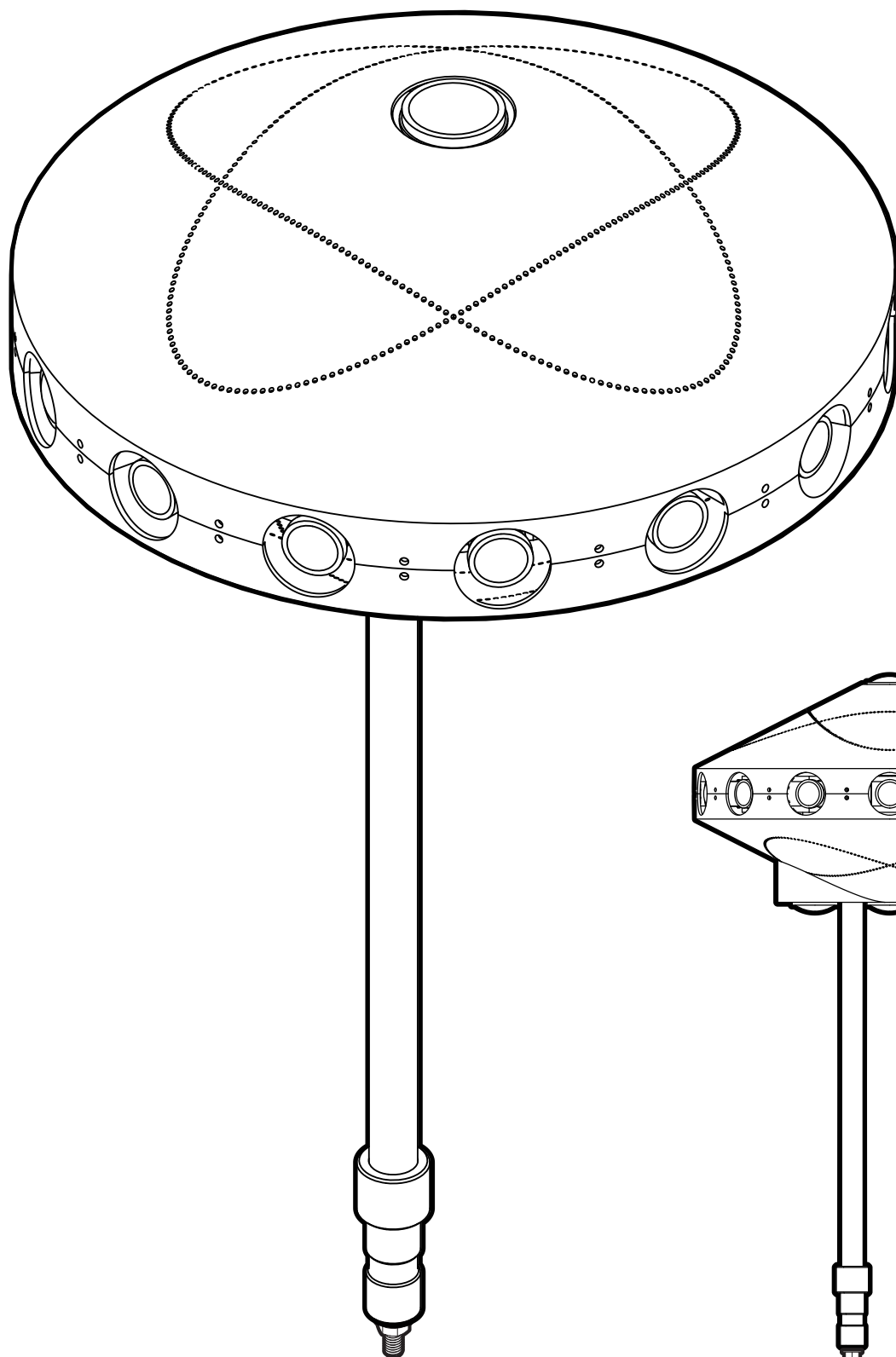


facebook

# SURROUND 360





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1

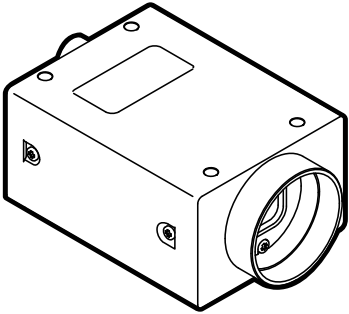
## Parts List

# 1

## 1.

### Camera & Lenses

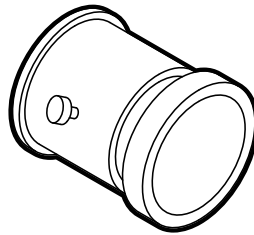
17x



#### Camera

Point Grey GS3-U3-41C6C-C

14x



#### Wide-Angle Lens

*with custom focusing barrel*

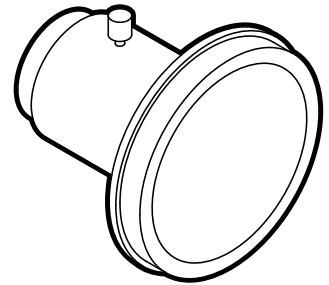
(FB360\_V1\_05, \_33)

Sunex DSL318B-650-F2.4

#### OPTIONAL:

M3 brass jam nuts (14x)

3x



#### Fisheye Lens

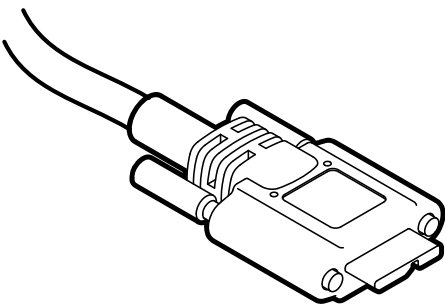
(FB360\_V1\_06)

