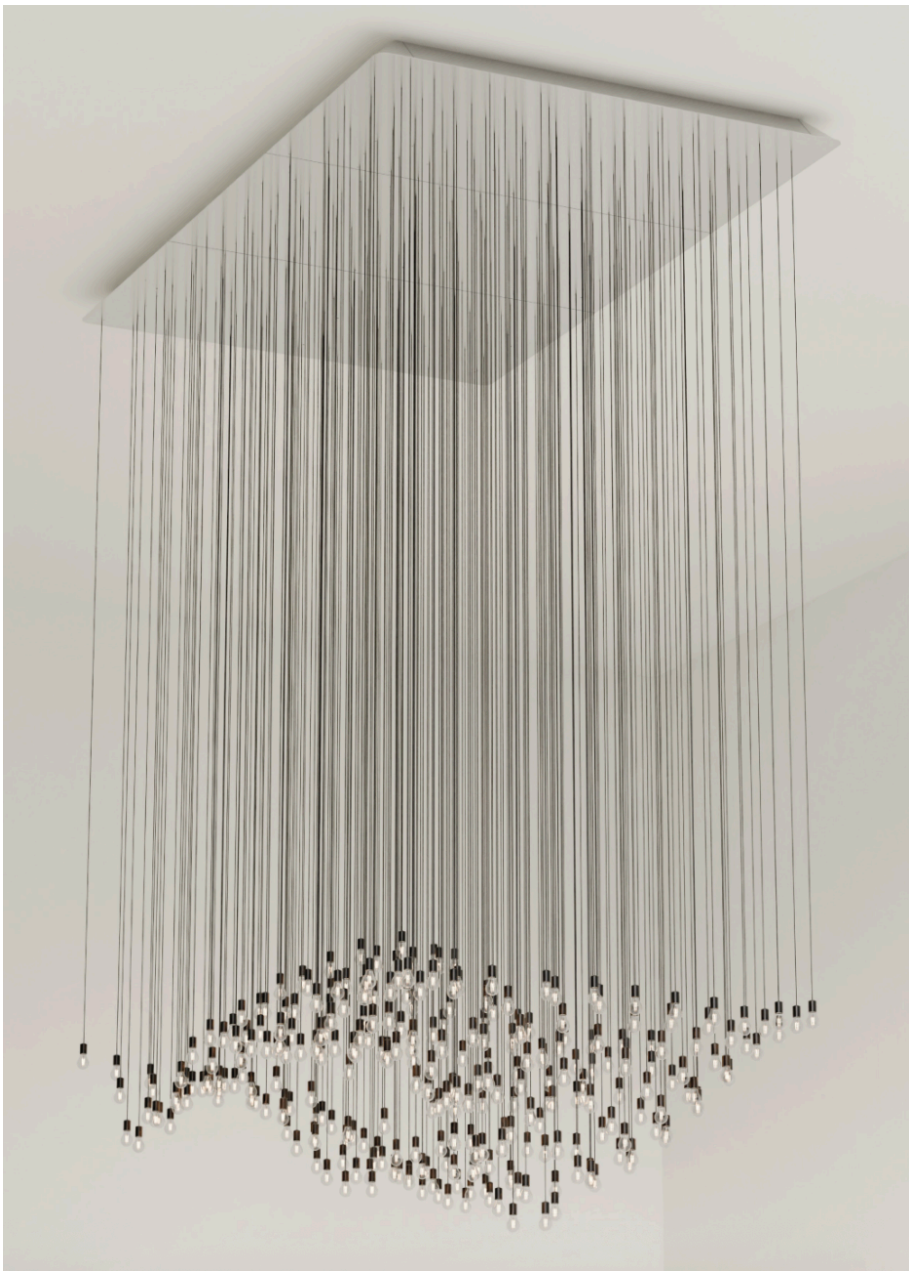
PULSE CHANDELIER

BY RAFAEL LOZANO-HEMMER



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GENERAL IMPORTANT INFORMATION

This short section must be read for proper operation.

PULSE CHANDELIER (2023)

BY RAFAEL LOZANO-HEMMER

Technique

LED filaments glass lightbulbs, DMX controllers, custom-made photoplethysmography sensor, computer.

Description

A Pulse Chandelier has three hundred Edison-shaped lights in polycarbonate or glass bulbs with 2700K LED filament inside. Each bulb softly glimmers to the heartbeat of a recording from the past. A photoplethysmography sensor is suspended and used as a light source beside the piece; when a hand is detected under this sensing light, the whole chandelier gradually pulses in sync with the participant's heartbeat and records this new data, erasing the oldest recording in the array. The piece features a global dimmer so that the brightness can be easily controlled, and the piece can also be switched on and off with a standard light switch.

Operation

Please refer to Appendix I - Installation for detailed system information and wiring diagram.

1. If the computer is set to a power **ON/OFF** schedule then the artwork will turn **ON/OFF** automatically at the set times.

2. It is possible to manually turn the computer **ON** via its power button by pressing it firmly for around one second. Once the PulseTopology app is running - it should be live within 2 minutes - all light bulbs should be flashing. To manually turn **OFF** the computer, use the provided keyboard and via the regular OSX menu, click the Apple icon, then Shutdown (you may have to quit the shown software first).

3. Placing a hand under the Heart-rate sensor for 10 seconds and longer will start the population process. Check the sensor to confirm.

   If the sensor's LED spot (warm white) changes to the LED ring (cool white) and your heart beat displays on the chandelier, the sensor is properly running.

4. If any sensor does not react, or if the piece didn't start properly: a power cycling of the computer is recommended. If it still doesn't turn on, then hold the power button all the way down for 10 seconds. Then, wait at least three seconds, then press the power button all the way down for one second, and you should be up and running again.

General Artwork Behaviors

When set into **Pulse Mode**, each light bulb glimmers to the pulse of a different participant, which contributes to a connective arrangement. The pulse patterns or 'choreography' of them across the lightbulb installation can be finely adjusted in brightness, speed and sequence using the custom software on the computer.

The artwork's mode can be changed to **Chandelier** to turn off these pulse patterns and transform the chandelier into a regular light fixture. The artwork's mode can also be changed to the **Off mode**, which, obviously, will turn off all the lights.

Interacting with the Artwork

When set into **Pulse Mode**, a participant interacts with the installation by placing their hand under the provided sensor. The sensor's camera reads the heartbeats by analyzing the changing skin tone of the hand placed in view. Then, all bulbs are 'taken over' and will pulse only this new heartbeat for a short time, then the software assigns the beat to one bulb while all others return to their previously displayed heartbeats.

A Sweep animation can be called by pressing the Sweep button in any of the different provided interfaces. This animation is basically a virtual band of a specific width that passes across the chandelier during a certain period of time and affects the brightness of the light bulbs contained within the said band by making it brighter, making the bulbs to almost look static instead of pulsing.

NOTE: A proper distance to read the heart rate is between 10 to 20 cm (4" to 7.75") away from the sensor bottom.

Maintenance

Clean the bulbs and their cables only if dust has accumulated or there are otherwise visible markings. Before cleaning the piece, ensure to use cotton gloves to avoid marking the bulbs and keep in mind it is preferable to ensure that all power has been turned off.

When cleaning the cables use a clean dry towel to gently wipe down the length of the cable. For the bulbs use a microfiber cloth sprayed with a light amount of glass safe cleaner. Never use water to clean the piece. Alternatively, a hand duster (like a Swiffer) could be used if the dust amount to remove is minimal.

Dust the space where dimmers are kept with compressed air when dust accumulates.

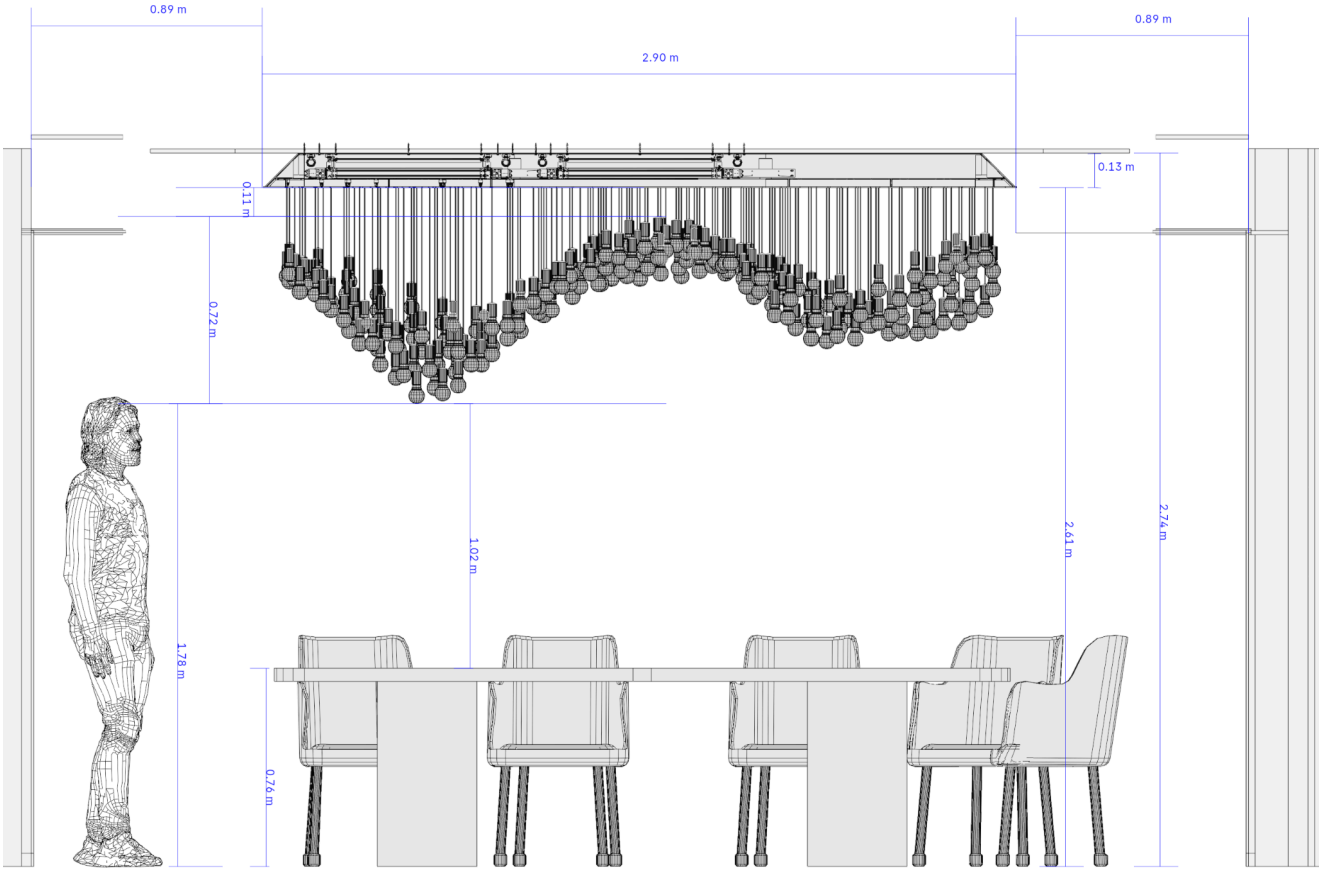
When cleaning the sensor, use a microfiber cloth with a light amount of diluted gentle dish soap. Avoid the underside of the bell where the electronics and camera lens is.

Placement Instructions

It is recommended to have at least 90 cm distance from each canopy edge to the nearest wall and a distance from floor to ceiling of 274 cm to provide enough space for a topology to be made.

It is possible to mount the canopy 6 meters or higher from floor though additional weight considerations may be involved as more cable mass would be used. It is required to choose a location for the sensor to be placed ~75cm from floor or at standard desk or table height.

This artwork can function in darkened rooms or with windows and natural light. The following image shows one installation of this piece as an example. The total weight of the piece is 198 kg or 436 lb.



DETAILED TECHNICAL INFORMATION

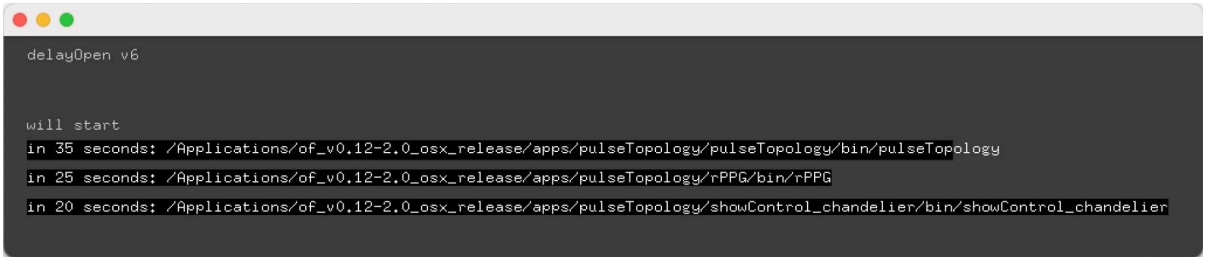
Normal Software Operation

At the time of writing this manual, the three apps operating on the computer are coded under openFrameworks' platform v 0.12.2. Software version referred to in this manual are #191 20250521 for the PulseTopology.app, #90 20250320 062627 for the rPPG.app and 0d4d86e 20250529 For the showControl_chandelier.app. The version numbers either are displayed as part of the GUI or can be extracted from the app's git repository.

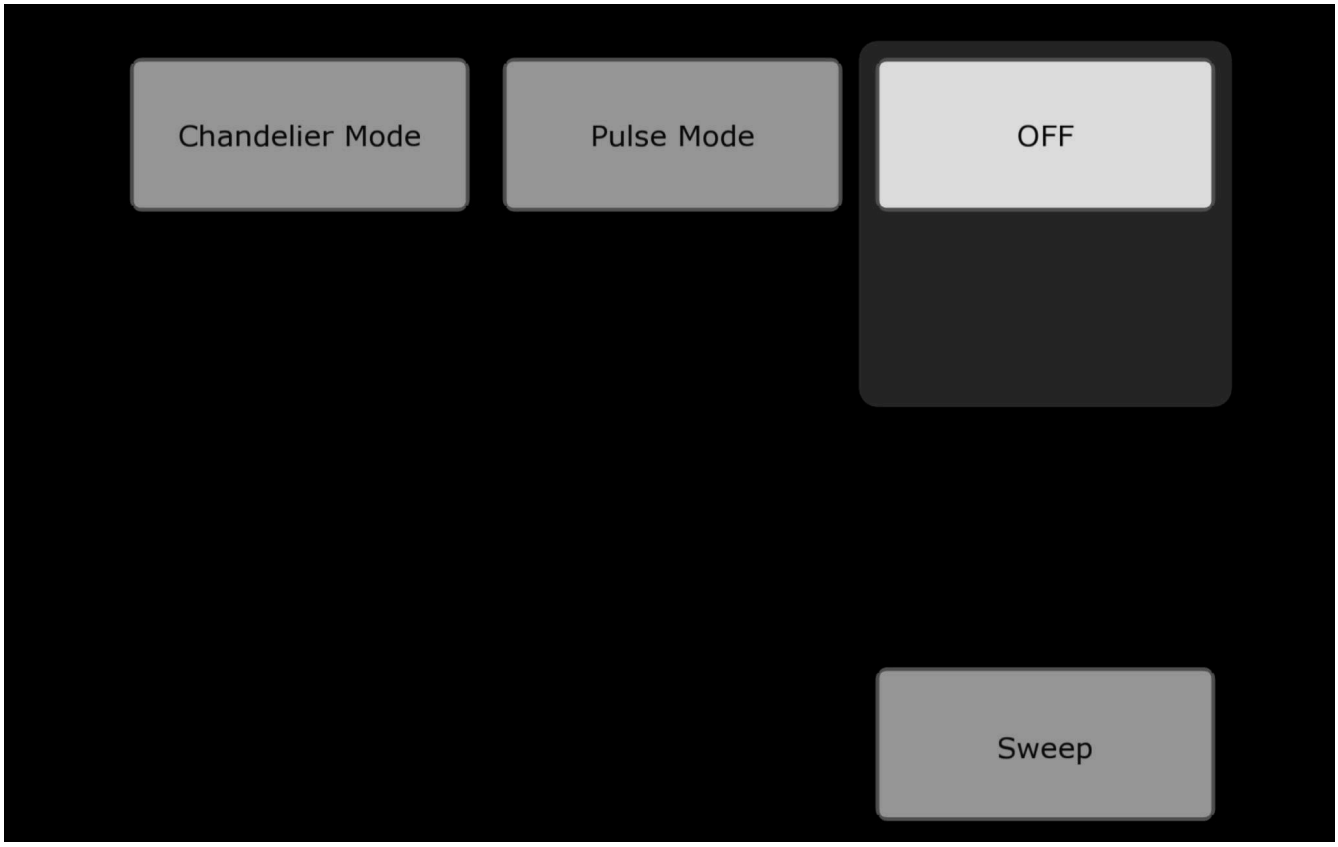
- pulseTopology.app: Controls the functions of the artwork, based on the defined parameters used in showControl_chandelier.app.
- rPPG.app: Controls the sensor and sends pulses information to the pulseTopology.app.
- showControl_chandelier.app: Controls simple aesthetics and functionality of the piece and is the only software a regular user should use to make adjustments.

All apps run on an Apple computer on OSX 13.4. Such software was initially released and tested on an Apple MacMini with an M2 processor, 8GB of RAM and 256 GB of storage.

The softwares showControl_chandelier.app, rPPG.app and PulseTopology.app are launched, in such an order, by the custom-made software delayOpen.app that, as the name implies, delays the software launch to allow all system resources to be loaded in priority. Once all the apps are loaded, the showControl_chandelier.app will go into fullscreen mode and hide all other apps.



delayOpen.app, used to launch the 3 needed softwares



showControl_chandelier.app

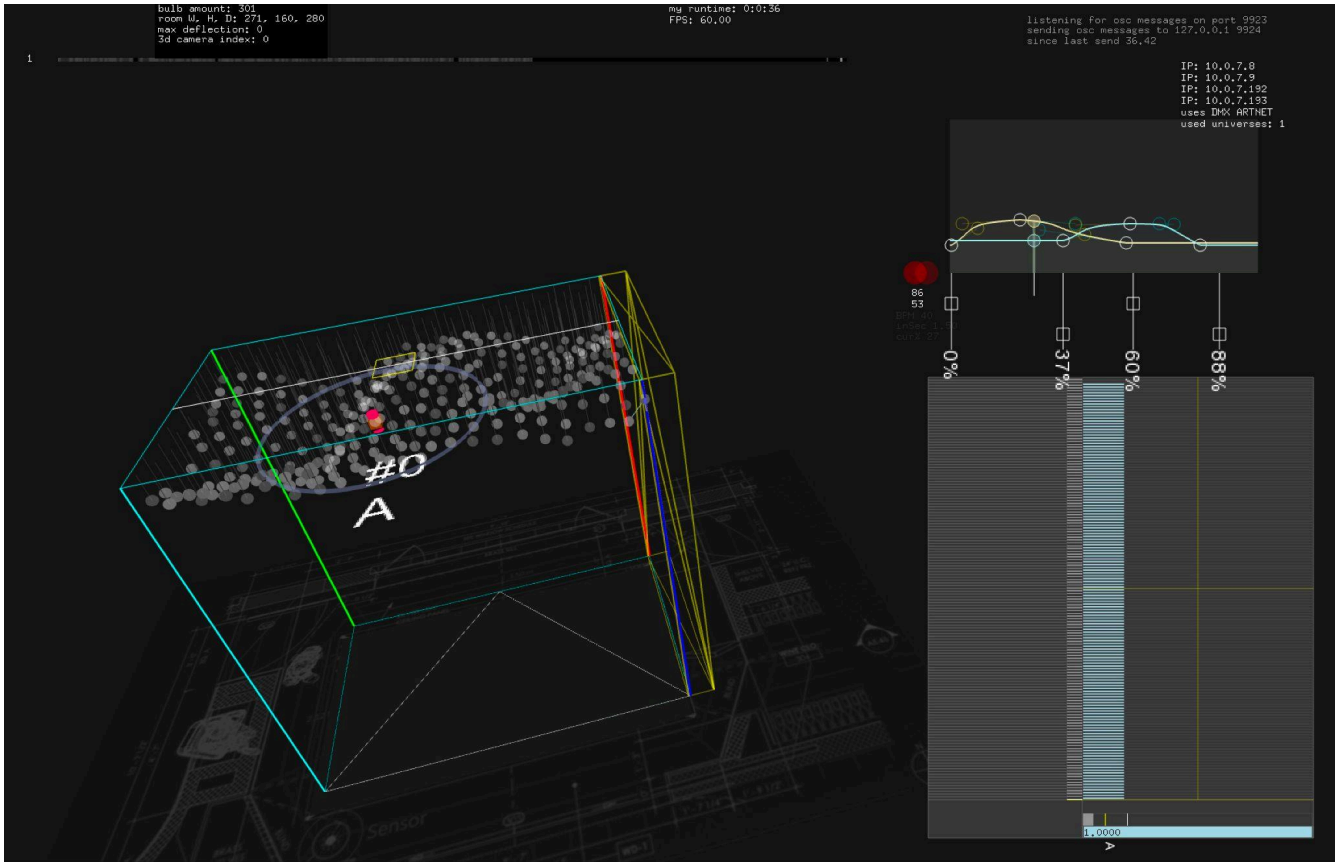
The following sections will go over the normal behavior of the different apps. In Manual Software Calibration we will explore all of the processes mentioned here in more depth and show adjustable variables.

