 | DP Only | No | No | No | No | No |
| YCbCr 12-bit 4:4:4 | DP/HDMI/ST 2110 | DP/HDMI/ST 2110 | No | No | No | No | No | No |
| YCbCr 12-bit 4:2:2 | DP/HDMI/ST 2110 | DP/HDMI/ST 2110 | No | No | No | No | No | No |
| YCbCr 10-bit 4:4:4 | DP/HDMI/ST 2110 | DP/HDMI/ST 2110 | No | No | No | No | No | No |
| YCbCr 10-bit 4:2:2 | DP/HDMI/ST 2110 | DP/HDMI/ST 2110 | DP Only | DP Only | No | No | No | No |
| **60 Hz** | | | | | | | | |
| RGB 12-bit | DP/HDMI/ST 2110 | DP/HDMI/ST 2110 | DP Only | DP Only | No | No | No | No |
| RGB 10-bit | DP/HDMI/ST 2110 | DP/HDMI/ST 2110 | DP Only | DP Only | No | No | No | No |
| RGB 8-bit | DP/HDMI/ST 2110 | DP/HDMI/ST 2110 | DP/HDMI | DP/HDMI | DP Only | No | No | No |
| YCbCr 12-bit 4:4:4 | DP/HDMI/ST 2110 | DP/HDMI/ST 2110 | DP Only | DP Only | No | No | No | No |
| YCbCr 12-bit 4:2:2 | DP/HDMI/ST 2110 | DP/HDMI/ST 2110 | DP Only | DP Only | DP Only | No | No | No |
| YCbCr 10-bit 4:4:4 | DP/HDMI/ST 2110 | DP/HDMI/ST 2110 | DP Only | DP Only | No | No | No | No |
| YCbCr 10-bit 4:2:2 | DP/HDMI/ST 2110/SDI | DP/HDMI/ST 2110/SDI | DP/HDMI/SDI | DP/HDMI/SDI | DP Only | DP Only | 4 x SDI Only | 4 x SDI Only |
| **30 Hz** | | | | | | | | |
| RGB 12-bit | DP/HDMI/ST 2110 | DP/HDMI/ST 2110 | DP/HDMI/ST 2110 | DP/HDMI | DP Only | DP Only | No | No |
| RGB 10-bit | DP/HDMI/ST 2110 | DP/HDMI/ST 2110 | DP/HDMI/ST 2110 | DP/HDMI | DP Only | DP Only | No | No |
| RGB 8-bit | DP/HDMI/ST 2110 | DP/HDMI/ST 2110 | DP/HDMI/ST 2110 | DP/HDMI | DP Only | DP Only | DP Only | No |
| YCbCr 12-bit 4:4:4 | DP/HDMI/ST 2110 | DP/HDMI/ST 2110 | DP/HDMI/ST 2110 | DP/HDMI | DP Only | DP Only | No | No |
| YCbCr 12-bit 4:2:2 | DP/HDMI/ST 2110 | DP/HDMI/ST 2110 | DP/HDMI/ST 2110 | DP/HDMI | DP Only | DP Only | DP Only | No |
| YCbCr 10-bit 4:4:4 | DP/HDMI/ST 2110 | DP/HDMI/ST 2110 | DP/HDMI/ST 2110 | DP/HDMI | DP Only | DP Only | No | No |
| YCbCr 10-bit 4:2:2 | DP/HDMI/ST 2110/SDI | DP/HDMI/ST 2110/SDI | DP/HDMI/ST 2110/SDI | DP/HDMI/SDI | DP Only | DP Only | DP / 4 x SDI | DP / 4 x SDI |

**NOTES:**

- HDMI signals cannot exceed 4K, regardless of bandwidth.
- HDR (High Dynamic Range) using both PQ and HLG is supported on all interfaces.

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# HELIOS Processor - Supported SDI Input Formats

The following is a list of supported SDI formats:

| Supported Resolutions for each SDI Input |
|:---:|
| 1280 x 720 |
| 1920 x 1080 |
| 2048 x 1080 |
| 3840 x 2160 |
| 4096 x 2160 |

| Supported Frame Rates |
|:---:|
| 23.98 / 24 |
| 24.97 / 25 |
| 29.97 / 30 |
| 49.95 / 50 |
| 59.94 / 60 |

**NOTES:**

- The pixel format must be YCbCr 4:2:2

- All video signals must be Level A with the exception of 1080p 50/60 Hz can be Level B.

- Inputs can be combined using 2SI or square division. Square division is only supported across separate physical inputs (not within a single 12G link). Inputs combined with square division can not be scaled.

- HELIOS does not support interlaced or progressive segmented frame (PsF) signals.

# HELIOS Processor - 100G Input ST 2110 Specifications

| Item | Value |
|:---:|:---:|
| Total number of streams | 4 |
| Supported Bit Depths | 8, 10, 12 BPC |
| Supported Color Formats | 4:4:4 or 4:2:2 |
| **A** input maximum bandwidth* | 2,124 Megapixels per second (8k@60) |
| **B/C/D** inputs maximum bandwidth* | 780 Megapixels per second (just under 6k@60) |

*Total for all inputs (even if not selected in HELIOS) must be less than or equal to 2,124 Megapixels per second.