Fujinon FE185C086HA-1

## 2.

### Wiring

17x



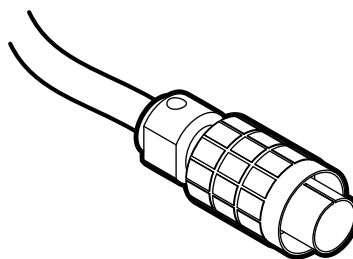
#### USB Cable

Type A to Micro-B

#### OPTIONAL:

M2 thread, 0.4mm pitch, 20mm long replacement screw

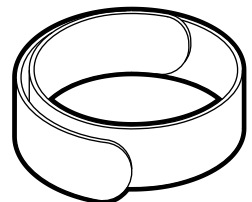
17x



#### GPIO Cable

(FB360\_V1\_05, \_33)

Hirose HR25 circular connector, 8 pins



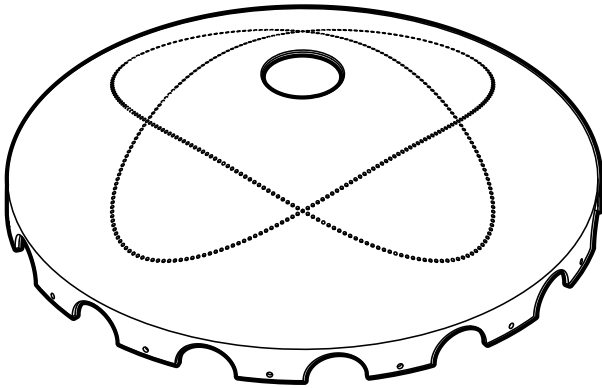
#### Velcro Straps

# 1

## 3.

### Machined Parts

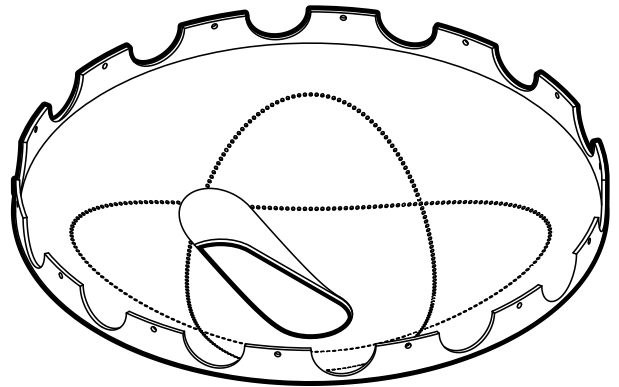
1x



**Top Cover**  
(FB360\_V1\_30)

mild steel,  
painted finish

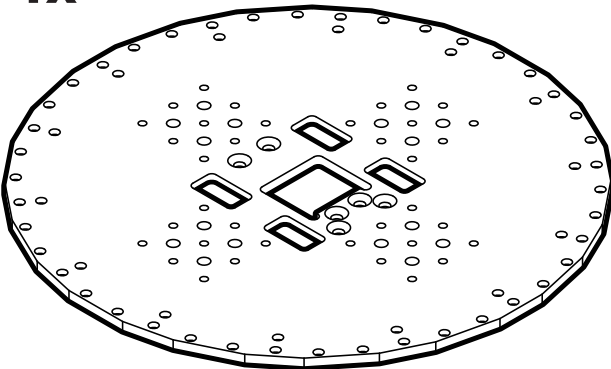
1x



**Bottom Cover**  
(FB360\_V1\_29)

mild steel,  
painted finish

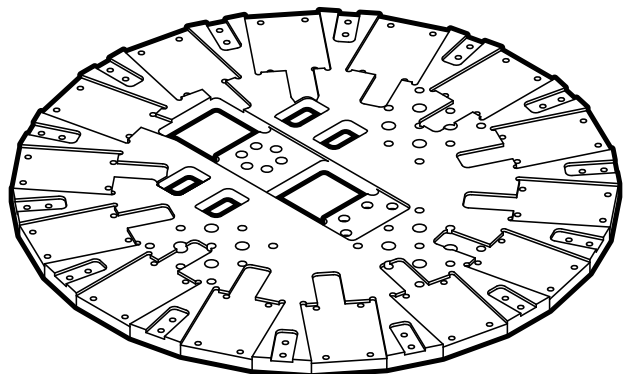
1x



**Top Plate**  
(FB360\_V1\_22)

1/4" thick Mic-6 aluminum,  
black anodize finish

1x



**Base Plate**  
(FB360\_V1\_21)

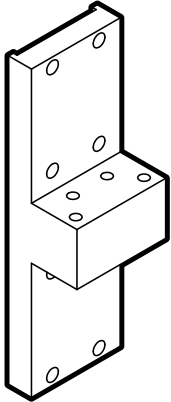
3/8" thick Mic-6 aluminum,  
black anodize finish

# 1

## 4.

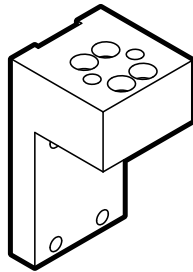
### Machined Parts

1x



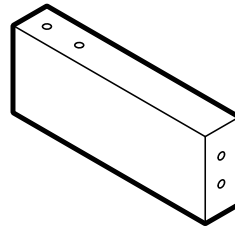
**Upright**  
(FB360\_V1\_23)  
6061 aluminum,  
black anodize finish

1x



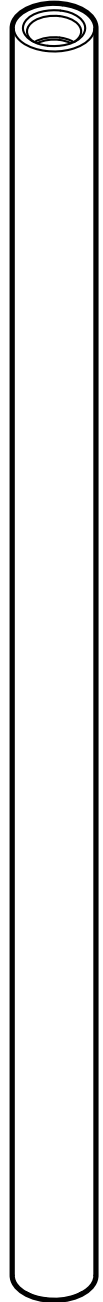
**Camera Bracket**  
(FB360\_V1\_24)  
6061 aluminum,  
black anodize finish