When in Pulse Mode and no one is participating, all 300 lights pulse at the BPM of a past participant.

Each light has a unique X,Y location and a Z value defined by the predesigned topology, it is assigned to a row and column number, is assigned to a DMX universe and a specific DMX channel. When the app starts it loads data/layout/layout.csv and data/BPMs.csv file which sets up the above mentioned variables. When the app closes all BPM readings get written to BPMs.csv.

As mentioned above, the showControl_chandelier.app is the main interface the user would see when looking at a monitor connected to the computer. This interface allows the user to switch between different modes: Chandelier Mode, Pulse Mode and Off. Please refer to showControl_chandelier.app section for further details.

In the App you can see 1 or many circle patterns drawn inside the heart grid; each representing the location of one of the rPPG heart rate sensors. Consult the screenshot below for an image of the Pulse Topology app running well.



PulseTopology.app software

The pulsing of each light follows a predefined set of bezier curves. These curves get generated every time a new heart rate is detected and gets assigned to a light. The brightness change follows the values of those bezier curves. Depending on the BPM the curve values change fast or slow.

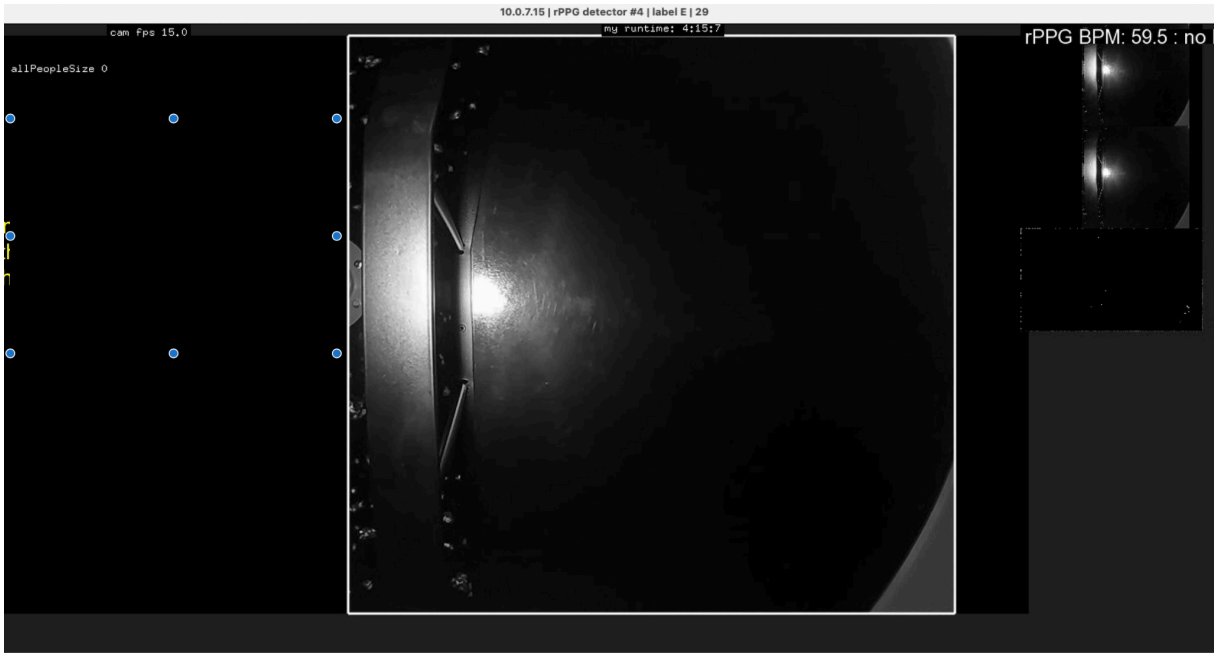
When a person places their hand under one of the sensors (10 cm away for best detection) a hand touch signal is sent from the rPPG.app to the PulseTopology.app. As soon as this happens the physical sensor sculpture switches from LED spot light to LED ring; warm to cold light.

This is the start of the "population" stage.

Shortly after a small group of lights near the sensor stop pulsing and turn to a fixed/solid brightness. It takes about 10-15 seconds until a proper BPM is measured by the rPPG.app via the sensor's built-in camera. Once a good BPM is acquired it is sent from rPPG.app to PulseTopoloy.app. At that moment the group of solid lights start pulsing to the new BPM reading. After a pre-defined duration more and more lights will start pulsing in unison. The amount of lights increases exponentially over time until all lights pulse together. When a hand is no longer detected by the sensor then the light amount decreases again. The decreasing animation does not have the sensor at its centre but a newly picked crystal. The light at the centre of this decreased animation will be the host for the new heart beat. The light containing the new heart beat will also be a bit brighter than all others.

This is the end of the "population" stage.

The reaction to a hand presented to the sensor is displayed in the rPPG.app to within 3 phases - noticeable via the label at top right of display and the exposed graph while reading: at first the software detects no hand, then detects a hand and after few seconds, finally displays the detected live heartbeat live.



rPPG.app - State of the app when no hand is under it.

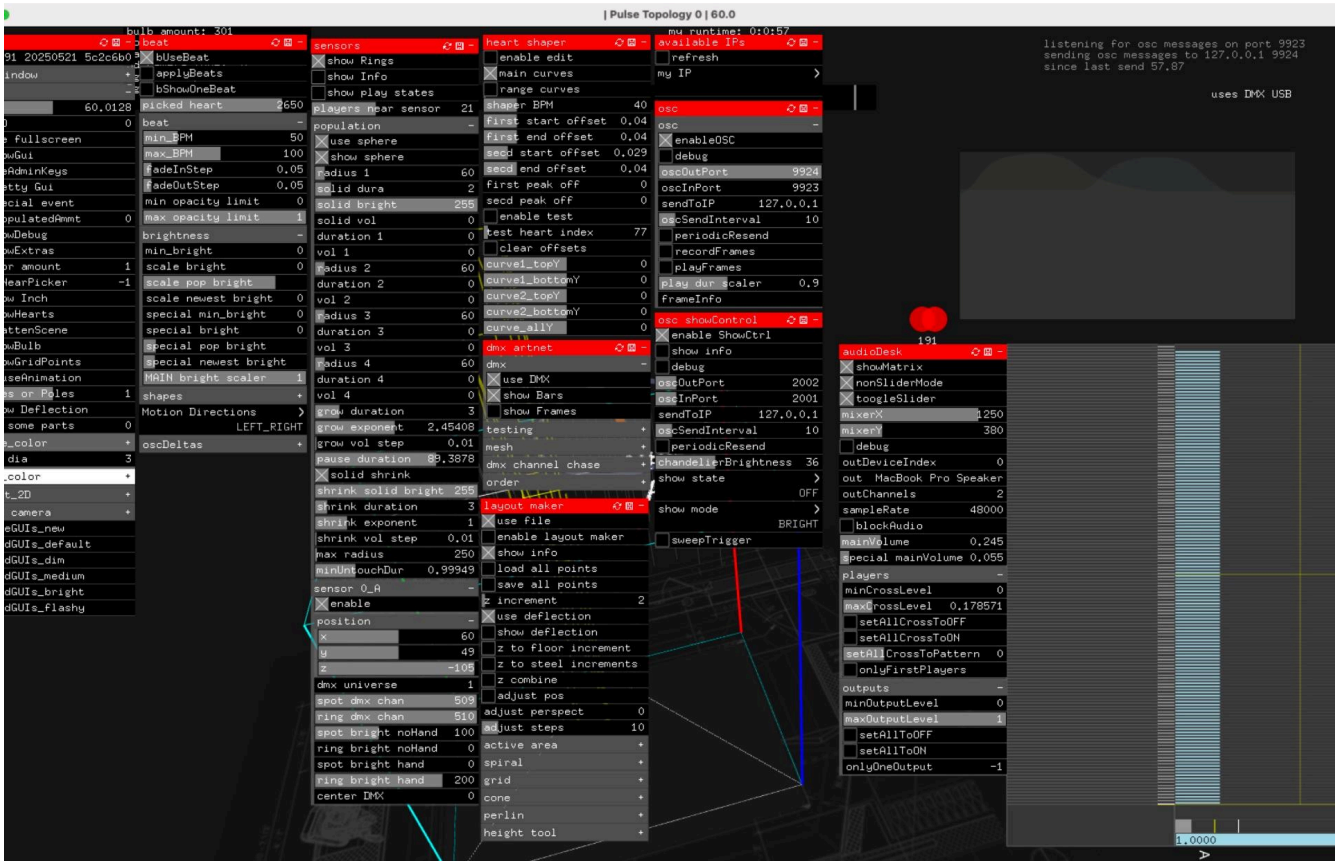
rPPG.app - State of the app when a new hand is placed under it.

rPPG.app - State of the app when the hand's heartbeat is detected

Manual Software Calibration

pulseTopology.app

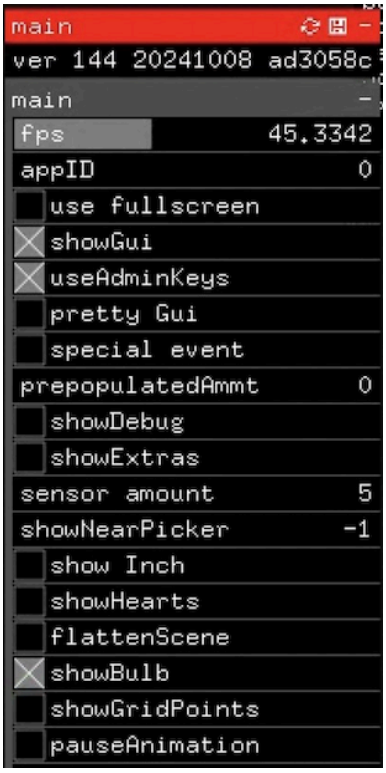
The pulseToplogy.app has a GUI function that can be accessed by pressing in the **g** key on the keyboard. **Be very careful when opening this option,** it controls everything and if the GUI is shut it will save the changes made to it. All GUI files can be found at: pulseTopology/pulseTopology/bin/data/GUIs/



PulseTopology.app with the gui visible.

The GUI is divided into subsections: a subsection name is labelled into a red or dark grey title bar and associated settings are listed under that title bar. Below, you will get information about different settings within each subsection. Only variables that you are likely to need to check or adjust will be explained. If for whatever reason the GUI values are accidentally changed, refer to a copy of the original code and these screenshots to help reset the variables.

Main



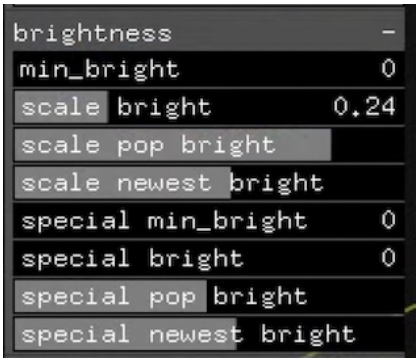
Setting	Description
appID	Set to 0. This denotes computer A. The pulseTopology.app only runs on computer A. Each rPPG and main app have their own appID.
FPS	Should be 60. Will be lower if someone is remotely connected but it should not be so severe that you see a visible change in the artwork.
special event	Should only be used when trained by Antimodular staff on how to run the piece for a special event. Can also be triggered by pressing the “s” key.
ShowNearPicker	Defines how much information about each light is displayed near the mouse cursor.
Sensor Amount	Set the number of sensors you are using, if there are 3 sensors then set the number to 3.
pauseAnimation	Pauses the heartbeats. Use this feature only for professional photographs of the artwork.

Beat

Setting	Description
bUseBeat	Should be selected.
min_BPM	Minimum BPM that will be saved into the artwork.
max_BPM	Maximum BPM that will be saved into the artwork.

Beat/Brightness

Setting the light brightness and visibility of heartbeats. Keep in mind when setting these that we never want the lights to be fully off or too bright that they hurt to look at.

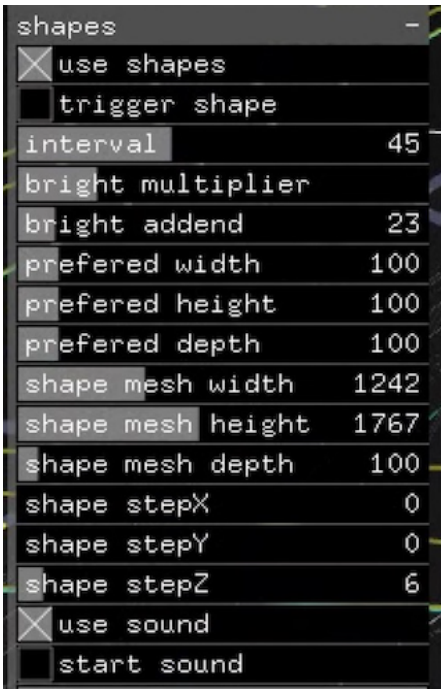


Setting	Description
bUseBeat	Should be selected.
min_bright	Minimum light brightness should never be 0.

Setting	Description
scale_bright	How bright a light can go. Should never be too bright to look directly at. Setting this to 0 would mean that the lights never get a pulse or brightness value.
Scale pop bright	How bright the active lights get when someone is using the sensor.
Scale newest bright	How bright the light that stores the last detected heartbeat is: should be different from the other lights.
Special min_bright	Min brightness for special event mode.
Special bright	Max brightness for special event mode.
Special pop bright	How bright the lights are when someone is using the sensor in special event mode.
Special newest bright	How bright the last saved heartbeat is for special event mode.

Beat/Shapes

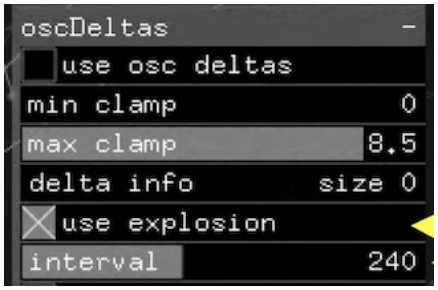
There should be an occasional sweep that goes through the artwork, the direction, size, and speed is determined by the artist. This is unique to each space.



Setting	Description
Use shapes	Should be selected. This enables the ‘sweep’ behavior every **x** seconds as set by the **interval** variable.
Interval	How often the sweep happens in seconds.
Shape stepX	Sets the x axis size; i.e. defines sweep direction.
Shape stepY	Sets the y axis sizei.e. defines sweep height.
Shape Mesh Width	Sets the width of lights covered by sweep.
Shape Mesh Height	Sets the height of lights covered by sweep.
Bright Multiplier	Increases the brightness of sweep.
Bright addend	Increases the brightness added to sweep.
Use Sound	Should be unselected.

oscDeltas

This sets some of variables related to the big bang cube animation



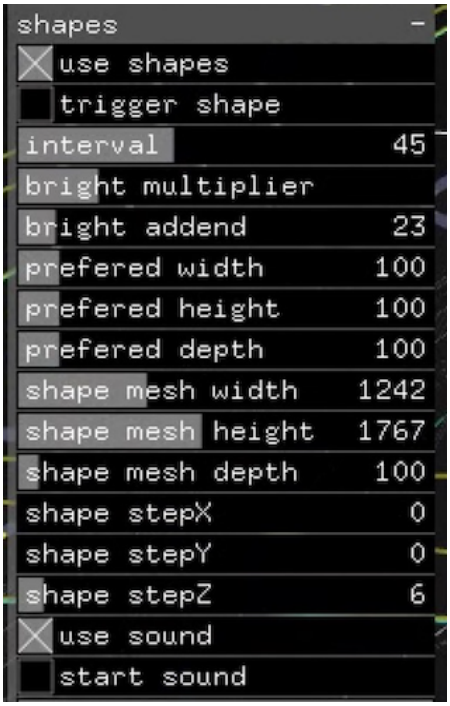
Setting	Description
Use explosion	Should be selected. This enables the ‘sweep’ behavior every **x** seconds as set by the **interval** variable.
interval	How often the explosion happens in seconds.

Sensors

For testing purposes buttons 1-6 on the keyboard can be pressed to simulate a sensor detection.

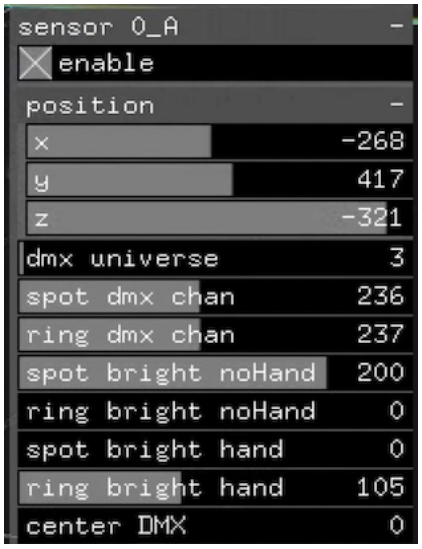
- 1 & 2 control sensor A
- 3 & 4 control sensor B.
- 5 & 6 control sensor C.
- 7 & 8 control sensor D.
- 9 & 0 control sensor E

Press 1, 3, or 5 once to select the corresponding sensor. This simulates a person placing their hand under the sensor. Then press a second time to activate it. This simulates the person's hand having been detected long enough to measure their heart rate Press 2, 4, or 6 once to deactivate the corresponding sensor. This simulates a person removing their hand.



Setting	Description
Show rings	Should be selected.
Show Info	Select when programming sensors to see more information.
Show Play States	Select to see when sensors are being activated. Helpful for determining population region and that sensors are labelled correctly.

Individual Sensor Menus

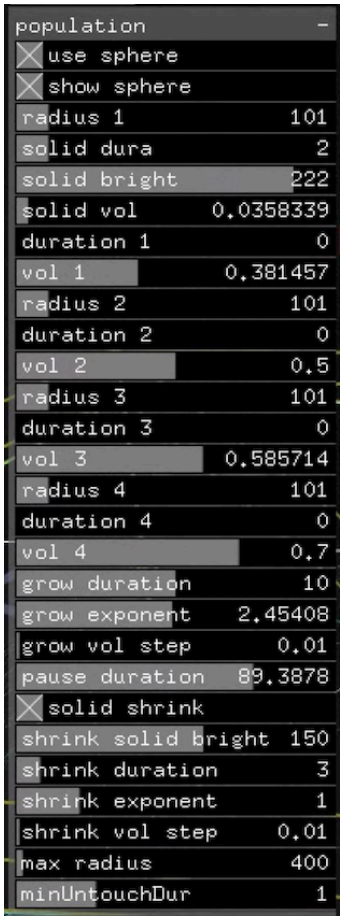


Setting	Description
Enable	Should be selected.
X	Sensor's X position in space.
Y	Sensor's Y position in space.
Z	Sensor's Z position in space.
dmx universe	Set this to the universe this sensor's LED ring and spotlight are plugged into.
Spot dmx chan	Set this to the dmx channel the spotlight has been plugged into (typically 509 or 510).
Ring dmx chan	Set this to the dmx channel the LED ring has been plugged into (typically 509 or 510).
Spot bright noHand	Turns the spotlight on when the RPPG.app does not detect a hand. It needs to be bright enough that it is visible when you walk into the space, so that people know where the interaction zones are but not so bright that it distracts from the artwork.
Ring bright noHand	Turns the ring light on when the RPPG.app does not detect a hand. should always be set to zero.
Spot bright hand	Turns the spotlight on when the RPPG.app detects a hand. should always be set to zero.

Setting	Description
Right bright hand	Turns the ring light on when the RPPG.app detects a hand. Needs to be bright enough that the sensor gets reliable readings every time a hand is seen by the RPPG.app. This value should be adjusted and tested thoroughly during the programming stage of installation.

Sensor / Population

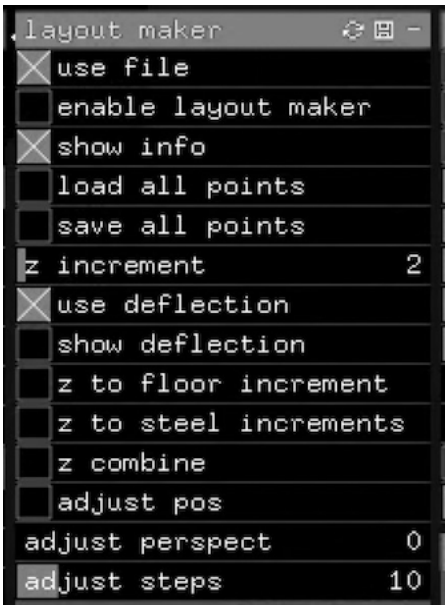
It is possible to define the first few sensor radii increases manually by setting duration1, radius 1, duration2, radius 2, etc to values larger than 0. After those radii get executed the exponential growing starts.



Setting	Description
Max radius	Adjusts the size of the sensor radius: the area that gets populated with your heartbeat when you're using the sensor.