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# HELIOS Processor - Output Port Capacity (Pixels)

| Bit Depth | 10 | 10 | 10 | 12 | 12 | 12 |
|---|---|---|---|---|---|---|
| Connection | Switch to Tiles | Switch to Tiles | HELIOS to Switch | Switch to Tiles | Switch to Tiles | HELIOS to Switch |
| Ethernet Speed (Gbps) | 1 | 2.5* | 10 | 1 | 2.5* | 10 |
| **Video FPS** | | | | | | |
| 24 | 1,275,000 | 3,187,500 | 8,500,000 | 1,062,500 | 2,656,250 | 8,500,000 |
| 25 | 1,225,000 | 3,062,500 | 8,500,000 | 1,020,000 | 2,550,000 | 8,500,000 |
| 30 | 1,020,000 | 2,550,000 | 8,500,000 | 850,000 | 2,125,000 | 8,500,000 |
| 48 | 635,000 | 1,587,500 | 6,350,000 | 531,000 | 1,328,125 | 5,312,500 |
| 50 | 610,000 | 1,525,000 | 6,100,000 | 510,000 | 1,275,000 | 5,100,000 |
| 60 | 510,000 | 1,275,000 | 5,100,000 | 425,000 | 1,062,000 | 4,250,000 |
| 120 | 240,000 | 600,000 | 2,400,000 | 200,000 | 500,000 | 2,000,000 |
| 144 | 195,000 | 487,500 | 1,950,000 | 160,000 | 400,000 | 1,600,000 |
| 240 | 100,000 | 250,000 | 1,000,000 | 90,000 | 225,000 | 900,000 |

\* 2.5G connectivity is dependent on the tile design capabilities set by the tile manufacturer. Check tile specifications to ensure the tiles are 2.5G capable. Most tiles are only 1G capable.

**NOTE:** Regardless of frame rate or bit depth, the maximum pixels per HELIOS output port is 8.5 million.

# Fiber Out / Data to Tiles

| | 720p<br>(1280 x 720) | 1080p<br>(1920 x 1080) | UHD<br>(3840 x 2160) | DCI 4K<br>(4096 x 2160) | 5K<br>(5120 x 2880) | 6K<br>(6016 x 3384) | 8K<br>(7680 x 4320) | DCI 8K<br>(8192 x 4320) |
|---|---|---|---|---|---|---|---|---|
| **120 Hz** | | | | | | | | |
| 444 12-bit | 1 x 10Gb | 2 x 10Gb | 5 x 10Gb | 6 x 10Gb | 8 x 10Gb | No | No | No |
| 444 10-Bit | 1 x 10Gb | 2 x 10Gb | 4 x 10Gb | 5 x 10Gb | 8 x 10Gb | 8 x 10Gb | No | No |
| **60 Hz** | | | | | | | | |
| 444 12-bit | 1 x 10Gb | 1 x 10Gb | 3 x 10Gb | 3 x 10Gb | 5 x 10Gb | 5 x 10Gb | No | No |
| 444 10-bit | 1 x 10Gb | 1 x 10Gb | 3 x 10Gb | 3 x 10Gb | 4 x 10Gb | 5 x 10Gb | 8 x 10Gb | 8 x 10Gb |
| **30 Hz** | | | | | | | | |
| 444 12-bit | 1 x 10Gb | 1 x 10Gb | 2 x 10Gb | 2 x 10Gb | 3 x 10Gb | 3 x 10Gb | 5 x 10Gb | 6 x 10Gb |
| 444 10-bit | 1 x 10Gb | 1 x 10Gb | 2 x 10Gb | 2 x 10Gb | 2 x 10Gb | 3 x 10Gb | 5 x 10Gb | 5 x 10Gb |

## Network Ports

The HELIOS Processor is running a Linux build based on Alpine Linux. The following network ports and services are used by the system:

| Network Ports | Notes |
|---|---|
| 80 (TCP) | Main Web UI and Public API (HTTP) |
| 443 (TCP) | Main Web UI, Public API (HTTPS) |
| 443 (TCP Outbound) | General Megapixel Cloud connections |
| 1900 (TCP+UDP) | Service Discovery (SSDP) |
| 2222 (TCP Outbound) | Megapixel Cloud back-channeled remote connections |
| 5353 (UDP) | Service Discovery (mDNS) |
| 5568 (UDP) | Public API / Control (sACN) |
| 56004 (TCP+UDP) | HELIOS Stacking |
| ICMP | Network ping, etc. |

## API

HELIOS has a REST-like API. The API documentation is available on request. Please get in touch via our **website** .

Select **API document** and complete the form to download.

## Thermal Sensor Alert Levels

The table below provides the alert and critical thresholds for several sensors.

| Sensor | Value | Alert Severity | |
|---|---|---|---|
| Tile CPU Temp. Alert | 85°C | Error (Orange) | 🟧 |
| Tile PHY Temp. Alert | 90°C | Error (Orange) | 🟧 |
| Tile CPU - Blackout to cooldown | 125°C | Critical (Red) | 🟥 |
| HELIOS Case Temp. | >60°C | Critical (Red) | 🟥 |
| SFP Temp. | >70°C | Error (Orange) | 🟧 |

## Normal Voltage Ranges

Sensor readings can be found on the **Devices** pane (examples marked with red rectangles below).