14x

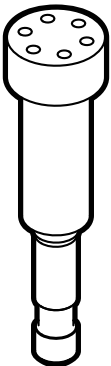


**Shell Support**  
(FB360\_V1\_28)  
6061 aluminum,  
black anodize finish

1x

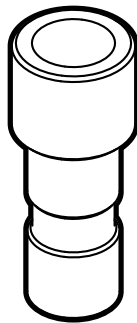


1x



**Post**  
(FB360\_V1\_25)  
1144 carbon steel,  
black oxide finish

1x



**Adapter**  
(FB360\_V1\_27)  
1144 carbon steel,  
black oxide finish

1x



**Stop Nut**  
(FB360\_V1\_31)  
Brass

**Support Tube**  
(FB360\_V1\_26)  
4130 CR tubing,  
black oxide finish

# 1

## 5.

### Hardware

152x



#### M3 Socket-Head Cap Screw

Type 18-8 stainless steel  
M3 thread, 6mm length,  
0.5mm pitch

152x



#### M3 Belleville Spring Lock Washer

Type 18-8 stainless steel  
M3 screw size

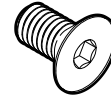
28x



#### M3 Flanged Button-Head Socket Cap Screw

Black-oxide,  
M3 thread, 10mm length,  
0.5mm pitch

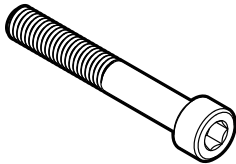
8x



#### M6 Flat-Head Screw

Type 18-8 stainless steel  
M6 thread, 14mm length,  
1.0mm pitch

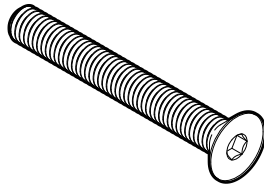
2x



#### M6 Socket-Head Cap Screw

Type 18-8 stainless steel  
M6 thread, 40mm length,  
1.0mm pitch

4x



#### M6 Flat-Head Screw

Type 18-8 stainless steel  
M6 thread, 50mm length,  
1.0mm pitch

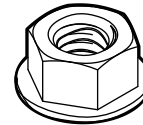
16x



#### M6 Belleville Spring Lock Washer

Type 18-8 stainless steel  
M6 screw size

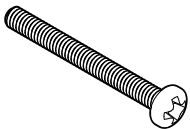
1x



#### Steel Rotating Flanged Nut

Black-oxide steel,  
5/16"-18 thread size  
3/4" flange diameter  
7/16" overall height

## Optional



#### M2 Socket-Head Cap Screw

Type 18-8 stainless steel  
M2 thread, 20mm length,  
0.4mm pitch

(replace USB locking screws)



#### M3 Jam Nut

Brass, M3 thread size,  
5.5mm Wide, 1.8mm  
High

(lock nut for Sunex barrel)