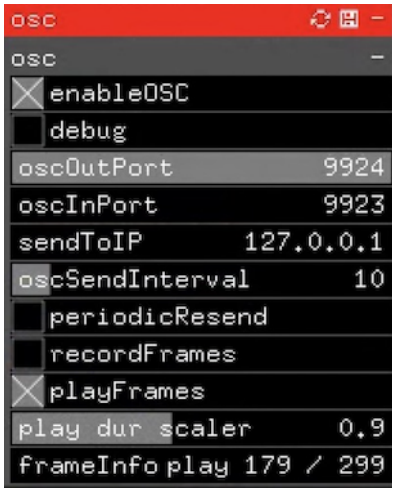
Layout Maker

Enable layout maker should ONLY be used by Antimodular to make topology design changes. This allows the software to read the layout.csv file which determines the light locations and dmx addresses. If you ever need to make changes to the layout.csv make a copy of the original file then change the new updated file to the name “layout.csv and put it in the correct location (mentioned above). Restart the pulseTopology app and your new csv will be loaded in.



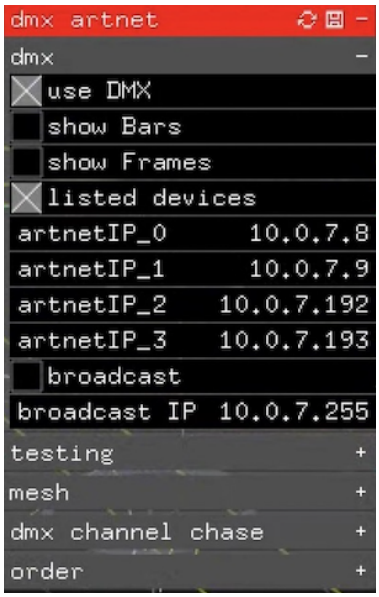
Setting	Description
Use file	Should always be selected

OSC



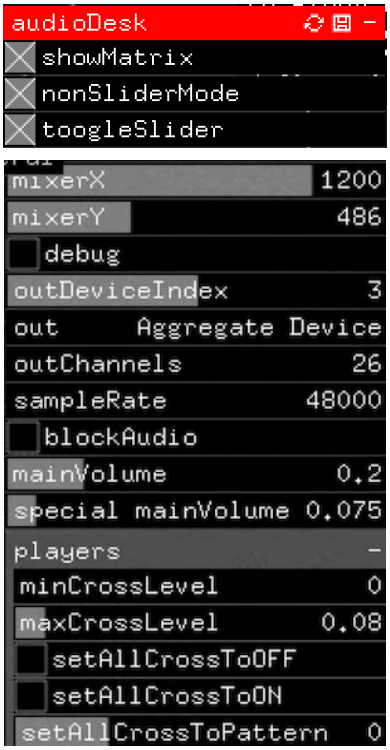
Setting	Description
enableOSC	Should be selected since the rPPG apps send data over OSC.
oscOutPort	pulseTopology.app should be set to 9924 to communicate with the different instances of RPPG.app.
oscInPort	pulseTopology.app should be set to 9923 to communicate with the different instances of RPPG.app.

DMX Artnet



Setting	Description
Use DMX	Should be selected.
artnetIP	Set to IP address of DMX device being used

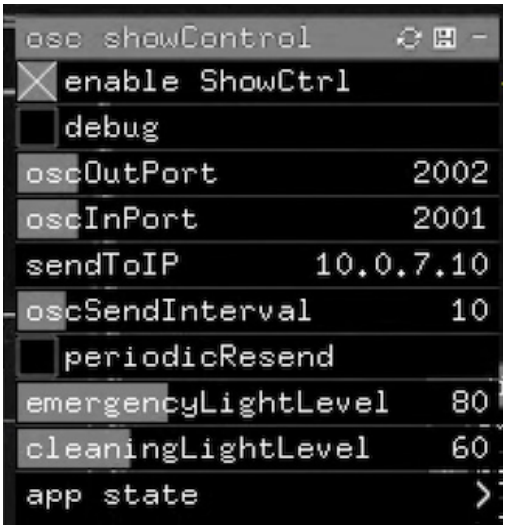
Audio Desk



Setting	Description
Show Matrix	Should be selected.
Out	Aggregate device should be selected. **Note:** The app will not open if it does not detect an Aggregate Device
outChannels	Set to 4.
SampleRate	Should be set to 48000.
mainVolume	Controls the general volume of the artwork.
Special mainVolume	Controls general volume of the artwork in Special mode.
minCrossLevel	Adjust this slider to increase the volume of the single heartbeat when someone is using a sensor.

OSC showControl

These variables control the app's ability to respond to the building control signals. Other than toggling the enable button on or off none of these values should ever be changed.

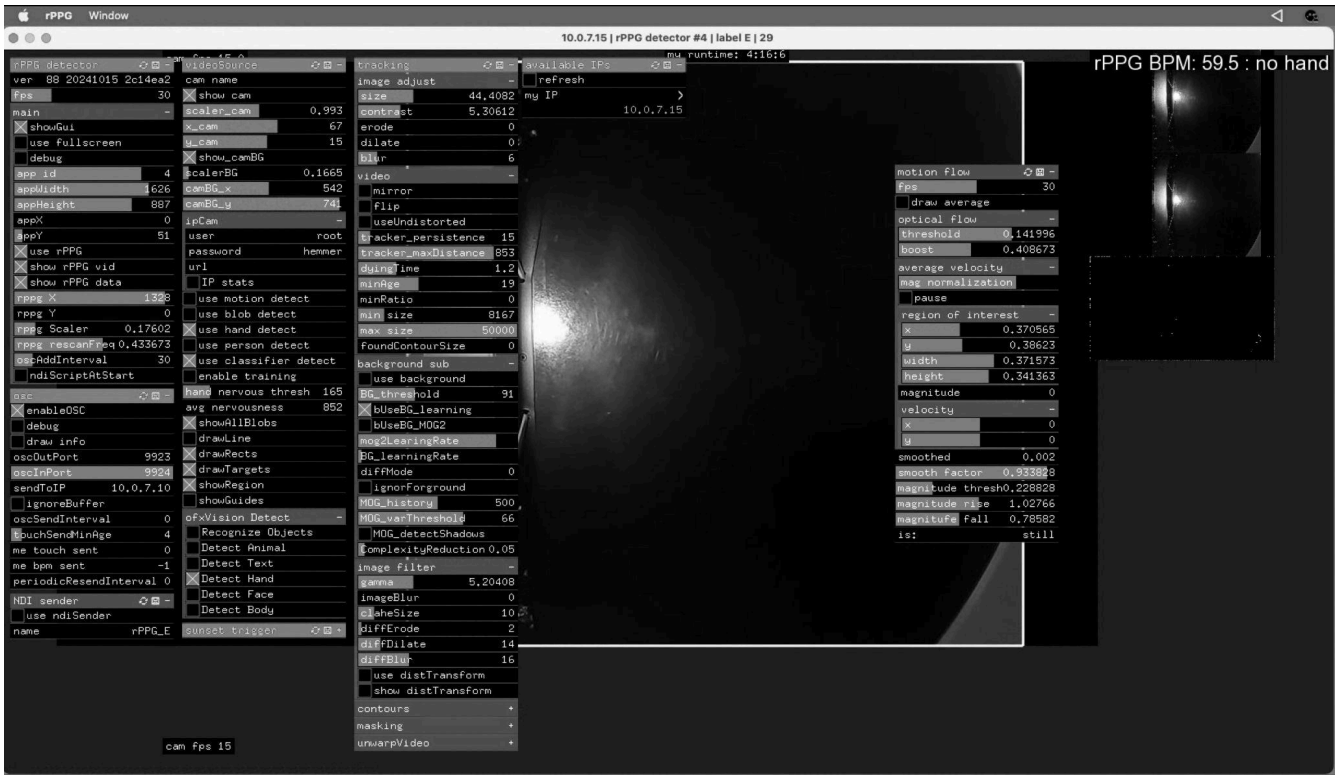


Setting	Description
enable ShowCtrl	Enables the building control via OSC messages to control the pulse topology app stage.

rPPG.app

The rPPG.app uses coreML's vision framework and a YOLO based object detector to find a person's hand. It then selects a part of the hand and tracks this section. A keypoint tracker is implemented. It then analyzes the color change over time to extract the heart rate values.

There aren't too many parameters that should need to be adjusted on site. Below are the main parameters to verify.



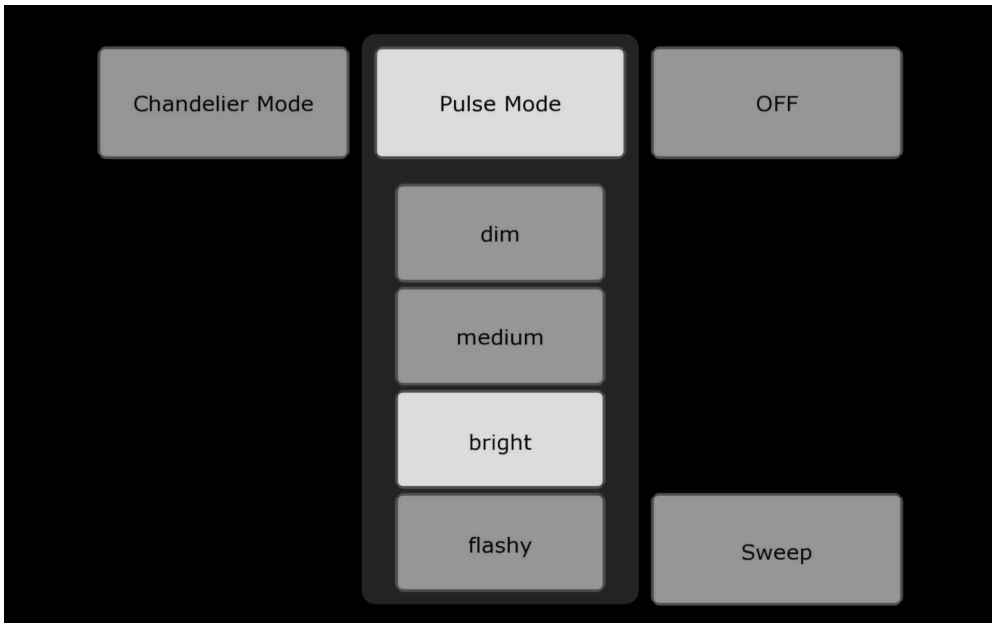
rPPG with the gui visible.

Setting	Description
rPPG detector / app id	each rppg.app needs its own app ID so the pulsetopology.app can differentiate them with their respective sensors. 0 = A, 1 = B, 2 = C
rPPG detector / use rPPG	*should always be selected*
rPPG detector / show rPPG	*should always be selected*
enableOSC	*should always be selected*
osc / oscOutPort	set to 9923

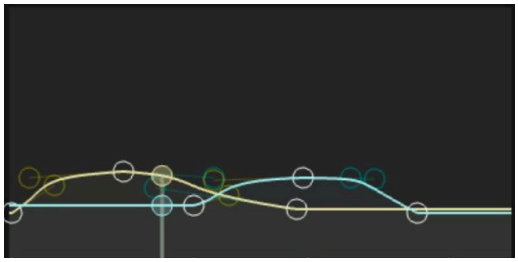
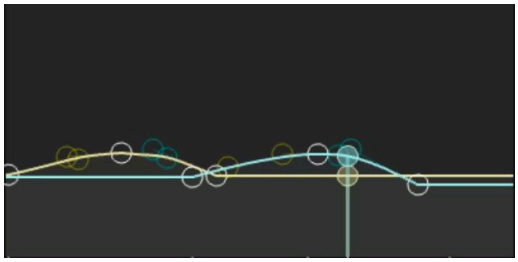
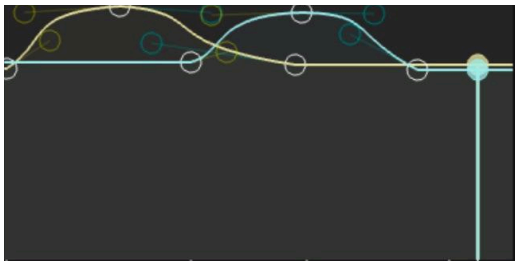
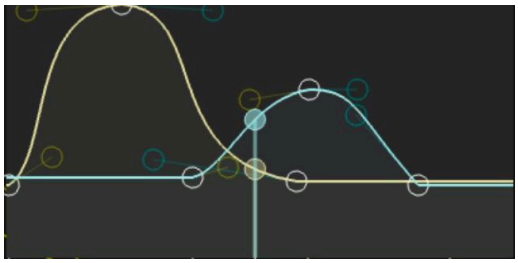
Setting	Description
osc / oscInPort	set to 9924
osc / sendToIP	set to IP address of pulseTopology.app (mac mini A)
UVC / exposureValue	sets the exposure of the camera. If this is not set correctly the sensor will not be able to detect heartbeats properly. The exposure value should be close to 1 so that the camera is very dark and you can only see the spotlight, as shown in the image below
User	Shows the axis camera login username
password	Shows the axis camera login password
url	When hovered over shows the ip and local camera url associated with this sensor.
Use classifier detect	Keep checked, allows the use of skeleton hand detection
Use classifier detect	Keep checked, also uses a hand object classifier trained on locally recorded images.
Enable training	If checked, enable the collection of hand images to train the classifier.

showControl_chandelier.app

The main interface of this app allows a quick swap between the different modes for the artwork. The Pulse Mode would typically be the default mode, as seen below: that said, any edition can be set differently so it could start in any of the three different modes. The different modes are as following:

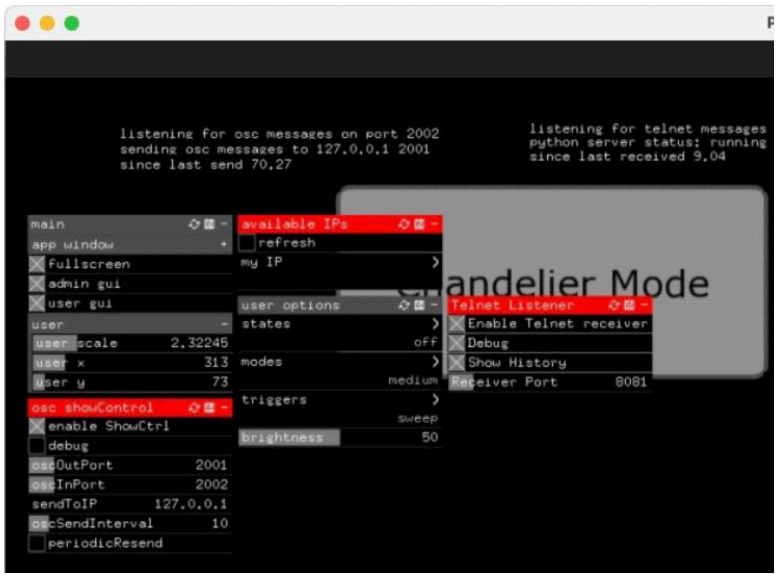


Mode	Description
Chandelier Mode	When selected, all chandelier's light bulbs would be lit to a static brightness, using the corresponding slider, similar to a normal light fixture. In this mode the sensor's lights are off.
Pulse Mode	4 presets are present with different pulsing intensities: Dim, Medium, Bright, Flashy. See table below for an explanation of the 4 different intensities.
OFF	When selected, all light bulbs are turned off, so are the sensor's lights.
Sweep Button	Allows the collector to trigger a sweep animation.

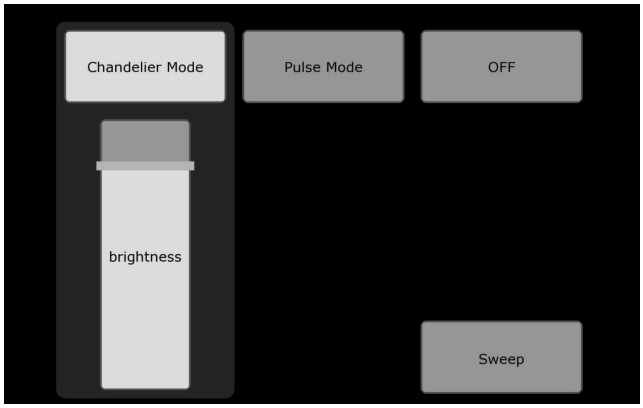
Pulse Intensity	Description	Graphical Rendering
Dim	Pulsing with a low brightness baseline and a narrow range between a bright pulse and said baseline.	
Medium	Pulsing with a medium brightness baseline and a narrow range between a bright pulse and said baseline.	
Bright	Pulsing with a high brightness baseline and a medium range between a bright pulse and said baseline.	
Flashy	Pulsing with a medium brightness baseline and a wide range between a bright pulse and said baseline.	

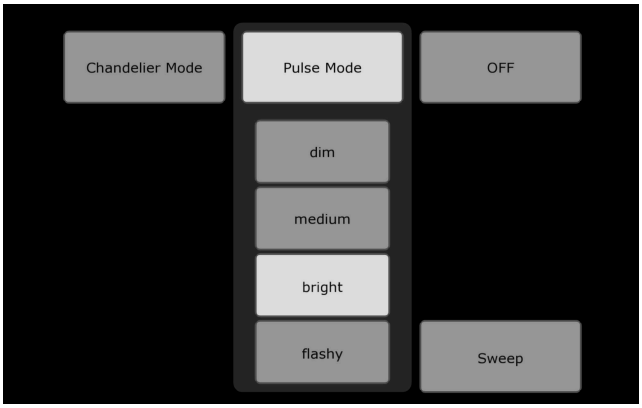
The showControl_chandelier app runs at the foreground of the piece and is enabled by the “enable ShowCtrl” checkbox in the main app seen in the image below.

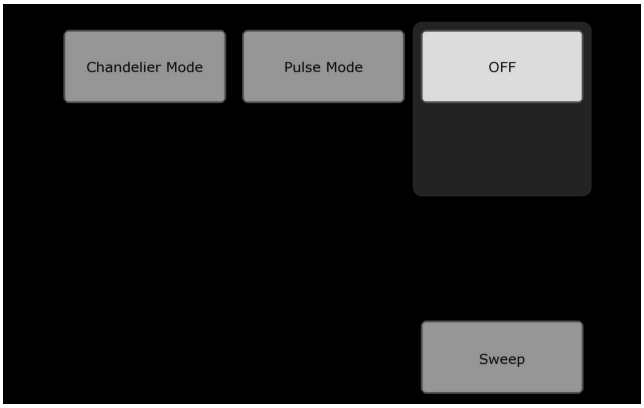
This application like the others mentioned has a GUI that can be opened and closed by pressing the ‘g’ key as seen in the image below. Showing the gui will automatically save the settings applied while it was open.



The following images show the three main buttons at use in the piece and the options that accompany them.







Remote Access to Artwork's Computer

There is a software installed on the computer running this artwork that allows the studio to connect remotely to the artwork. This feature is helpful when you require assistance from the studio, as we can remotely connect to it, do a quick inspection, and do a debugging session of your components, if needed. In order to enable this feature, the computer has to be connected to the internet at all times. Depending on the computer's operating system (Windows 7/8/10/11, OSX), the procedure to set the computer online will vary. Please look online for tutorials, if necessary.

Preliminary Troubleshooting Steps

When placing a hand under the sensor the population stage does not occur

Is the LED light from the sensor switching from spot to ring? If it is not, the sensor computer is offline and needs to be booted up. If it is, and it's constantly changing instead of holding on to one, the hand placed is not close enough to get a proper reading or the exposure settings in the rPPG.app need to be adjusted. Follow the steps outlined in the Manual Software Calibration → rPPG app section.

A section of lights are off.

Ensure that all dimmers are on, if they are not that means the dimmers are not receiving power and there has been something unplugged/disconnected.

If all dimmers are powered, follow the DMX chain and check the connection or cable for that dimmer.

A single lightbulb is off

Is it fully screwed in? The light bulbs work best if they are fully screwed in then let off a quarter of a turn, add or release the thread while plugged in to find the sweet spot of that bulb.

Is the bulb working? Take a bulb next to it that is currently functioning, if the bulb is placed in the socket and works fine, then you need to replace the broken bulb.

If that did not work, check the button contact of the bulb, the levered metal might have been bent too far in and now does not make proper contact with the bulb. Using a wood implement or POWERING OFF and using your finger can raise the lever to contact.

If that did not work, check the red and black bulb connections to the dimmer bay, tug on them to see if they were properly nested or not.

Finally, if all those steps did not work, you need to replace the affected socket with a socket that is proven to work.

Everything is on but there's the lights are off

You may have accidentally entered "special event mode" . Ensure "special event" is not selected in the Main section of the GUI or press "s" to exit special event mode.

Troubleshooting Assistance

Prior to contacting the Antimodular Studio with a problem about your artwork, please ensure that you went through the preliminary troubleshooting steps outlined in the previous section.

The troubleshooting process will vary depending on the problem. In order to make the process easier, it is recommended that you collect and send the following information to the studio:

- Date and time when the problem first happened;
- Description of the problem;
- Actions taken so far and conclusions;
- Detailed photographs (or videos) displaying the problem;
- Detailed photographs (or videos) of the suspected faulty component;
- Detailed photographs (or videos) of the whole artwork and its surroundings;
- Personnel involved.