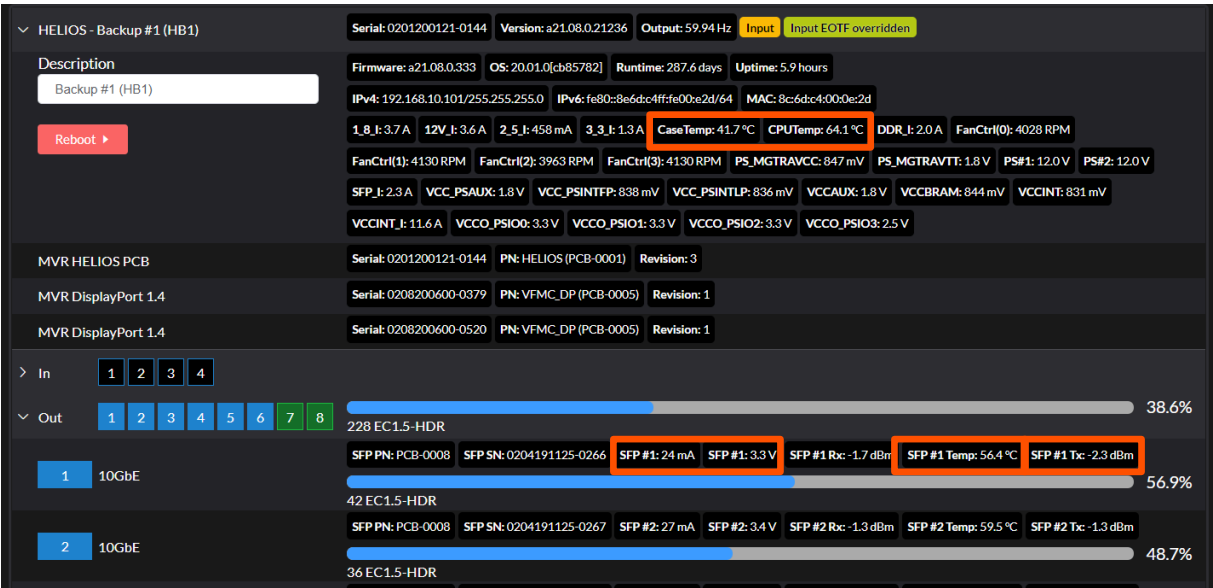| Sensor | Value |
|---|---|
| SFP Voltage | 3.2 – 3.4 V |
| SFP Current | 1 – 45 mA |
| SFP Tx Power | –7.0 – 1.0 dBm |
| SFP Rx Power | –8.0 – 1.0 dBm |



**Figure 204:** Devices Pane Sensor data

# HELIOS Functions Tracked by Stacking

Below is a comprehensive list of features that the HELIOS Stacking feature tracks when enabled. For more information on how to use Stacking see the **Processor Stacking** section.

- **Global**
  - Blackout
  - Freeze
  - Lock Controls
  - Image Settings
    - Brightness
    - Gamma
    - Color Temperatures + Duv
  - Video Patterns
    - Test pattern settings (Enable, Color, Motion, Type)
    - Show Still toggle, but not the selected still
    - Show Tile Topology
- **Mapping**
  - Canvas Lock
  - Tile Position & Rotation
  - Positioning Tools (CAD style selection)
  - GhostFrame bypass
  - Group assignment
  - Group settings (all, incl. mask media selection)
- **Seams**
  - Tile Seams (Show seams)
- **Input**
  - HDCP allow
  - Input adjustments (all sliders + range/standard overrides)
  - Aspect ratio
  - EOTF adjustments
  - NanoSync (Enable, Delay, No input freq.)
  - Output window (Canvas repeat)

- **Output**
  - Curves (Enable + Curve points)
  - Adjustments (Enable, Lift, Gamma, Gain, Offset, Saturation, Legacy)
  - Display gamut
    - Gamut type
    - Custom gamut points
  - Calibration
    - Bypass calibration
    - LDM level correction
    - Clip to widest
  - Display bit depth
  - Light science
  - Latency (TLL + PLL + frame delay)
  - Output adjustments (R/G/B, Black Clipping, Gamma offset, Limit to lowest)
- **Camera/GhostFrame**
  - Enable
  - Video streams
  - Chroma colors
  - Slices with gains
  - Advanced timings (Active, Refresh, Overclock)
- **Settings**
  - Interface (Dark mode, Language)
  - Tiles (Identify behavior, Fan control, Low power mode)
  - Redundancy (Mode, backup test pattern, Offline on input failure)

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**NOTES:**

- Inputs are per named input; so processors in a stack both have to have an "HDMI1" for example (so HDMI and HDMI1 don't match)

- While the widest/achievable gamut type is synchronized, the actual achievable points are not, and are dependent on the tiles connected to the processor