1x

#### Steel Threaded Rod (FB360\_V1\_32)

ASTM A193 grade B7 steel  
5/16"-18 thread  
20-1/4" long  
fully threaded





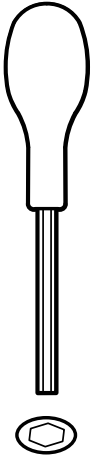
# 1

# 6.

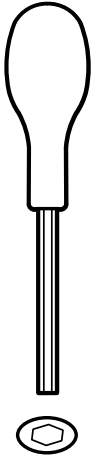
Tools

## Hand Tools

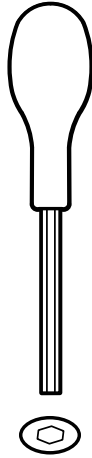
5mm  
HEX



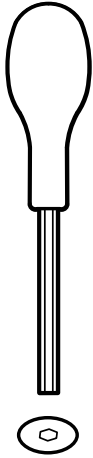
4mm  
HEX



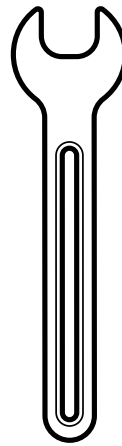
2.5mm  
HEX



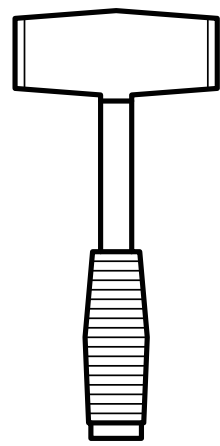
2mm  
HEX



9/16"  
Wrench

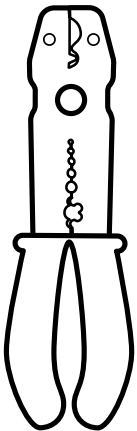


Rubber  
Mallet

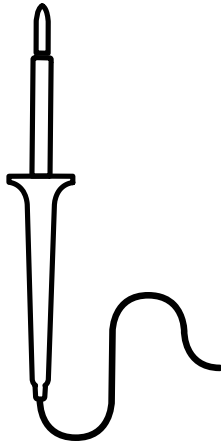


## Wiring Tools

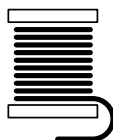
Wire  
Cutter



Soldering  
Iron

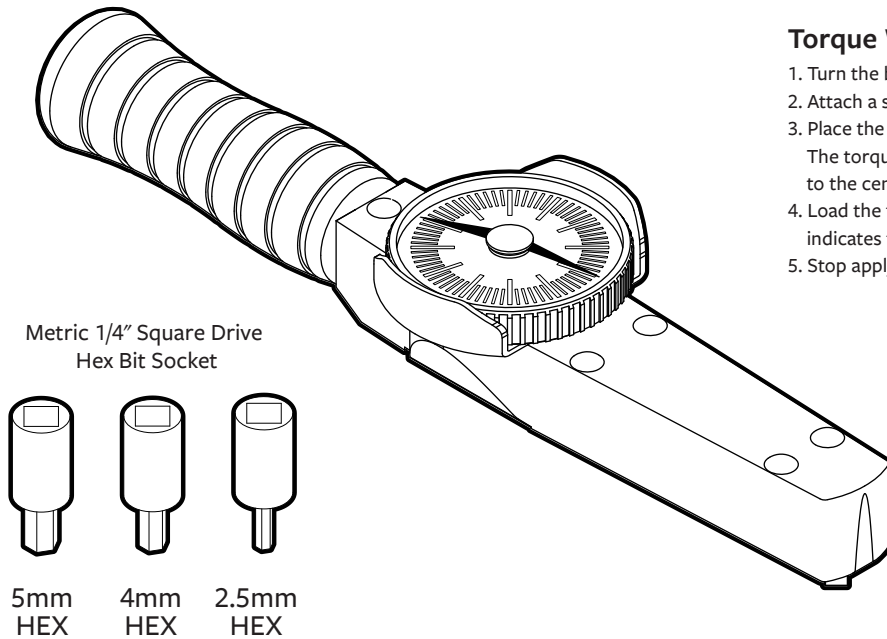


Solder



# 1 | 7. Tools

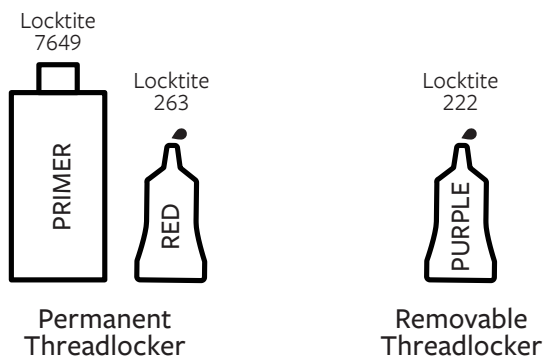
## Torque Wrench



### Torque Wrench Instructions:

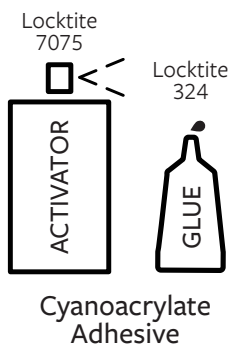
1. Turn the bezel until pointer is resting on zero.
2. Attach a socket or attachment to the square drive.
3. Place the socket or attachment over the fastener to be torqued.  
The torque wrench handle must be perpendicular (90 degrees) to the centerline of the drive, socket and fastener.
4. Load the torque wrench at a slow and steady rate until the pointer indicates the desired torque.
5. Stop applying force. The pointer should return to zero.

## Threadlockers & Adhesive



### Threadlocker Instructions:

1. Apply primer to surface of bolt and nut.
2. Apply several drops of the threadlocker onto the bolt at the nut engagement area.
3. Assemble parts and tighten as required. Sets in approximately 10 minutes and fully cures in 24 hours.



### Adhesive Instructions:

1. Apply the surface activator to both surfaces.
2. Wait 20 seconds for the activator to completely dry.
3. Apply glue sparingly to one side only using approximately one drop per square inch of surface.
4. Press parts together immediately.
5. Hold in place for 30 seconds or until bond sets.

# 1

## 8.

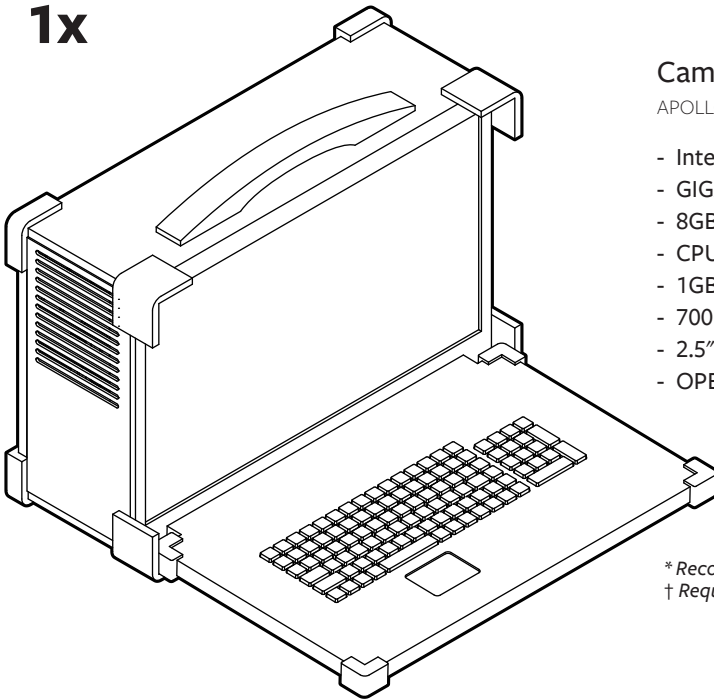
### Computer Hardware



#### Assembly Note

See system setup instructions for details

1x



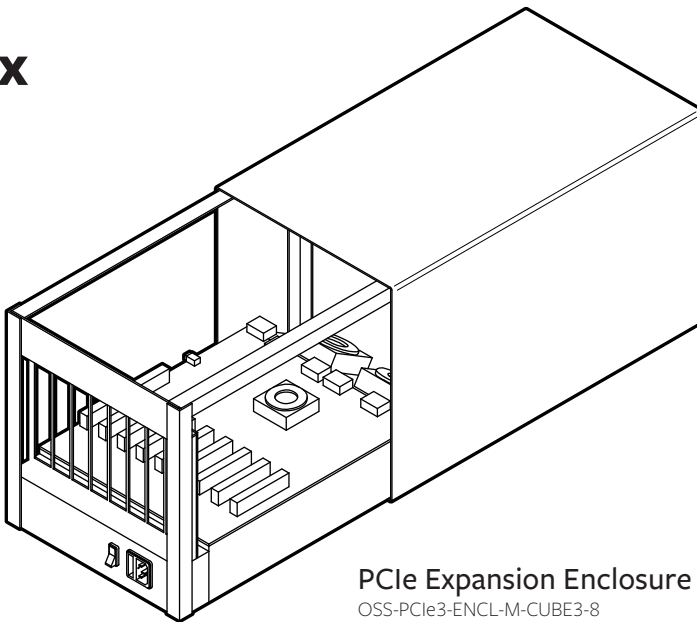
#### Computer - Ruggedized "Lunchbox" Computer