Support (Contact Us)

If you would like support for the piece, please feel free to call Lozano-Hemmer's studio in Canada:

Antimodular Research
4462 rue Saint-Denis
Montréal, Québec, Canada
H2J 2L1
Tel 1-514-597-0917
info@antimodular.com
www.antimodular.com

APPENDIX I - INSTALLATION

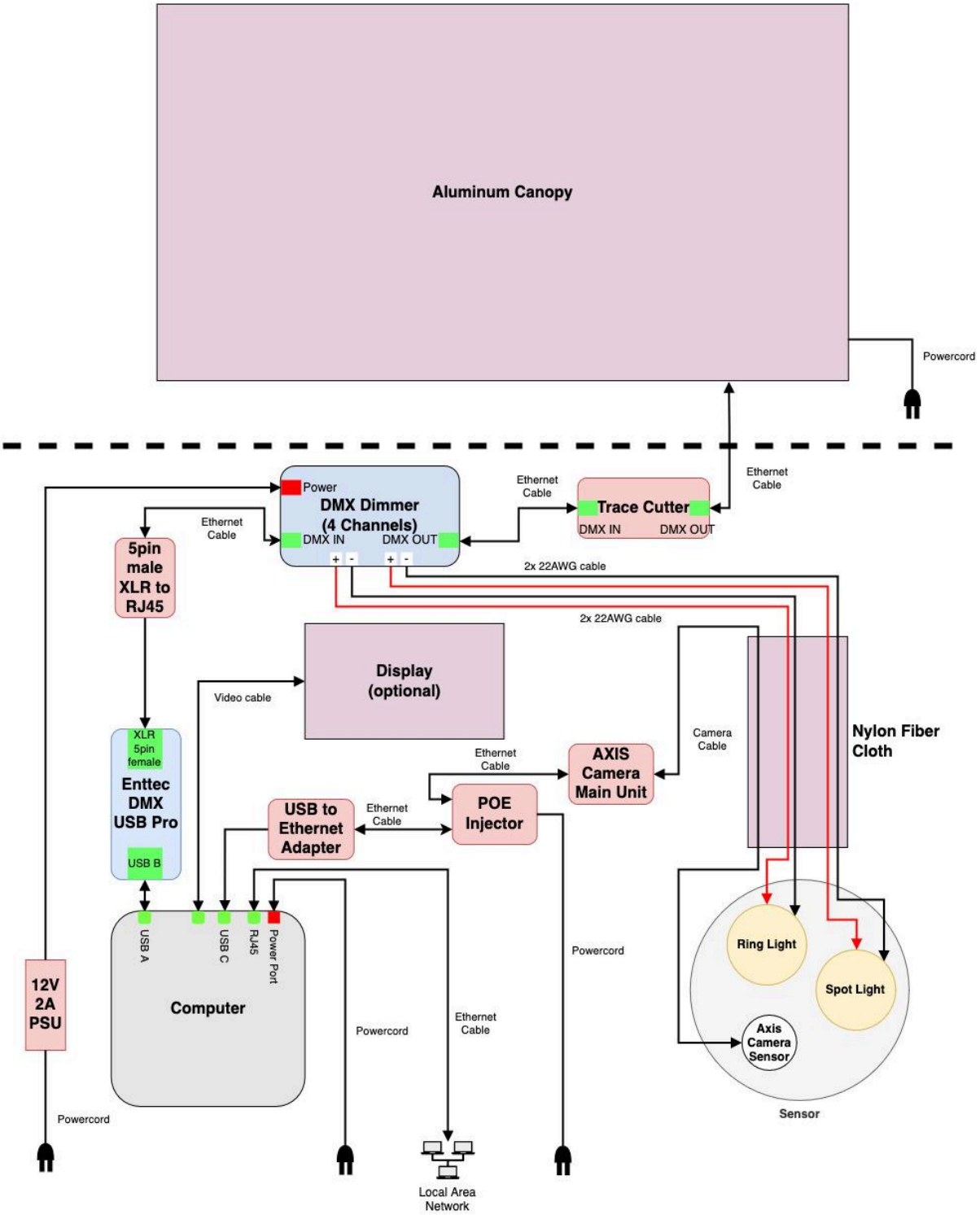
Description of Components

This artwork requires the following components:

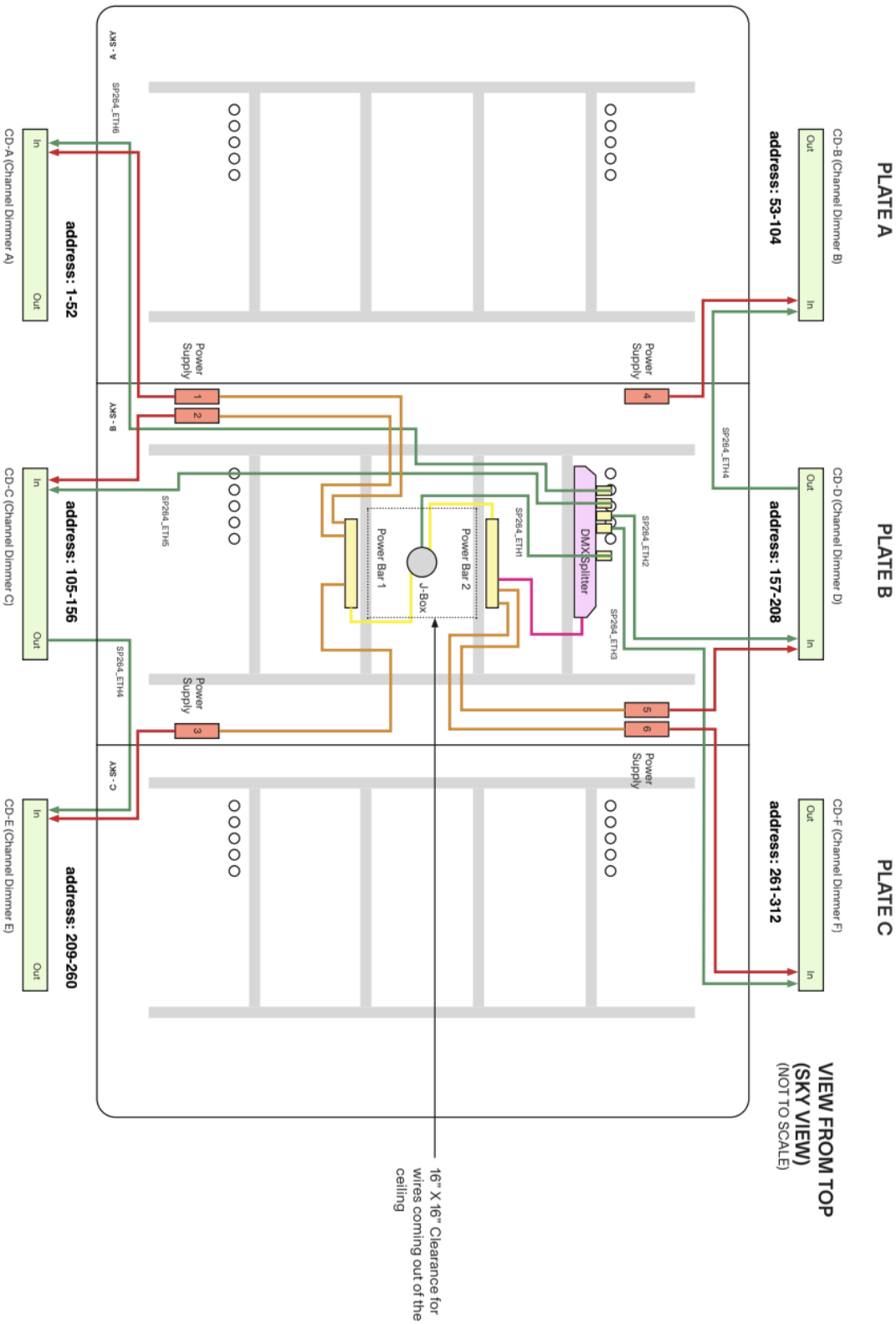
Component	Description
Aluminum Canopy Structure	Supports and houses the electronics in the piece related to power and DMX signal distribution to the light bulbs. Allows for the piece to be securely hung from the ceiling and bulbs to be appropriately placed.
Sensor Assembly	Detects the heart beats of participants via the use of a camera.
Camera	Sits in the sensor assembly, used to detect individual heartbeats.
Computer	Typically an Apple Mac Mini, the computer acts as a receiver for the sensor's input and as the main control hub of the piece.
DMX Controller	Transmits the DMX signal from the main computer to control the sensor and canopy DMX dimmers.
5pin male XLR to RJ45 adapter	Converts the needed XLR cable needed for the DMX signal into a regular network cable
4 Channels DMX Dimmer	Receives the DMX signal and dim their attached light bulbs accordingly, or the sensor's lights.
Trace Cutter	Isolates the DMX signal by cutting the power injection from the 4 Channels DMX dimmer, allowing a connection between the dimmer and the Aluminum canopy's DMX splitter.
DMX Splitter (In Canopy)	Takes the DMX signal from a single universe device and boosts it for stable control and refresh rate over many lights.
52 Channels DMX Dimmer (In Canopy)	Receives the DMX signal and dim their attached light bulbs accordingly, or the sensor's lights.
Light Bulb Assembly (Suspended from Canopy)	LED Light and cabling forming the light topology.
Monitor (Optional)	Used to control and display the softwares. When no monitor is connected, we recommend a video fooler.
Video cabling	Connects the main computer to the display, when exhibited. Typically using an HDMI cable.
Ethernet Cabling	Used to interconnect the computer, the DMX controllers, the sensor's camera, any wired network, etc., in order to carry data (XLR, network). Should be at least CAT5e and shielded.

Wiring Diagrams and Connections

In order for the piece to run properly, the computer should be connected according to the following diagrams.



Wiring Inside of Canopy



General Power Requirements

The power source feeding the artwork should always come from a consistent power source, not on a generator or a dimmable system.

It is recommended to use 2 distinct circuits (2x 15A @ 120V or 2x 10A @ 230V), one for the canopy, which includes the dimmers and the light bulbs, and one for the rest of the electronics. We **highly recommend** the use of surge protection devices to protect the electronics from any voltage spikes.

A standard 300 bulbs installation will use 6 channel dimmers hidden in the canopy. In theory, 5 dimmers would be feeding 52 channels, while a last unit would be feeding only 40 channels, but this may vary.

Each 52 channel dimmer's power supply unit is rated for a maximum of 65W, but the channel dimmers contain Hi512D chips that are set with a BL321 to limit the channels to only 6.25% (4/64) of potential power, meaning we limit each channel to 0.15W (6mA on 24VDC). This means a fully populated dimmer could draw up to 7.8W, while the whole canopy would draw up to 50W. However, considering the nature of the work, the real consumption should be a maximum of 40% (averaging around 20W total), depending on the average brightness of the artwork.

The electronics driving the artwork (computer, display, sensor, adapters, etc., typically organised in a server rack or hidden in a cabinet) would need up to 100-150W.

APPENDIX II - TECHNICAL DATA SHEETS

Aluminum Canopy Structure

The aluminum canopy part has been designed by Lambert & Fils, a lighting and design studio based in Montréal, Canada. Shop drawings and an assembly manual have been prepared by them and got transferred to the collector during the acquisition process. In the following pages, you will retrieve some drawings extracted from that document and explanation about different parts included in this structure. That being said, please refer to the Lambert & Fils documents for further information.

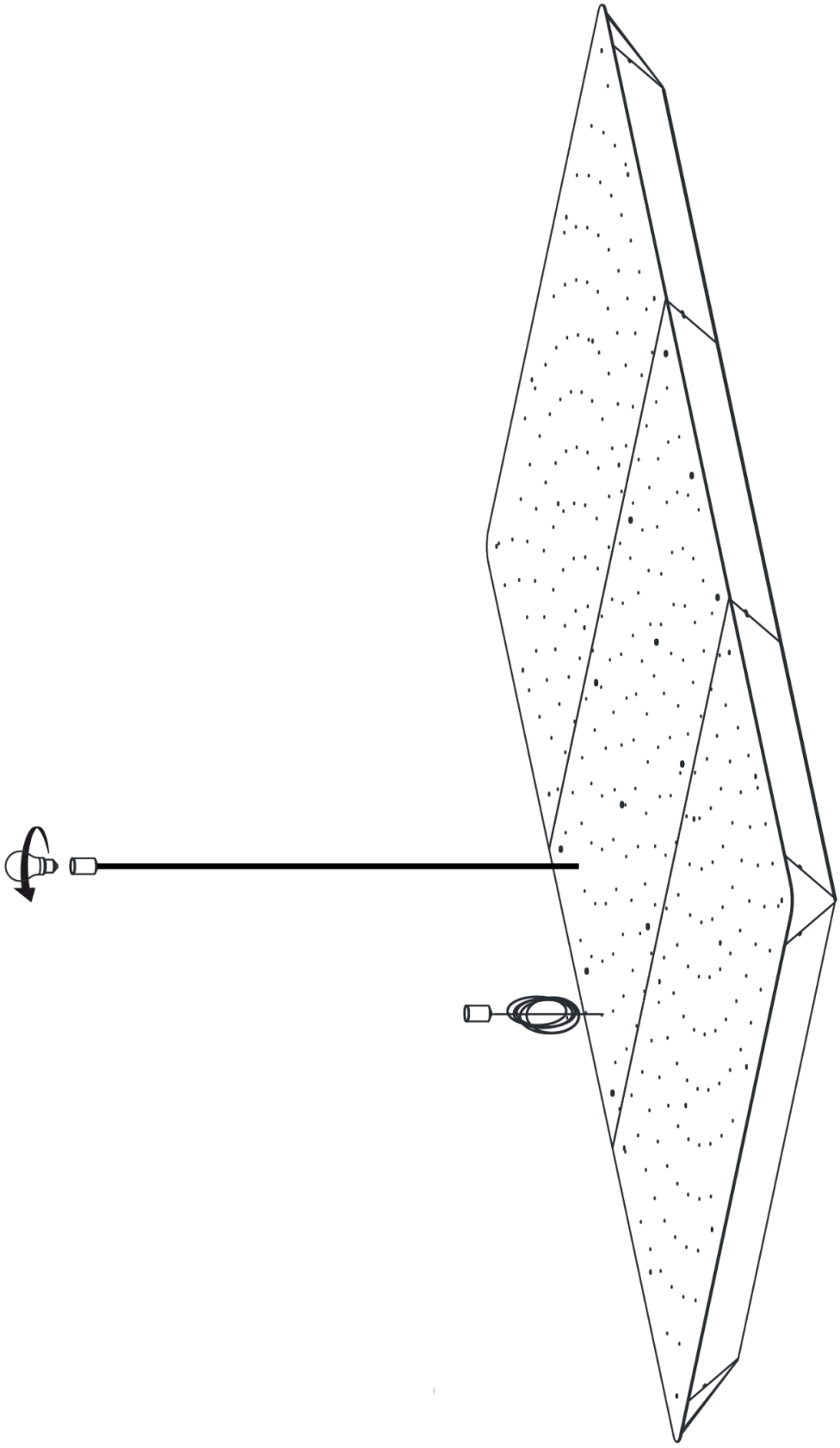
The canopy comes divided into 3 smaller sections: the center one (section B) and the side ones (sections A & B).

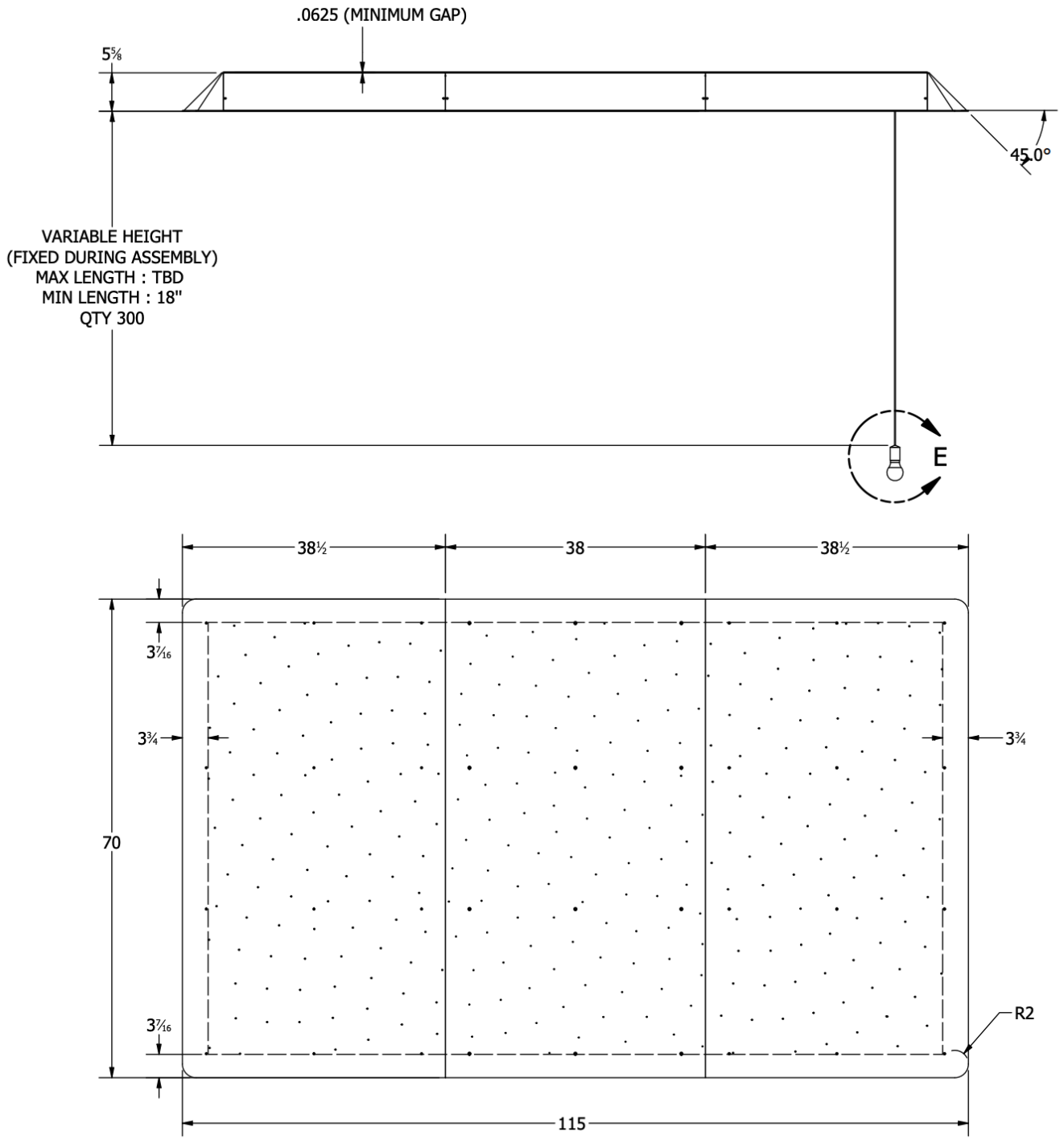
In terms of weight and dimensions, the aluminum canopy and its inner components measures approximately 292.1 x 177.8 x 14.3 cm (115 x 70 x 5 ⅝ inches) and should weight maximum 227 kg (500 lbs). It is mostly made out of aluminum and is painted with a textured grey powder coat.