APOLLO-A1 MODEL

- Intel Core i7-5960X Haswell-E 8-Core 3.0 GHz LGA 2011-v3\*
- GIGABYTE GA-X99P-SLI (rev. 1.0) LGA 2011-v3 Intel X99 Motherboard\*
- 8GB DDR4 2400 288-PIN Memory = (64GB of Memory Installed)\*
- CPU COOLING FAN FOR LGA 2011-v3\*
- 1GB NVIDIA PCIe x16 VIDEO CARD\*
- 700 WATT POWER SUPPLY\*
- 2.5" 128GB SSD\*
- OPERATING SYSTEM - UBUNTU 14.04 LTS†

\* Recommended  
† Required

1x



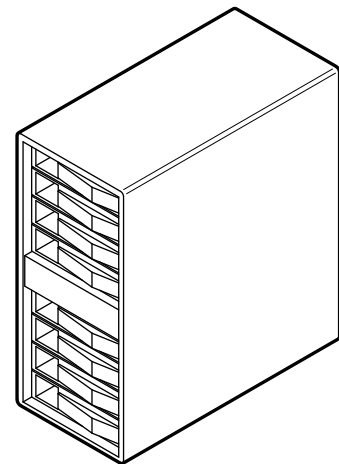
#### PCIe Expansion Enclosure

OSS-PCIe3-ENCL-M-CUBE3-8

#### Expansion Backplane

OSS-BP-452

1x



#### 8-bay 12G SAS RAID Tower

ARC-4038

# 1

## 9.

### Computer Hardware



#### Assembly Note

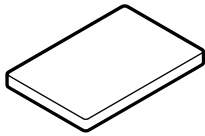
See system setup instructions for details

1x



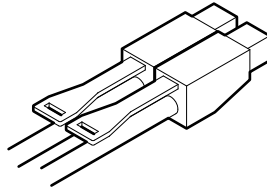
Shunt Jumper  
390088-1

8x



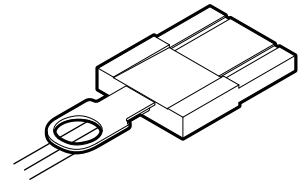
1TB SSD  
MZ 7KE1T0BW

2x



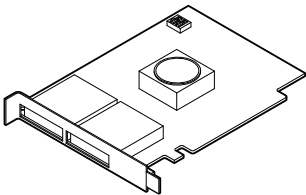
External 4x HD Mini-SAS Cable  
SFF-8644 to SFF-8644

1x



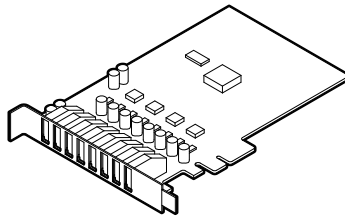
PCIe x8 Active Optical Cable  
OSS-PCIe3-CBL-ACT-x8-50M-1x

2x



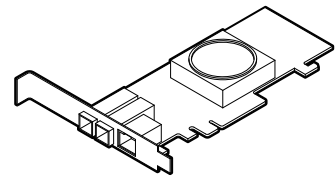
PCIe x8 Gen 3 Cable Adapter  
OSS-PCIe-HIB38-x8-DUAL

5x



USB 3.0 Expansion Card  
UE-1008 or UE-1004

1x



PCIe 3.0 x8 SAS RAID Adapter  
ARC-1883X

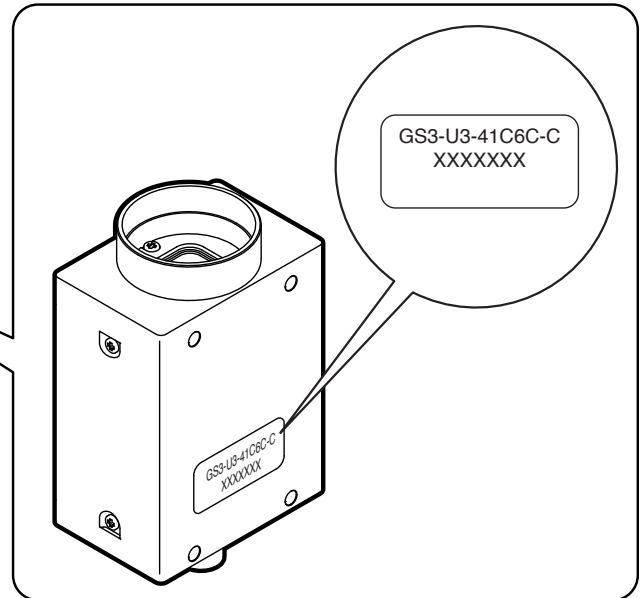
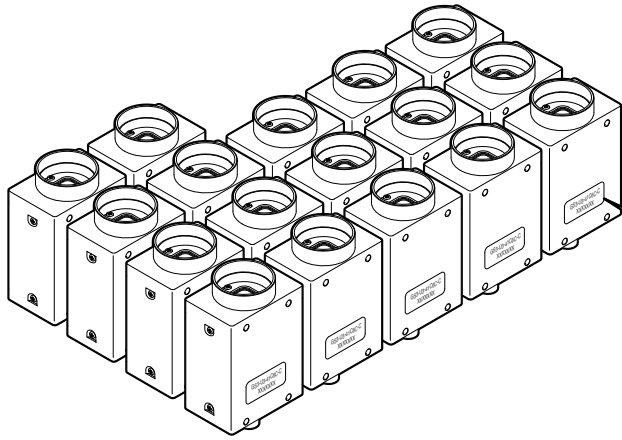
# 2