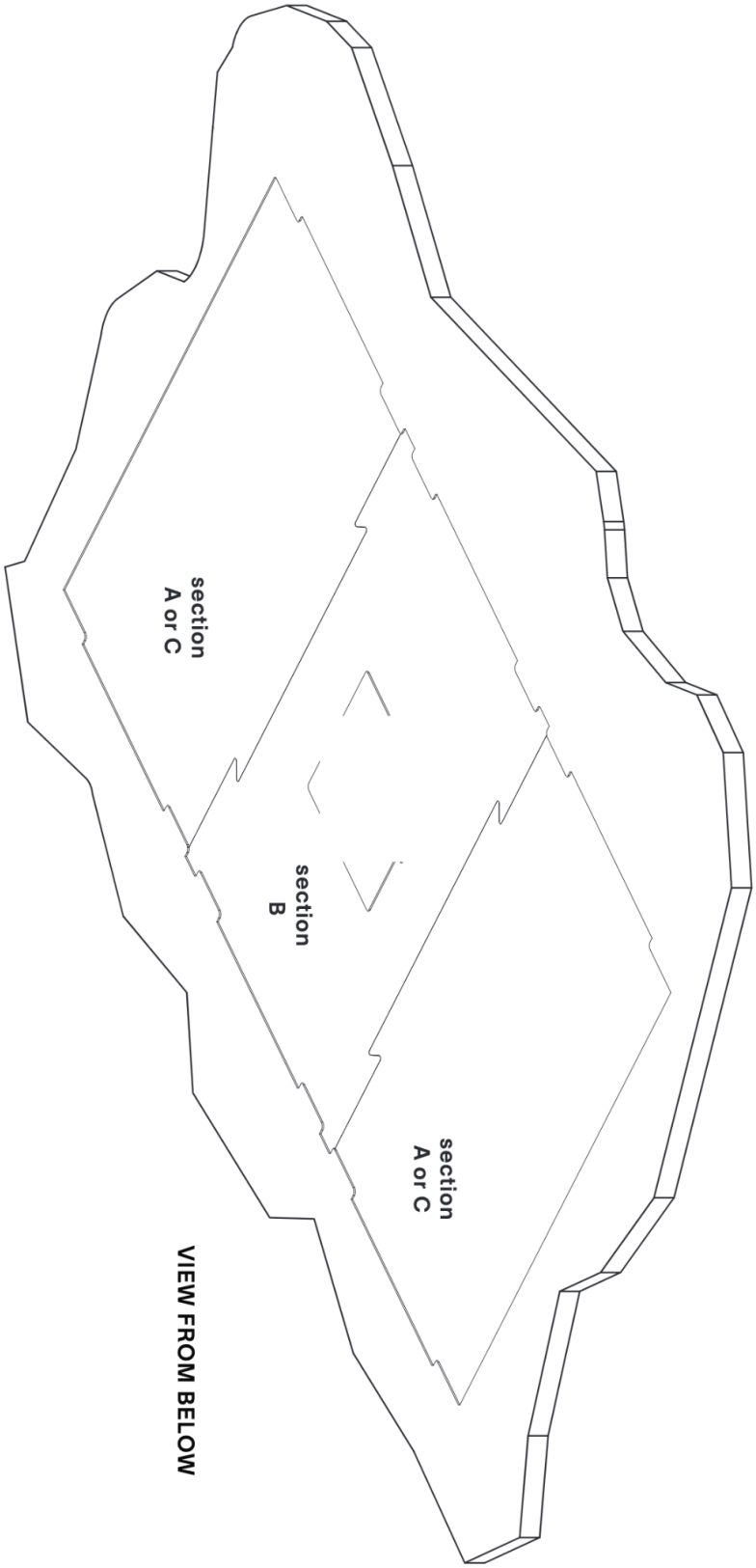
The ceiling's structure has to be prepared in advance to bear the weight of the whole assembly, according to local standards. **Atelier Lozano-Hemmer cannot be held accountable for any deficient ceiling's anchoring support.**

Component	Description
Templates	1 per section - Template panels to install on ceiling: used to guide you in the installation of the canopy components in the canopy's final location.
Ceiling support brackets	4 units per section, 12 in total. These are installed on the ceiling, inside template panels cutouts, secured to the ceiling with the use of ¼-20 rods/screws and flange nuts - provided by the installation's team. Will be used to lift and secure the sections to the ceiling.
Plastic brackets and black foam tape	Used to cover the templates and hide variations in ceiling level.
Aircraft cable	4 per section - Suspend the section to the ceiling support brackets during the assembly. Once the installation is over, the cables are removed from the section's assembly.
Cable gripper (In Section)	4 per section - Installed in each section, acts as a break around the aircraft cable in order to suspend the section to the ceiling support brackets.

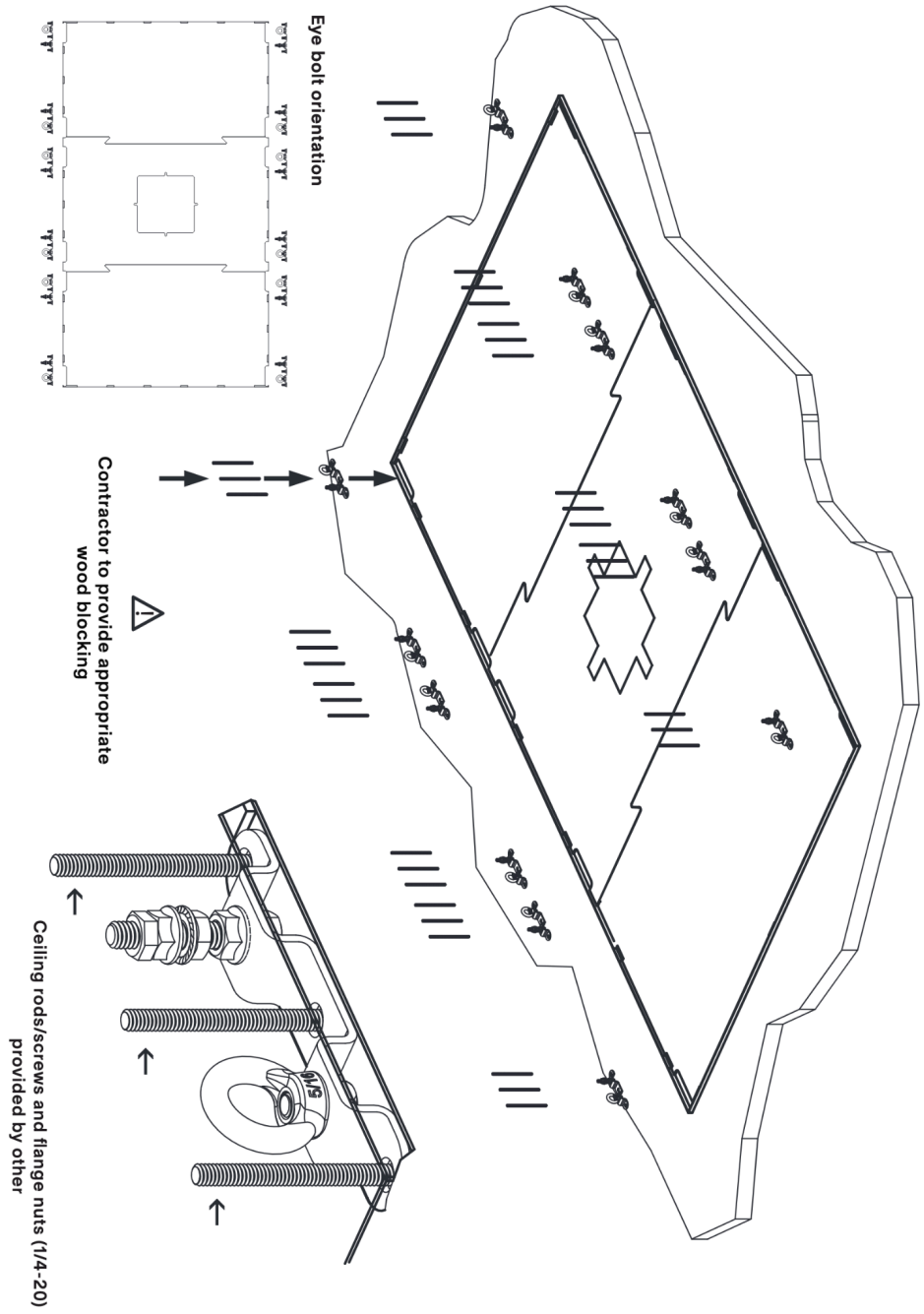
Component	Description
Lifting handles	2 per section - used during the installation to hold the section in the air and raise it in the air, without touching the core parts of the section. Once in place, the handles are stored within the section.
3D printed handle cover plates	Used to make the handles more secured when stored within the section.
Section's attachment brackets	4 brackets in total - Used to consolidate the 3 sections into a single chandelier.
Section's cover plate	This is the part visible from under the chandelier. Used to hide the skeleton and the components hosted within the sections.
Section's side plates	Used to hide the parts and components above the section's bottom cover plate.
Section's corner plates	Used to hide the parts and components above the section's bottom cover plate.



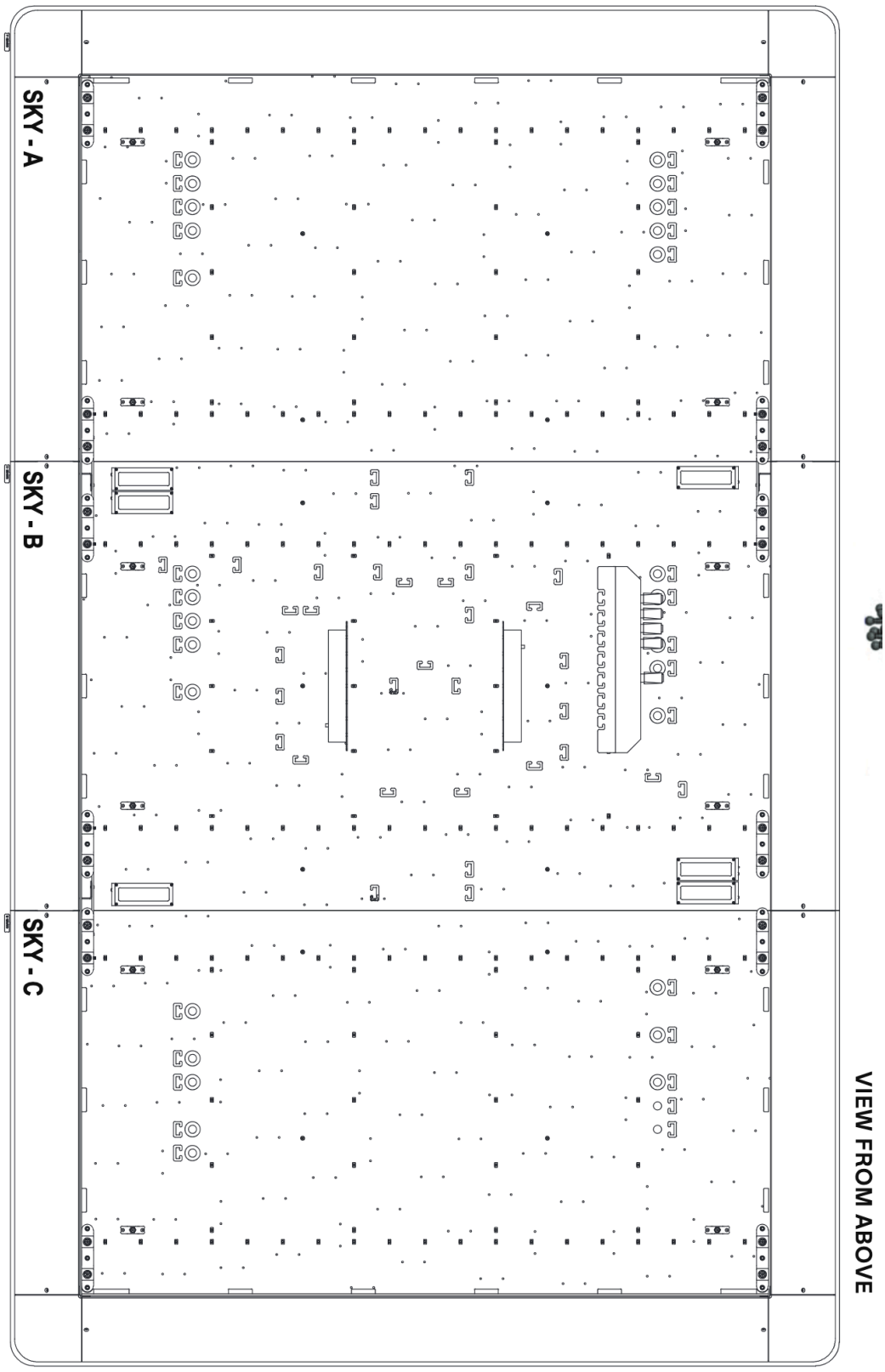

.0625 (MINIMUM GAP)
5⅝
45.0°
VARIABLE HEIGHT
(FIXED DURING ASSEMBLY)
MAX LENGTH : TBD
MIN LENGTH : 18"
QTY 300
E
38½
38
38½
3⅞16
3¾
3¾
70
3⅞16
R2
115



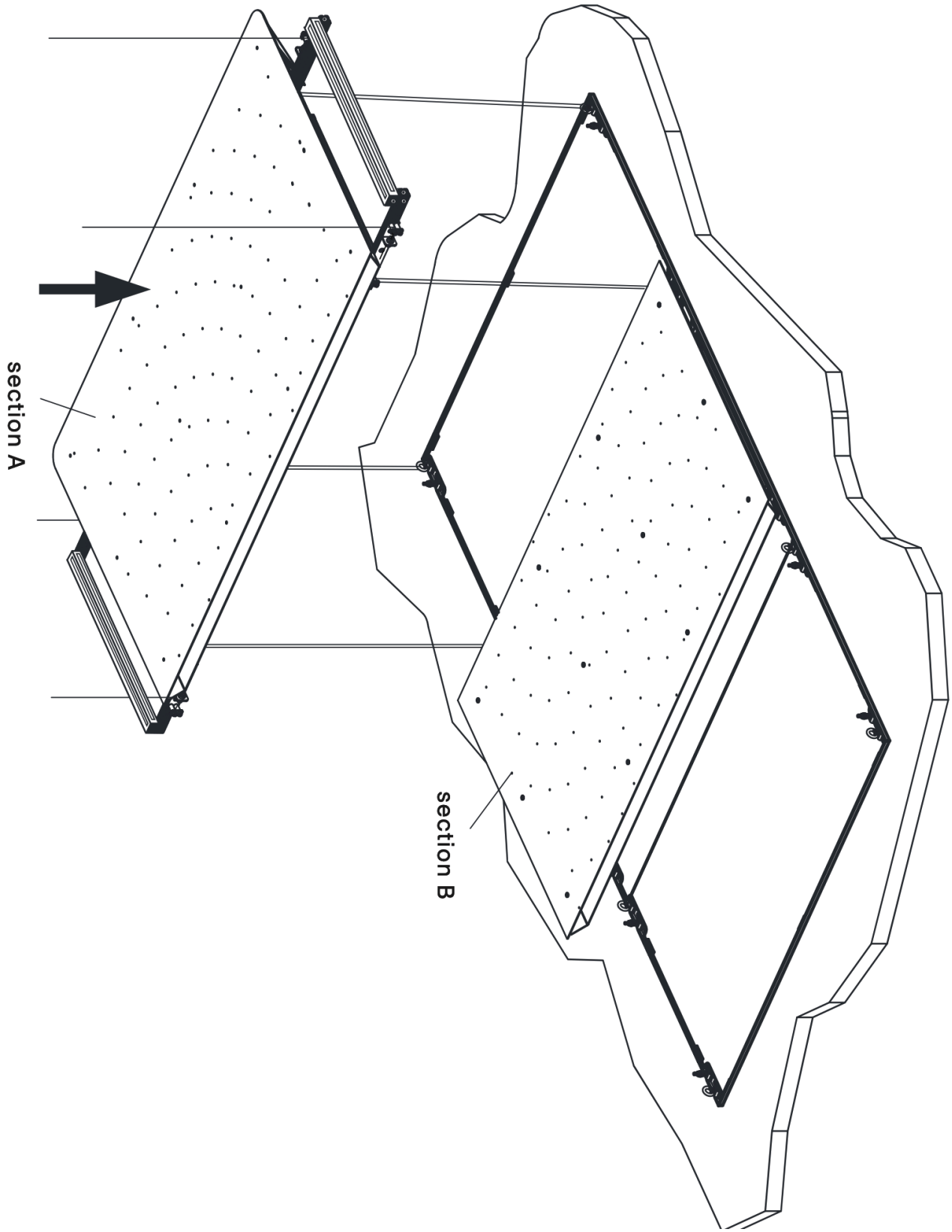
Templates



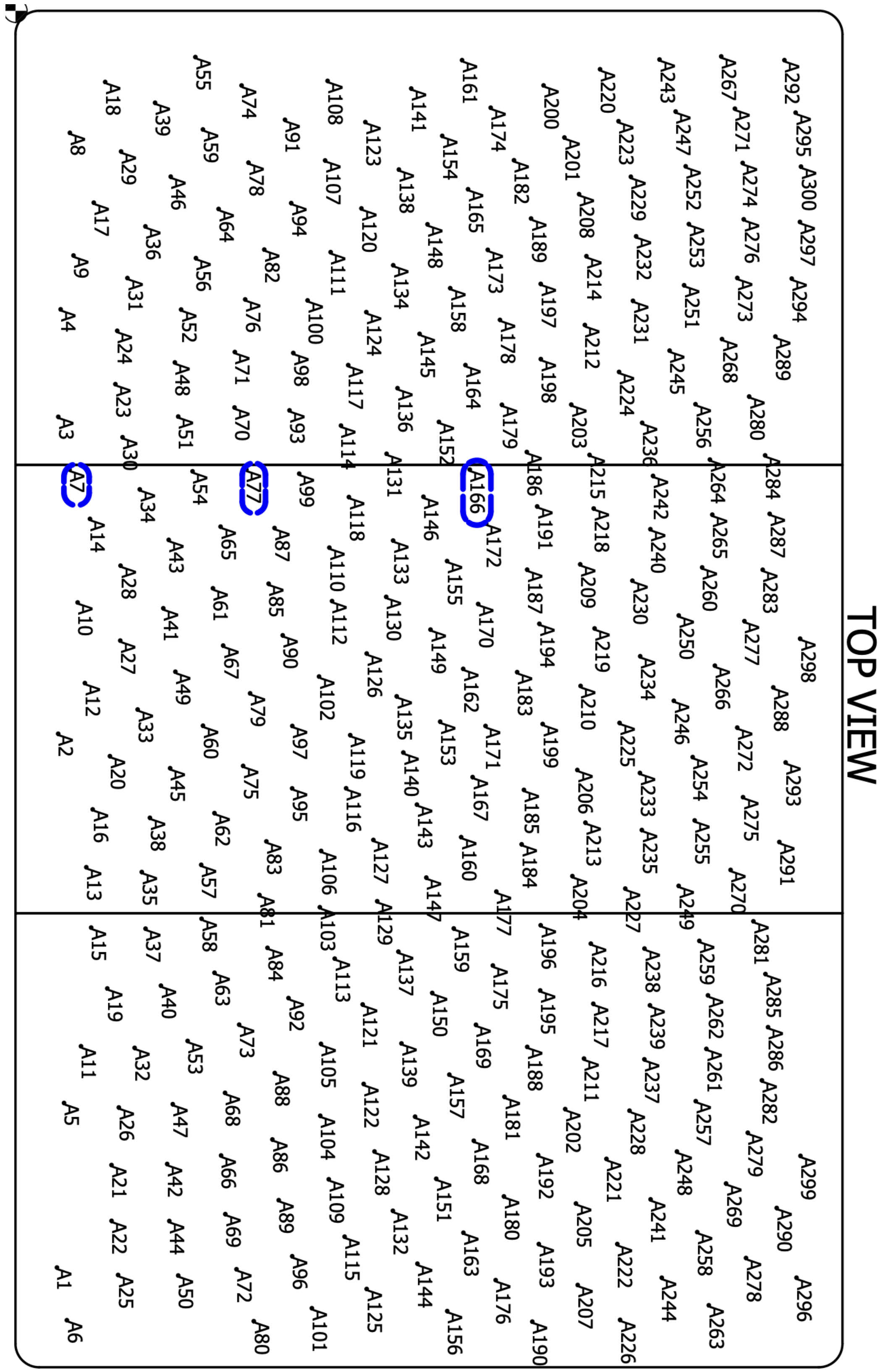
Templates and Ceiling Support Brackets



Sections and Ceiling Support Brackets



Sections being lifted up with Aircraft cable



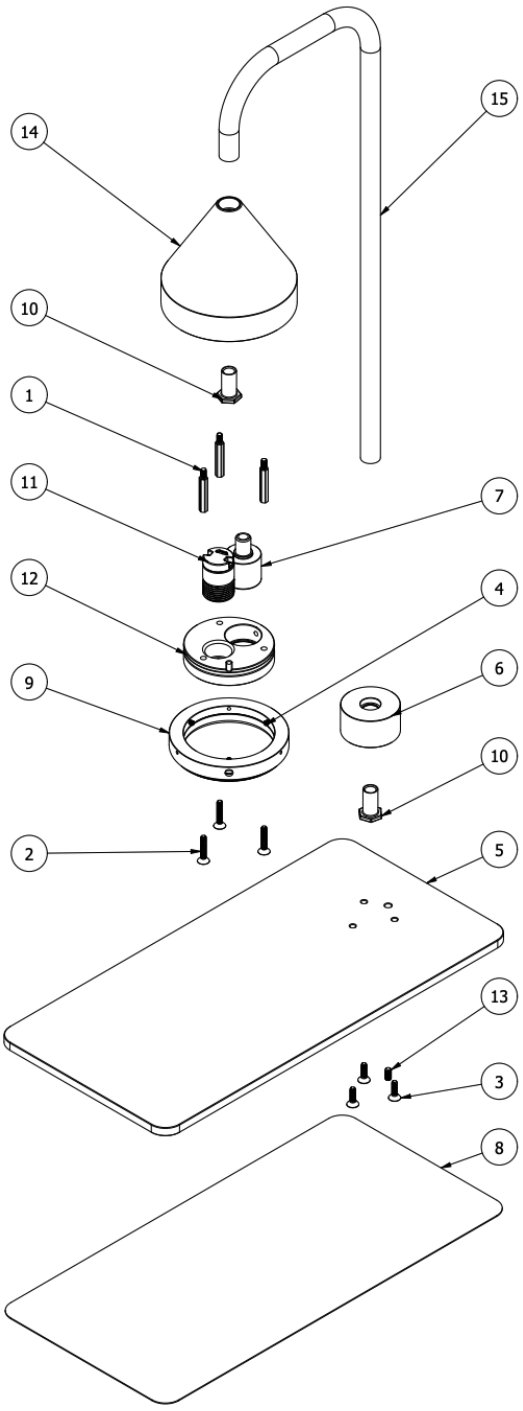
Chandelier’s Light Topology - Reference only, please consult technical documents for final layout

Sensor Assembly

The sensor assembly hosts all the elements used to detect the visitor's heartbeat and transmit it to the computer. It is composed from the following elements, all detailed in the next page:

Component	Description
Sensor Stand	The metal assembly containing all the electronics forming the sensor.
LED Ring Light	The LED ring light has a 76mm diameter. Used to give a flat and equal lighting of the hand under the sensor, it will turn on when an object is detected. Will be typically connected into address 510.
LED Spot	A mini 3000 Kelvin spot light used to give presence to the sensor, will be turned on by default. Will be typically connected into address 509.
2-leads 22AWG cable	Two of these cables are used to transmit the power needed to light up the LED ring light and LED spot.
Camera	Reads the pulses from the hand of a user. The camera is composed of 2 distinct elements: the lens body (in sensor assembly) and the main unit (outside the assembly).
Camera Cable	A proprietary cable interconnecting the camera's lens body and the camera's main unit.
Nylon Fiber Cloth Sleeve	Wraps all the cabling (2 power cables and camera cable), getting out of the sensor stand ^

Sensor Stand



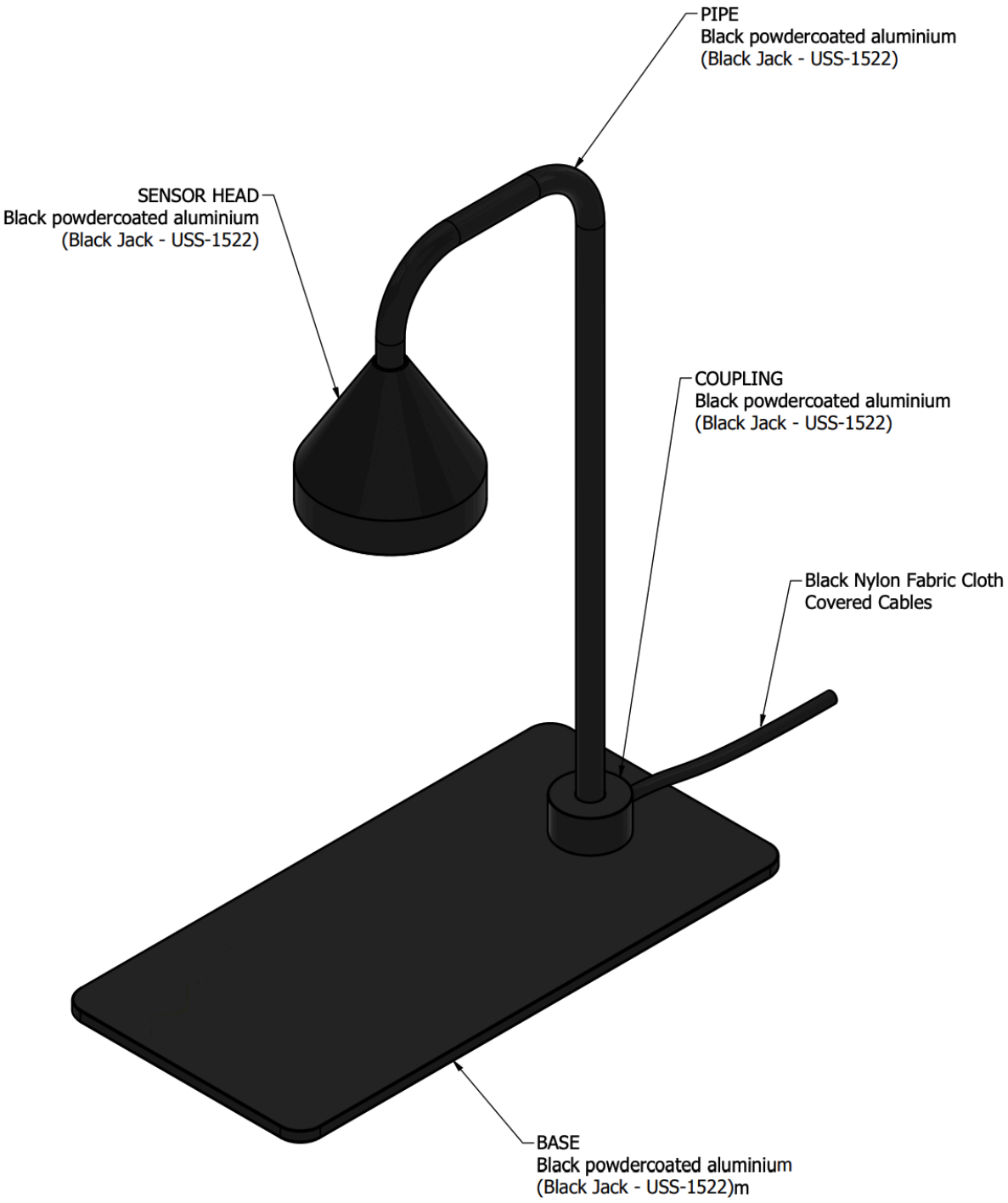
ITEM	QTY	PART NUMBER
1	3	91075A117_Male-Female Threaded Hex Standoff
2	3	91253A151_Black-Oxide Alloy Steel Hex Drive Flat Head Screw
3	3	91263A516_Zinc-Plated Alloy Steel Hex Drive Flat Head Screw
4	3	92313A103_Super-Corrosion-Resistant Cup-Point Set Screw
5	1	BASE_LZN_SENSOR
6	1	CPL_LZN_SENSOR
7	1	DE1-W4F-830-G3
8	1	FEUTRE_BASE_LZN_SENSOR
9	1	LED_RING
10	2	NP_H_1/8-27M_3/4_ST
11	1	P1245_Fa1105_UnitAss_1516057_M3_2.SW
12	1	PLT_LZN_SENSOR
13	1	SCR_AS_M4_8MM_NYLWH
14	1	SHD_LZN_SENSOR
15	1	TUBE_LZN_SENSOR
16	1	WIRE_TUBE_LZN_SENSOR

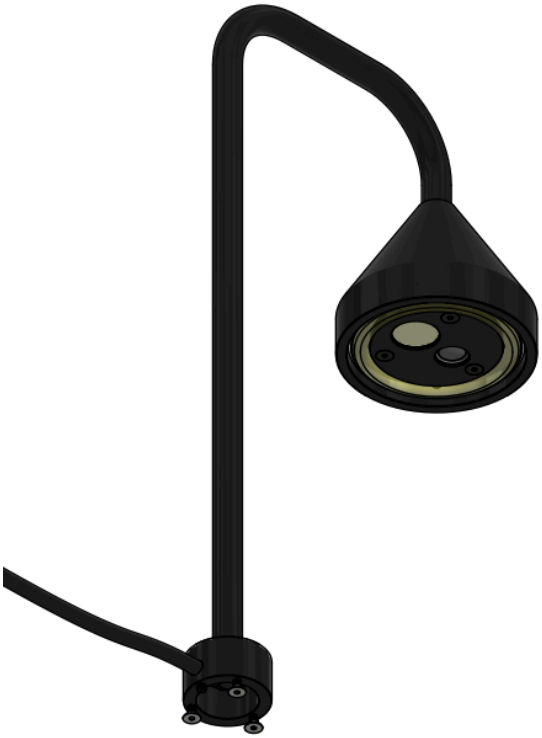
Provided by others :

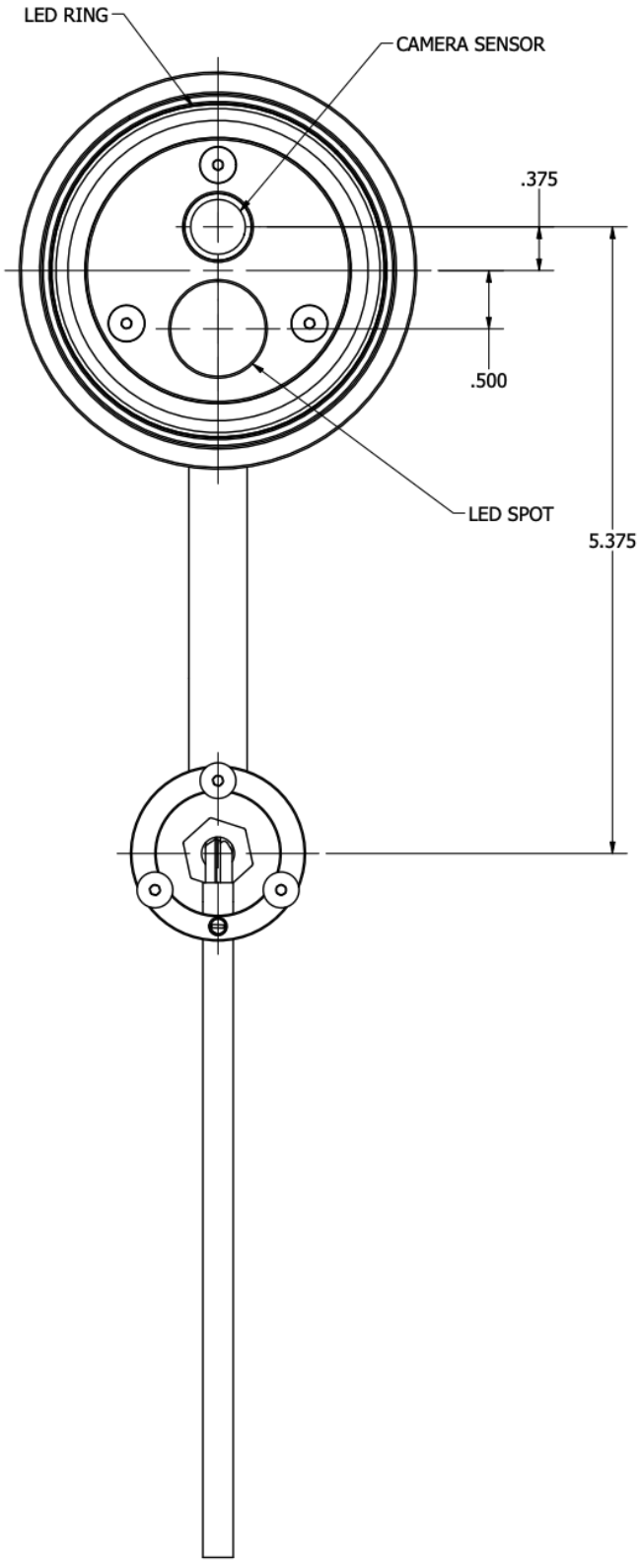
- Camera sensor (AXIS)
- LED Ring
- LED Spot

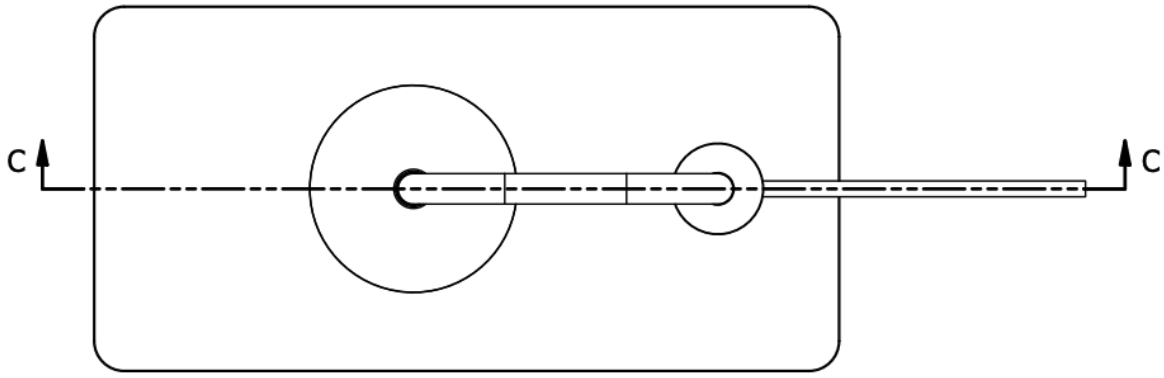
SENSOR UNIT

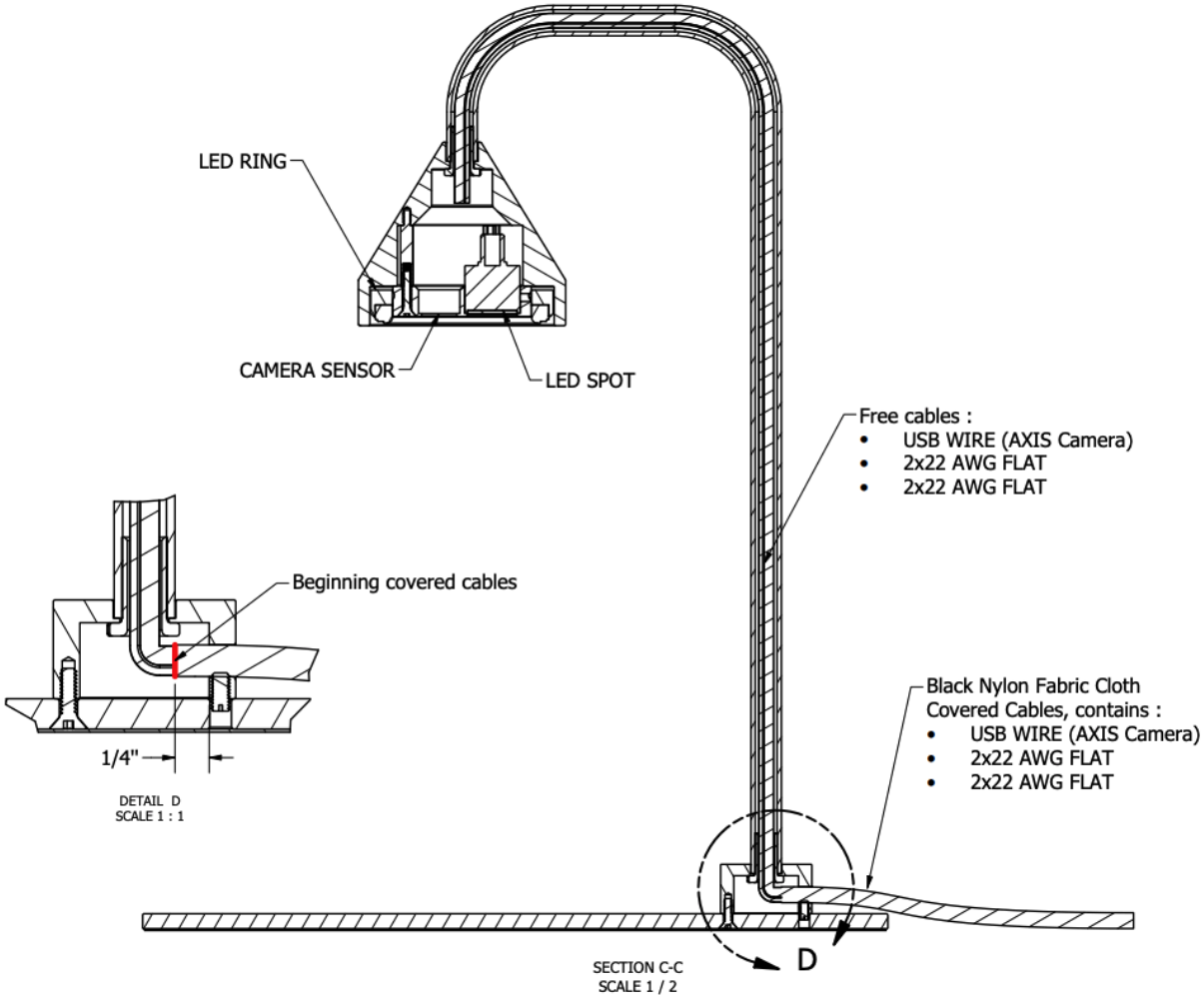
Finish and materials

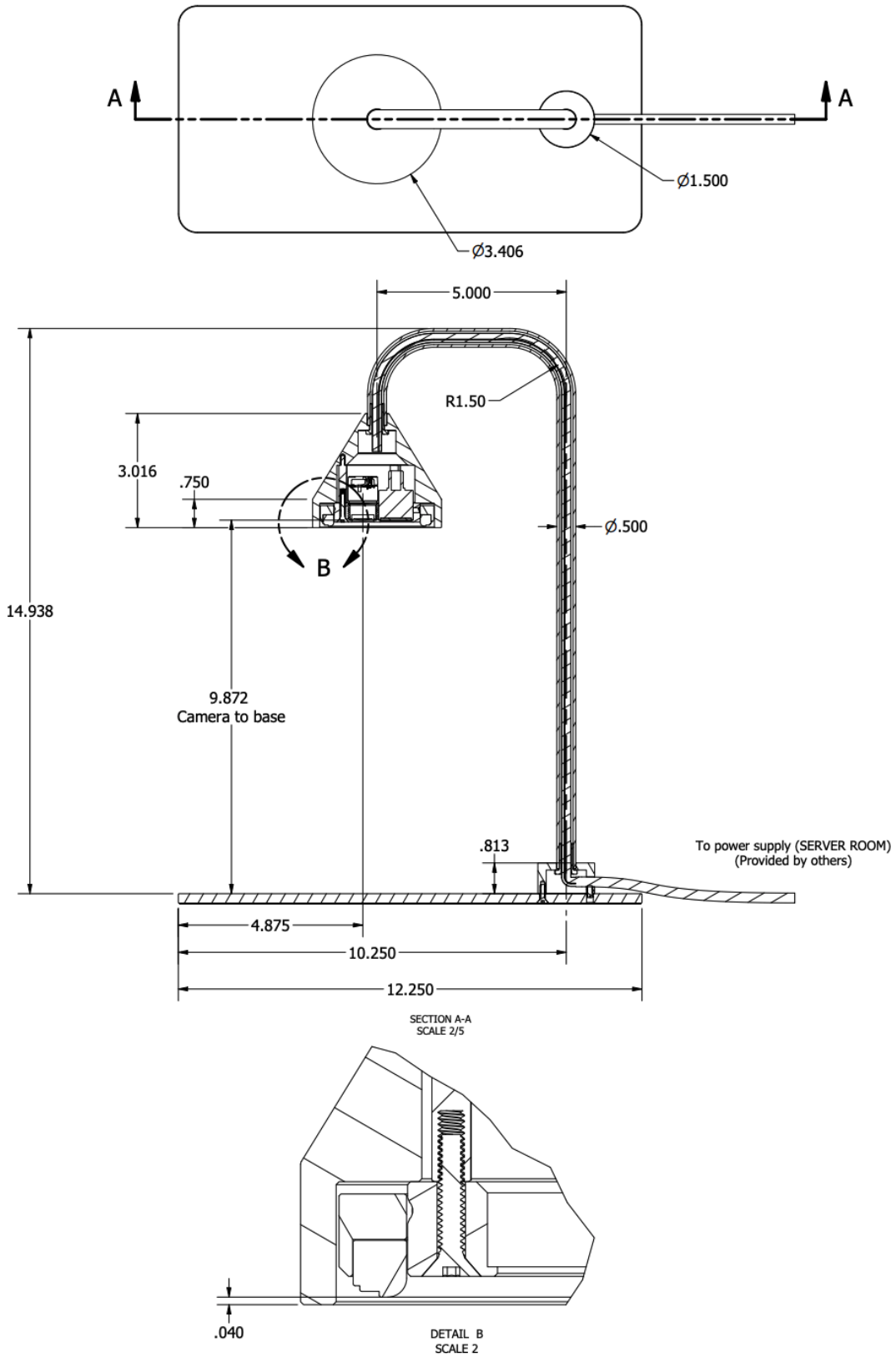




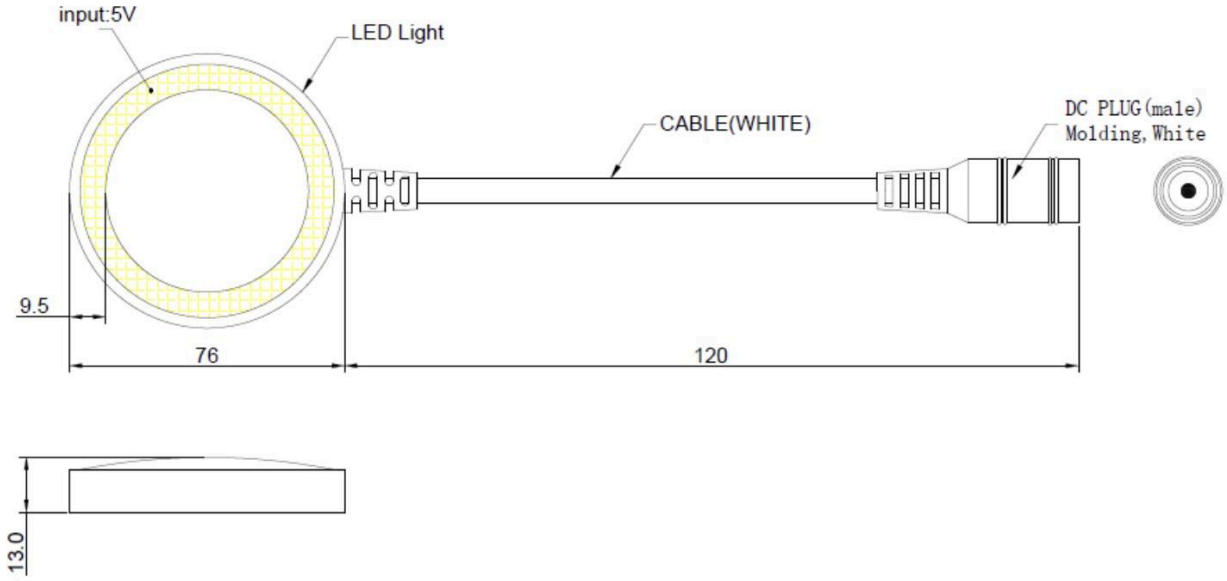

LED RING
CAMERA SENSOR
.375
.500
LED SPOT
5.375


C
C


LED RING
CAMERA SENSOR
LED SPOT
Free cables :
• USB WIRE (AXIS Camera)
• 2x22 AWG FLAT
• 2x22 AWG FLAT
Beginning covered cables
1/4"
DETAIL D
SCALE 1 : 1
Black Nylon Fabric Cloth
Covered Cables, contains :
• USB WIRE (AXIS Camera)
• 2x22 AWG FLAT
• 2x22 AWG FLAT
D
SECTION C-C
SCALE 1 / 2