## Before You Start

# 2

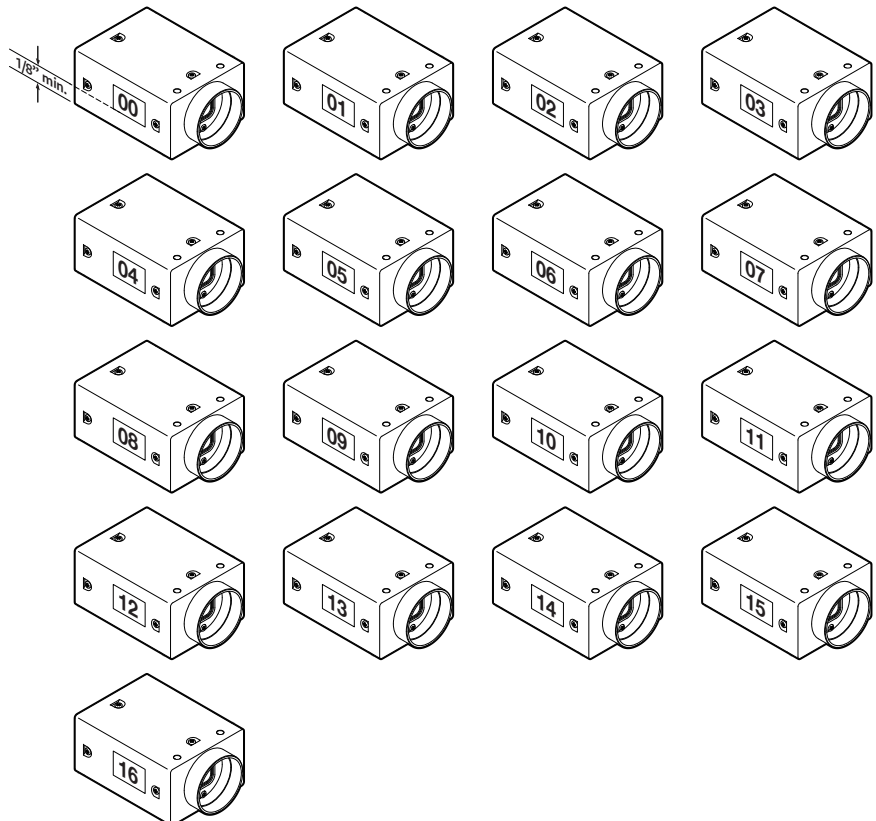
## 1.

Arrange Cameras in Ascending Sequential Order (Per Serial Number)



## 2.

Label Cameras # 00 - 16



**Tip:**

Keep labels 1/8" min. away from bottom of camera to clear mounting plate

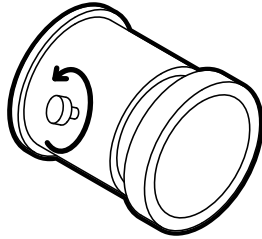
# 2

## 3.

### Replace Focusing Barrel of Wide-Angle Lenses (# 01 - 14)

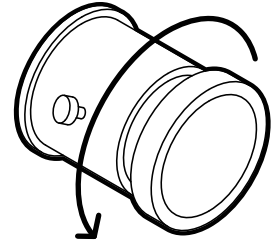
#### Step 1:

Remove thumb screw



#### Step 2:

Remove existing barrel and internal spring (counterclockwise)



#### Step 3:

Screw on new focusing barrel\* clockwise and tighten thumb screw

#### Step 4 (Optional):

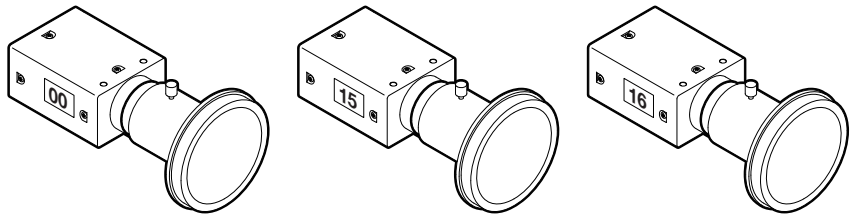
Tighten optional lock nuts (M3 brass jam nuts)

\* Refer to DWG FB360\_V1\_33

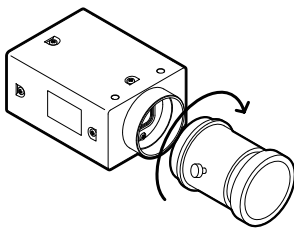
## 4.

### Mount Lenses

#### Fujinon Fisheye - # 00, 15, 16

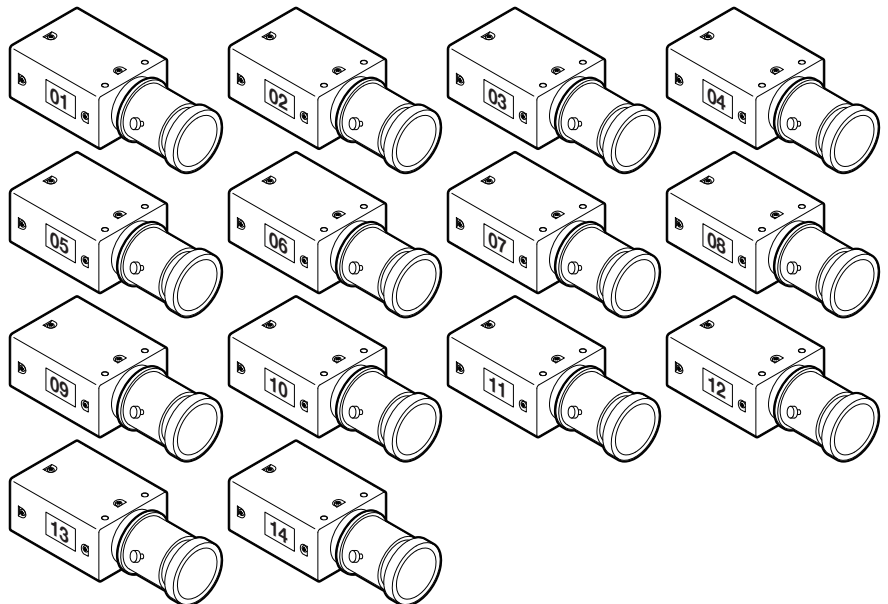


#### Sunex Wide-Angle - # 01 - 14



#### ! Tip:

Screw lens onto camera clockwise till its snudge



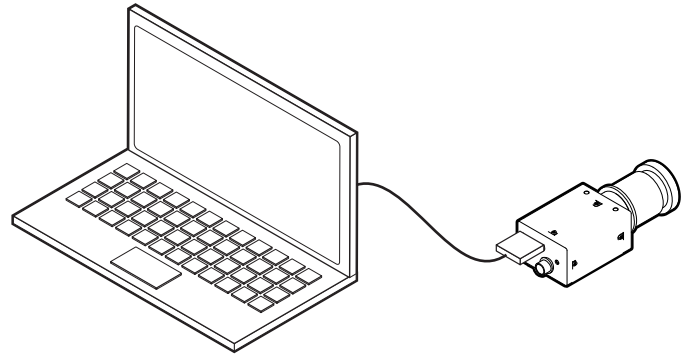
# 2

## 5.

### Firmware Update

**Firmware Version Required: 2.23.3.0**

Follow instructions in camera control README file



## 6.

### Focusing Lenses

**Step 1:**

Download and install FlyCapture from Point Grey (<https://www.ptgrey.com/support/downloads>)