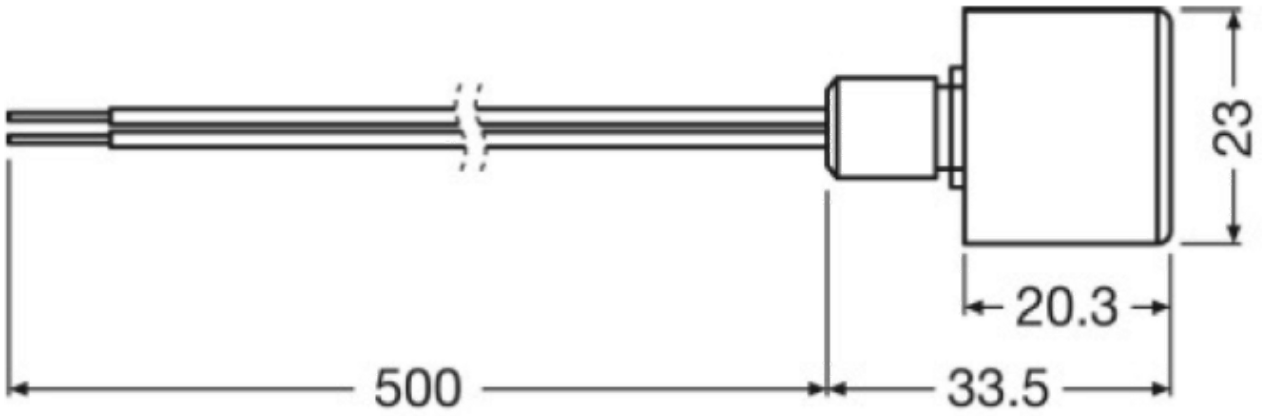

A
A
Ø1.500
Ø3.406
5.000
R1.50
3.016
.750
Ø.500
B
14.938
9.872
Camera to base
.813
To power supply (SERVER ROOM)
(Provided by others)
4.875
10.250
12.250
SECTION A-A
SCALE 2/5
.040
DETAIL B
SCALE 2

Ring Light



Specification	Details
Manufacturer	AdaFruit
Model Number	Model 4433
Light Tone	Cool White

Spot Light



Specification	Details
Manufacturer	OSRAM
Model Number	DE1-W4F-830-G3 Osram DRAGONeye
Color Temperature	3000K
Energy Consumption	1Wh - 0.35A @ 2.9VDC
Nominal beam angle	15 degrees
Light intensity	100 lumens

Camera

Specification	Details
Manufacturer	Axis Communications
Model Number	P1245 Mk II
Image Sensor	1/2.9” progressive scan RGB CMOS // Pixel size 2.8 µm
Resolution	1920 x 1080
FPS	25/30
Focal Length	2.8mm
Horizontal field of view	111 degrees
Vertical field of view	61 degrees
Lens mount	M12
Power	Power over Ethernet
PoE Class	2

Camera Cable

Specification	Details
Manufacturer	Axis Communications
Model Number	F7301
Length	1m
Ports	Male RJ12, male micro-usb

Computer

At the time of writing this manual, the computer used in this piece is an Apple computer running OSX 13.4 with an M2 processor, 8GB of RAM and 256 GB of storage.

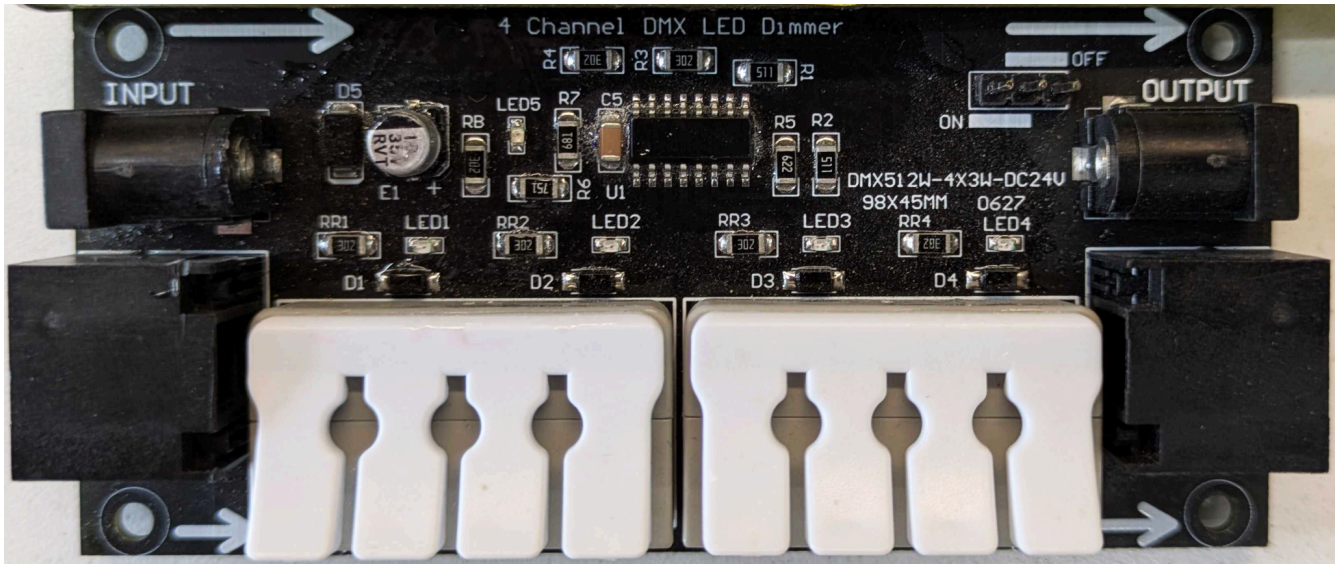
DMX Controller

The DMX controller will carry over the playback commands from the computer to the DMX Dimmers.

In the current version, an Enttec DMX USB PRO controller has been used. Controlled by the computer via ArtNet protocol, the device transfers the commands to the dimmers as DMX signals. Only one universe is used with a splitter inside the canopy. Future setups could use a different controller brand or model: to be discussed with the artist's studio.

Specification	Details
Manufacturer	Enttec
Model Number	DMX USB PRO (70304)
Input Voltage	5v/300mA (Via USB)
Power Draw	1.5 W
Connectors	1 x DMX output (female XLR5), 1 x DMX input (male XLR5), 1 x USB 2.0 Type-B
Protocols	USITT DMX512-A, ANSI E1.20 RDM1
Dimensions	8 cm (3.12in) x 5.8 cm (2.28in) x 4 cm (1.57in)
Weight	80 g / 0.18lbs

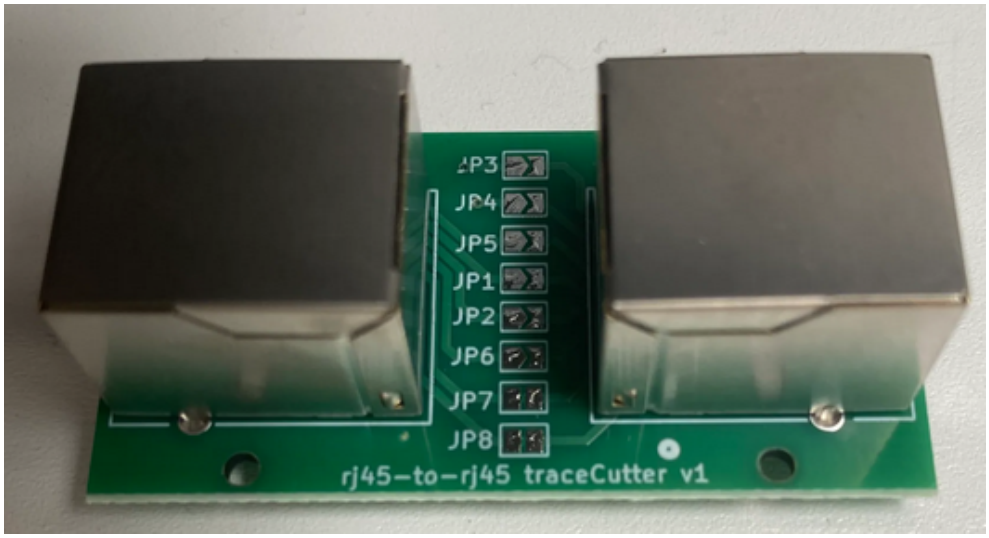
4 Channel DMX Dimmer

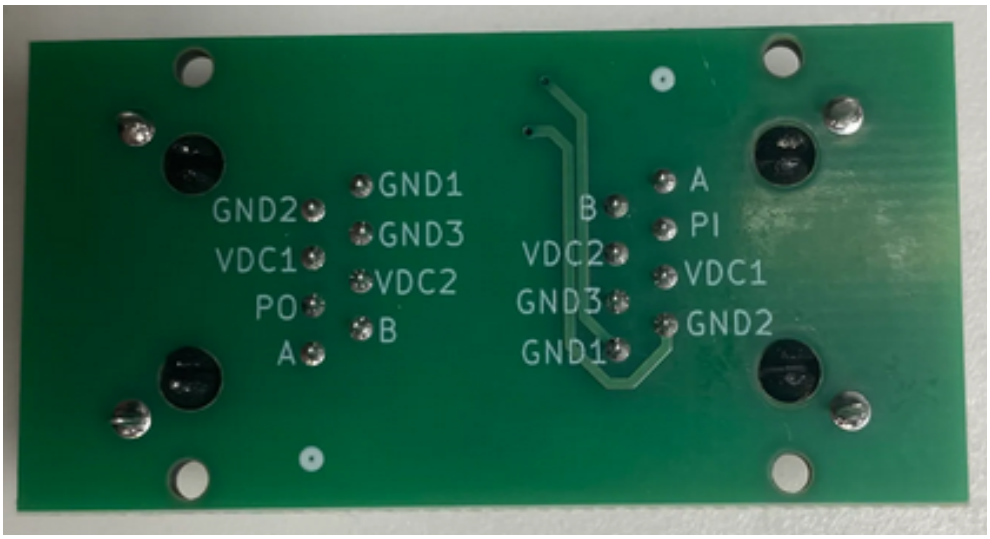


Takes 12VDC (24VDC is possible for this device, but for Pulse Chandelier, it is important to use 12VDC) power through a barrel connector on the left side and distributes power through 2x 4-ports push pin connectors: each 4 pins connectors is in fact 2 DMX channels (positive and negative leads).

Receives DMX data in an input and an output RJ45 port, translates this data to 4 DMX channels.

Trace Cutter

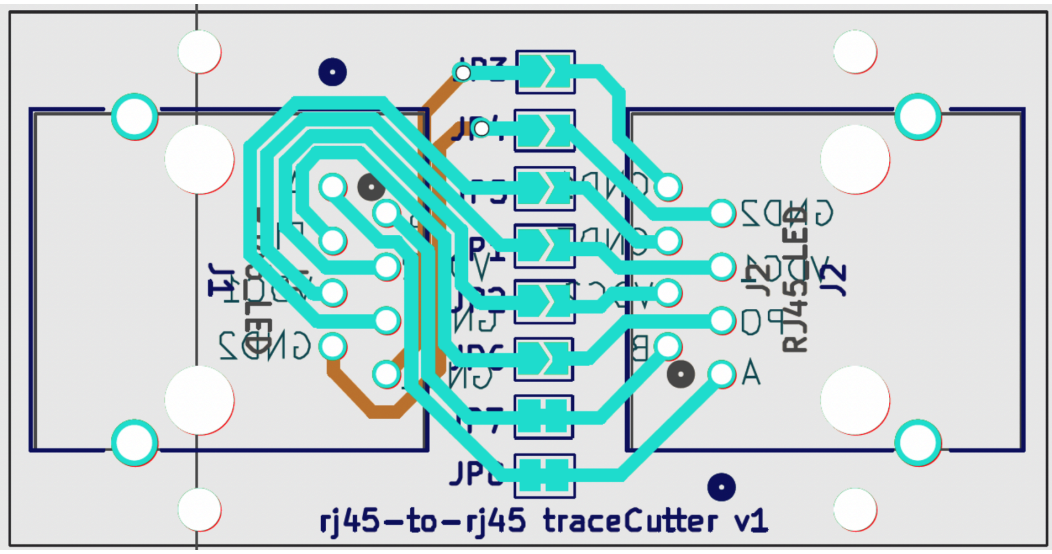




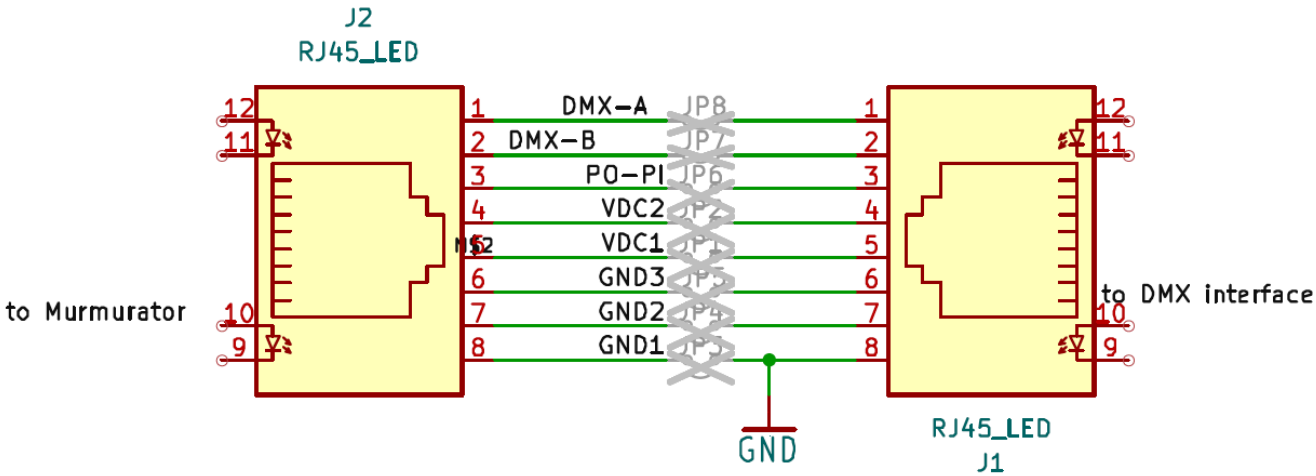
Used to only allow the DMX signals to travel between connectors to avoid any other signals or power to jump between devices. Similar to a regular RJ45 coupler this device routes the pins from one connector to the other, but here the connections can be cut or joined via 8 separate solder jumpers. In the most common build, only pins 1 and 2 are jumped over.

PCB

The PCB has been designed by the studio. The latest version of such PCB is labeled as "**rj45-to-rj45 traceCutter v1**".



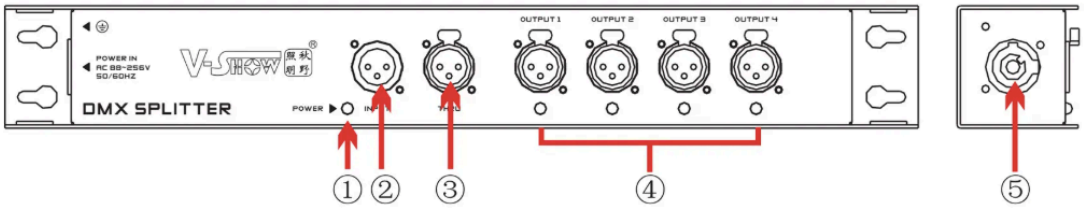
Main PCB



Schematics

DMX Splitter

Used to send DMX signals to the two sides of the metal canopy.

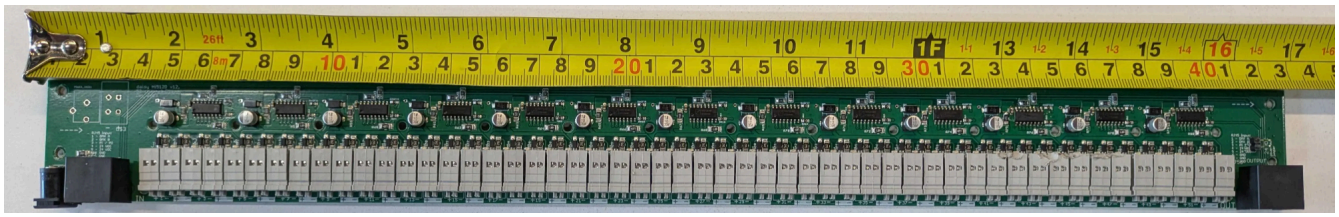


Panel introduction

① Power indicator:	the power indicator shows if the device powered and if power supply unit of the device is working.
② DMX input:	used to input the DMX signal.
③ DMX Pass-Thru:	used to connect the next DMX Splitter.
④ DMX outputs:	used to output the DMX signal to the DMX lighting.
⑤ Power input:	used to input AC88~256V 50/60Hz.

Specification	Details
Manufacturer	VSHOW
Model	DSP04 DMX Splitter 4
Power Input	AC88~256V 50/60Hz
Dimensions	4 x 5.4 x 5.3 cm
Weight	0.5 kg

52 Channel DMX Dimmer



Takes 24V power through a barrel connector on the left side and distributes power through two pin gray connectors.

Receives DMX data in an input and an output RJ45 port, translates this data to 52 ports. Each port outputs 1 DMX channel.

While 1 port is 1 channel an group of 4 are controlled by 1 chip and if issues appear in 1 of the 4 ports they will soon travel to one or more of the others on that chip

WARNING: Must be programmed to output a maximum current, otherwise some DMX ports could be fried, since the bulbs could draw too much current.

Two versions of the device exist, **green boards (v12)** and **black boards (v12.1)**. In your canopy's assembly, there would be only one type of dimmer, v12 **or** v12.1.

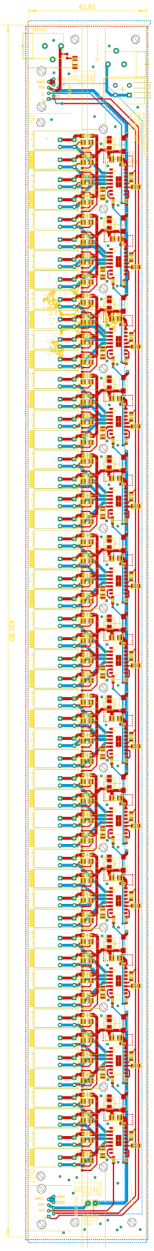
The **green boards (v12)** use several 4.7 Ohm resistor (part# RMCF1206JT4R70) for REXT. To avoid overheating, **all** the current settings must be set to 4.

The **black boards (v12.1)** use several 4.7 kOhm resistor (part# RC1206FR-074K7L) for REXT. To avoid overheating, **all** the current settings must be set to a maximum value of 13.

ALWAYS PROGRAM PARAMETER FIRST. SEE INSTRUCTIONS HERE: PROGRAMMING THE 512D CHIP.

Main PCB

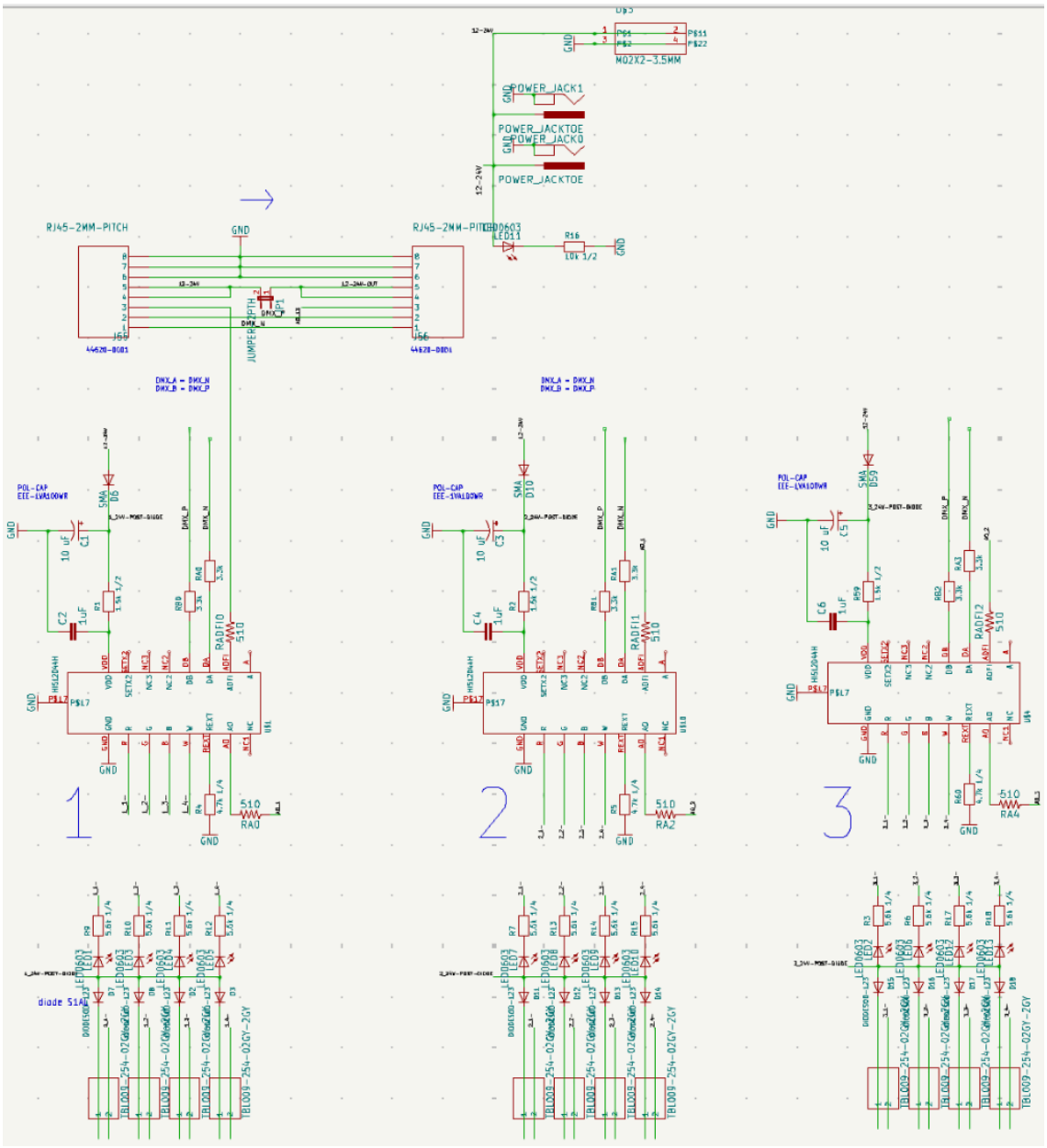
The main PCB has been designed by the studio. The latest version of such PCB is labeled as "**daisy Hi512D v12.1, 52 channel DMX, Dec 2023**" The main PCB is controlling the power feed to the light bulb's power line and, by extension, their on/off state. The board has 13 onboard chips, each controlling 4 outputs for a total of 52 channels. Each Hi512D chip is set to limit their output to 6.25% (4/64) of their potential strength.

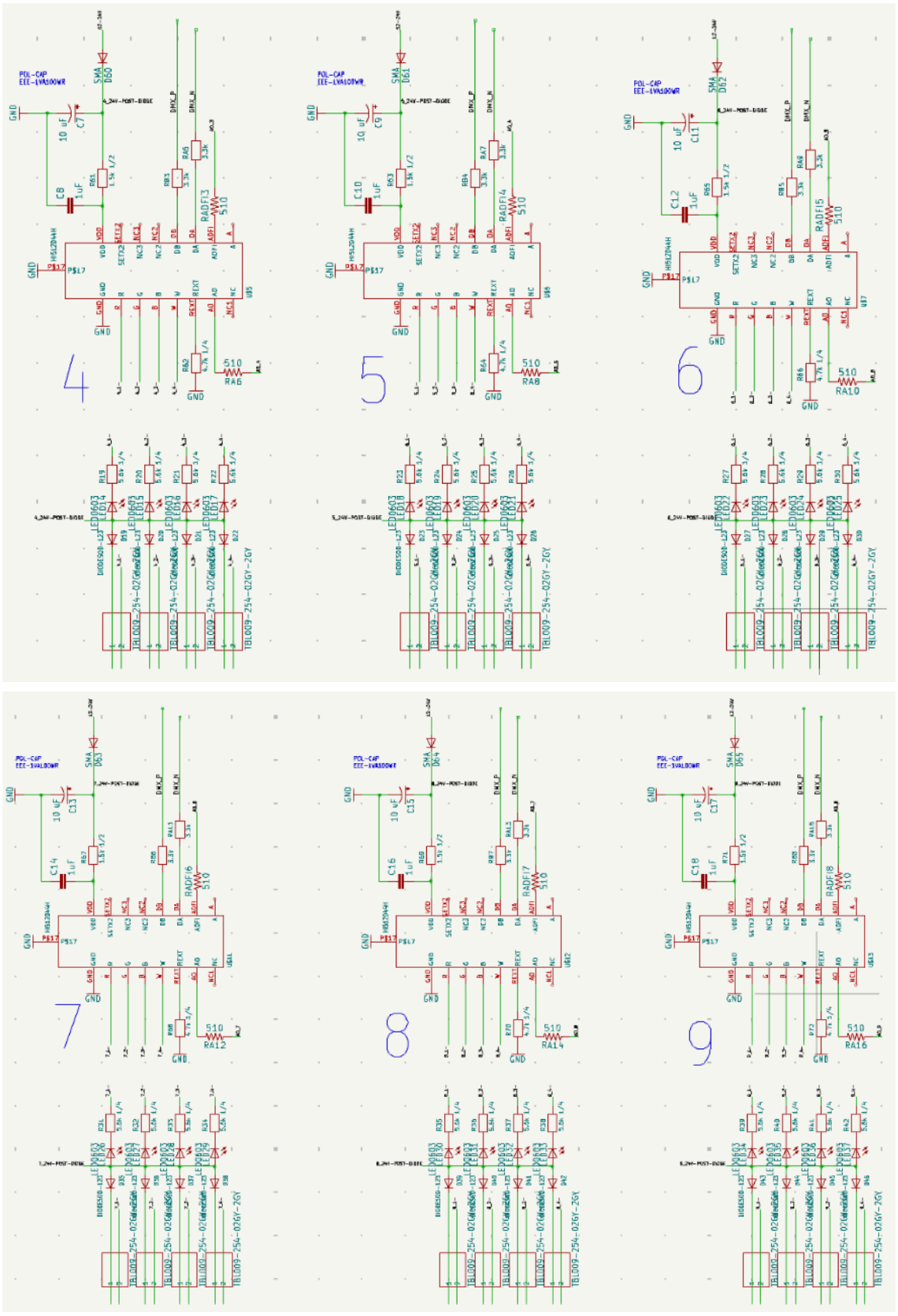


Main PCB

Schematics

In order to include the entire schematic it has been split up across the next pages.

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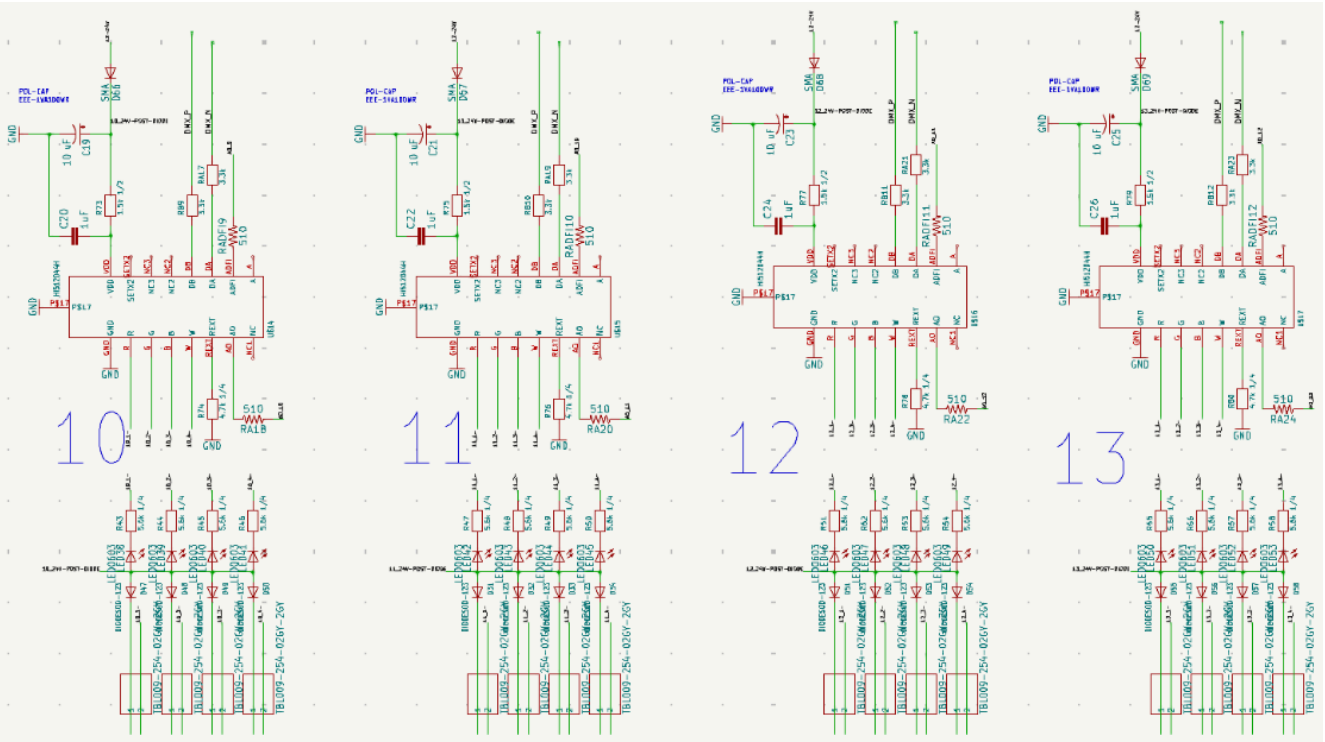
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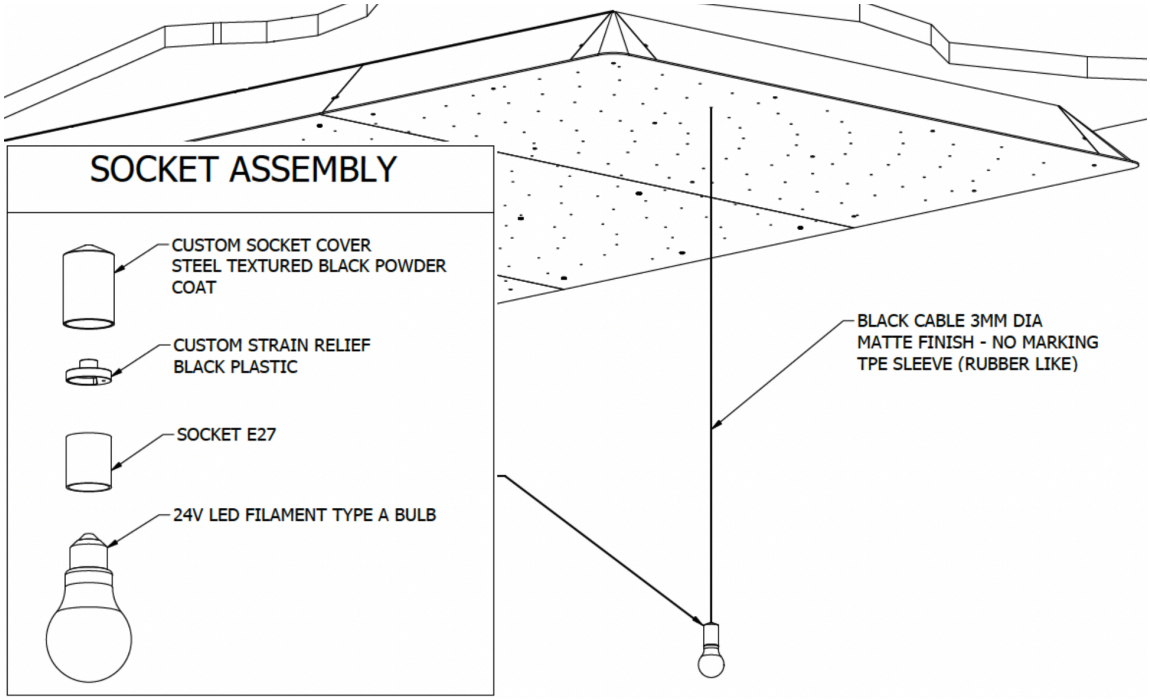
11
12
13

Power Supply

Specification	Details
Manufacturer	Phihong
Model	PPL65W-240
Output Power	65W
Output Volt	24V
Output Amp	2.71A

Light Bulb Assembly



Component	Description
Power cable	The wire carrying power to the socket. Should be 22AWG 2 leads in a 3mm diameter matte black TPE sleeve, without any printing or marking on them.
Socket Cover	A black powder coated steel bell covering the socket to make a cleaner assembly.
Strain Relief	A black plastic clip that prevents the weight of the light bulb assembly or accidental mishandling from damaging the socket and cable connections.
E27 Socket	Connects the light bulb to the power cable.
Light bulb	An E26 24VDC LED light, with a clear glass bulb. The bulb has an A19 Edison shape (+/- 11cm long, 6cm of diameter), is dimmable and has a 2700K color temperature. There's typically 4 filaments inside the bulb, each about 38mm long. The bulb could produce about 320 lumens (3W), but is limited by the provided equipment in the canopy so it would emit less light at full intensity.

Labeling of cabling

Each light is assigned a unique identifier to allow DMX commands to be sent to each one individually. Three panels make up the whole canopy. Each panel is split in half and sectioned accordingly: #A and #B, #C and #D, #E and #F. Each panel has one DMX Controller associated with it. So the labels for individual bulbs are composed the following way.

#Panel ID (Letter referring to panel) **Bulb ID** (DMX address on respective dimmer)

For example the bulb associated with the first DMX address in each panel will have the following labels.

#A01
#B01
#C01
#D01
#E01
#F01

These labels can be found in six parts of the installation.

1. **Socket:** Found by lifting the metal socket of the bulb and checking its number. Helpful during assembly, and when troubleshooting.

2. **Cover Plate (Ceiling Side):** Found on the ceiling side of the cover plate. Helpful during assembly.

3. **Cable Bracket:** Found within the Canopy structure, next to the strain relief cable bracket. Helpful during the assembly.

4. **End of Bulb Cable:** Found on the end of lightbulb cable. Helpful during pre-assembly of all cables and when troubleshooting.

5. **End of Internal Wiring Cable (Bracket Section):** Found inside the canopy, attached to the Wago connector. Helpful during pre-assembly of all cables and when troubleshooting.

6. **End of Internal Wiring Cable (Channel Dimmer Section):** Found plugged into the dimmers. Helpful when troubleshooting.

APPENDIX III - REPAIRS AND OTHER MANIPULATIONS

Programming the 512D chip

How to program the 512D chip for a single 24V Bulb. First familiarize yourself with the BL-321 unit.

The left side of the unit has the power on switch, a SD card port for firmware updates, and a USB C port for charging the unit. Switch the power on.

The screen of the unit is backlit, it will open to a page titled “Addressing Device” with several options.

The following table explains the functionality of each of these buttons.

Options	Details
Addressable	The basic addressing format, safest to use as it will only effect the DMX address
TestEffect	A testing interface to test the lights DMX functionality, not often used.
Addr. Check	A testing interface to test the lights DMX address, good to use to confirm from programming
Other Settings	Do not use, not applicable to our system
Advance Addr.	Advance programming, needed for reprogramming of a unit.
Version	Firmware version, note this if ever talking to a tech about an issue with the BL-321 or reprogramming
DMX Control	Do not use, not applicable to our system
Language	Only available options are Mandarin Chinese and English

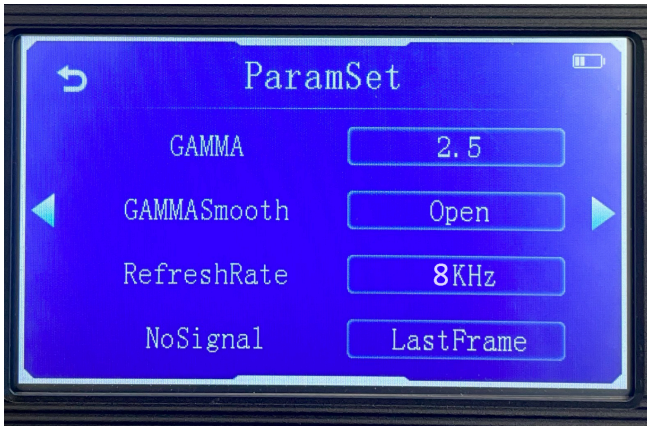
In order to program the unit you will need to use the Advanced Addr. option. First make sure that nothing is plugged into the BL-321. Then open the “Advanced Addr” option and apply exactly the settings seen in the following table.

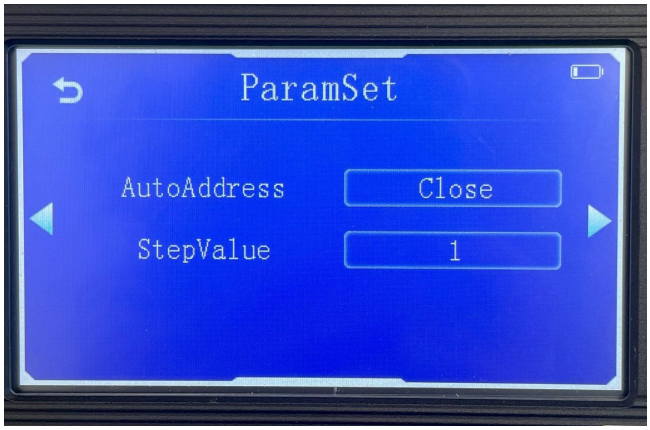
Settings	Value
GAMMA	2.5
GAMMASmooth	Open

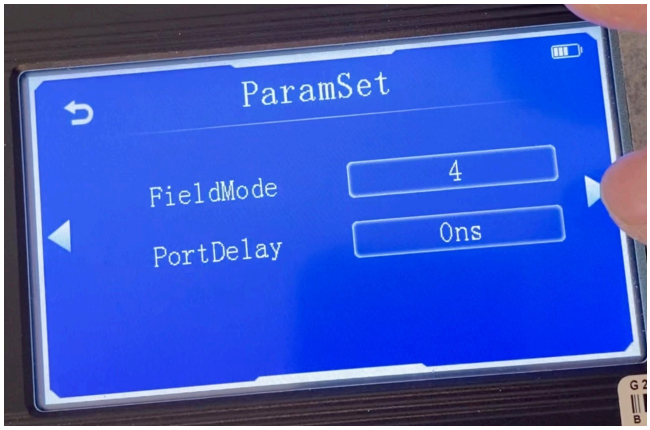
Settings	Value
RefreshRate	8kHz
NoSignal	LastFrame
AutoAddress	Close
StepValue	1
FieldMode	4
PortDelay	Ons
ColorR	255
ColorG	255
ColorB	255
ColorW	255
ColorA	255
CurrentR	4
CurrentG	4
CurrentB	4
CurrentW	4
CurrentA	4

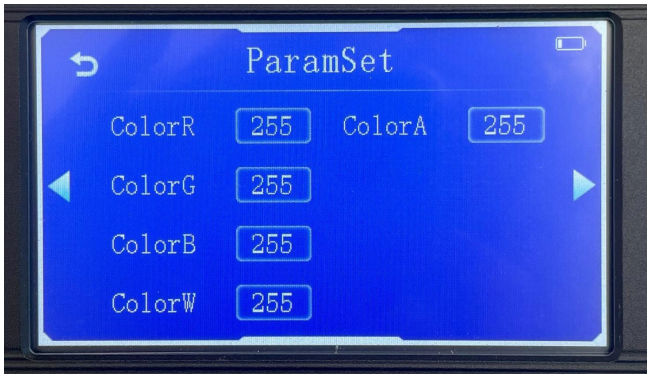
Once all these are set, press the Return icon at the top left corner of the screen and check the box next to Param. Set.

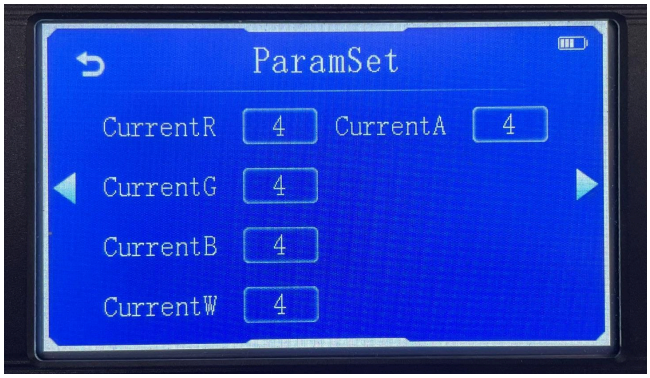
Next open Addr. Set You should see a screen that looks like the image below. Make sure that your settings in the top row are set to be the same as the ones in the image. The “Lights” and “Amount” setting will change automatically, do not touch either yourself. The “Start Add” number must be set to the address of the unit you are replacing or reprogramming. This address should be indicated on a label after the Box ID. Please match it exactly.











WARNING: Must be programmed to output a current of 4 (for the green PCBs and 13 for the black PCBs), not doing so could burn the ports, since the bulbs could draw too much current.