**Step 2:**

Connect camera (with lens) to PC or Linux computer

**Step 3:**

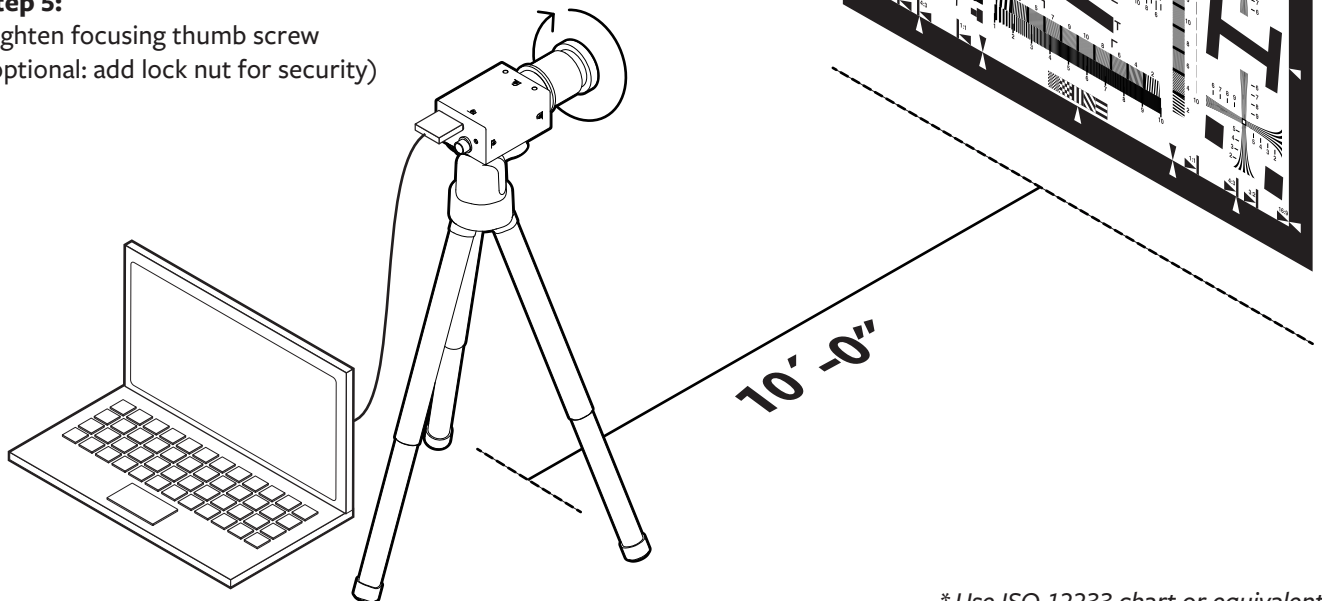
Set camera on a tripod about 10 feet away from chart\* on wall

**Step 4:**

Loosen focusing thumb screw on lens and rotate focusing barrel till image in preview pane is sharp. Zoom in when necessary

**Step 5:**

Tighten focusing thumb screw (optional: add lock nut for security)



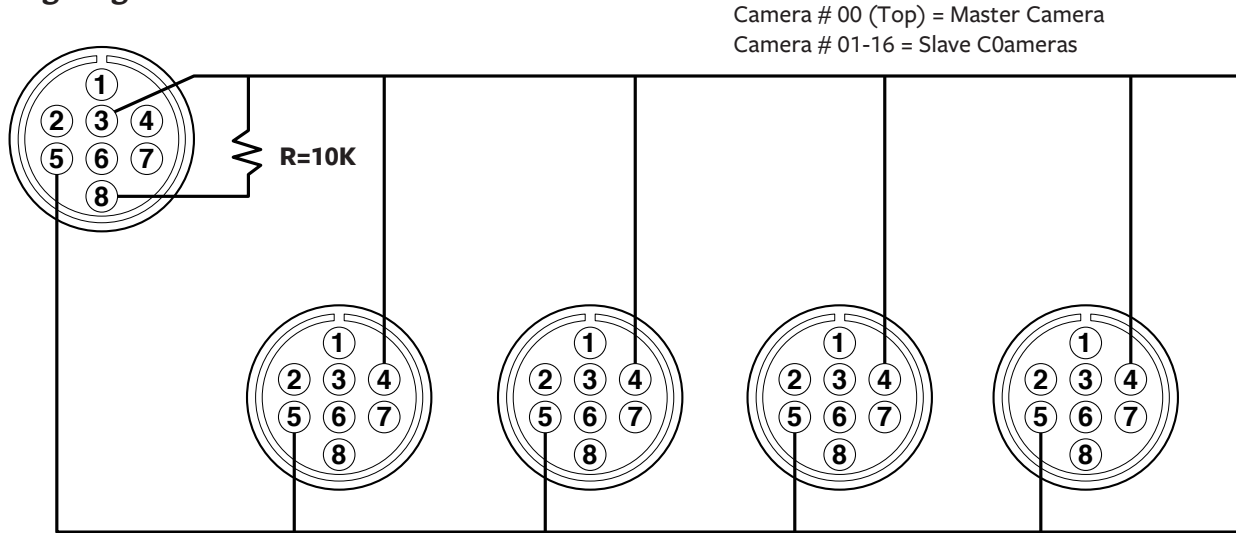


# 2

## 7.

### GPIO Trigger Cable

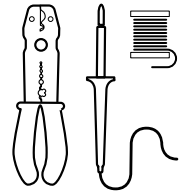
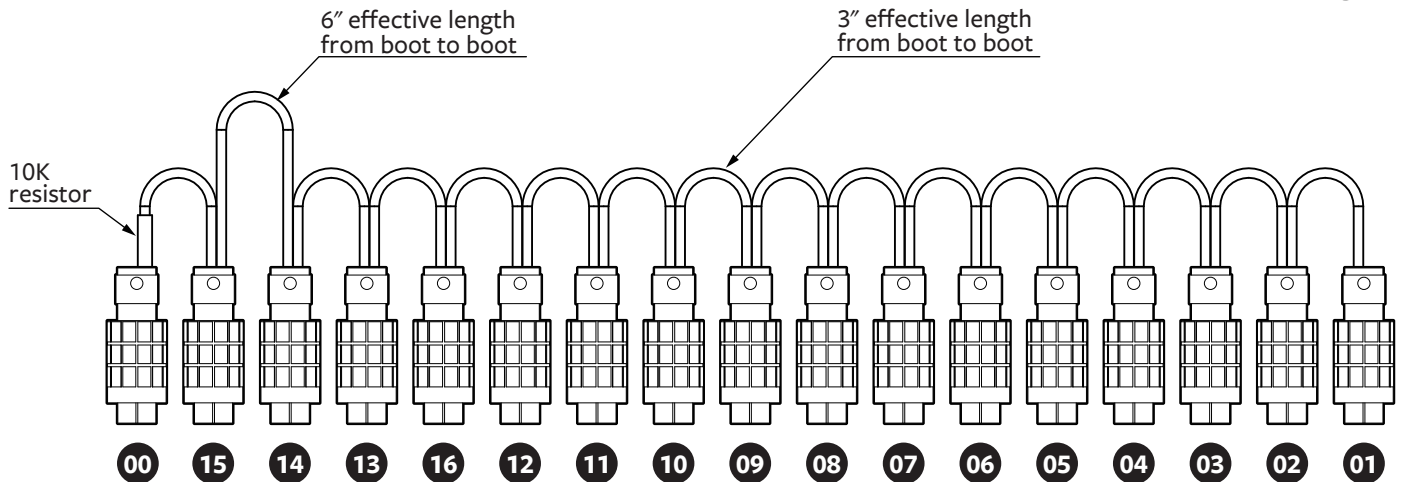
#### A - Wiring Diagram



- PIN ③** IO2 - Input/Output/Serial Transmit (TX)
- PIN ④** IO3 - Input/Output/Serial Receive (RX)
- PIN ⑤** GND - Ground for bi-directional IO,  $V_{EXT}$ , +3.3V pins
- PIN ⑧** + 3.3V - Power external circuitry up to 150mA

\* Refer to DWG FB360\_V1\_34

#### B - Cable Lengths From Boot to Boot



\* Refer to DWG FB360\_V1\_34

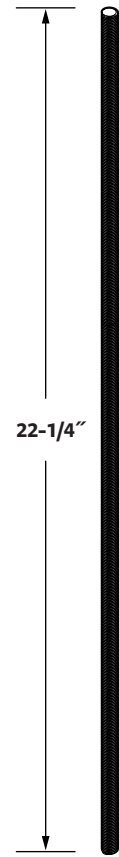
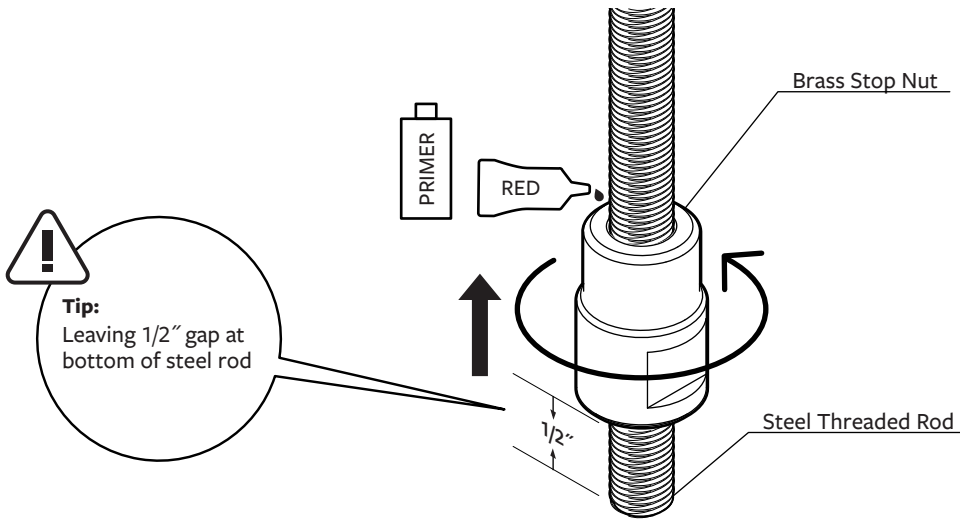
# 3

## Camera Assembling Instructions

# 3

## 1.

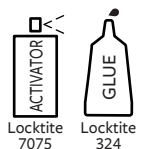
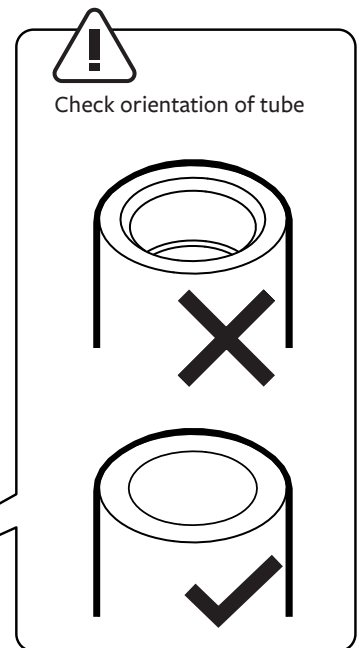
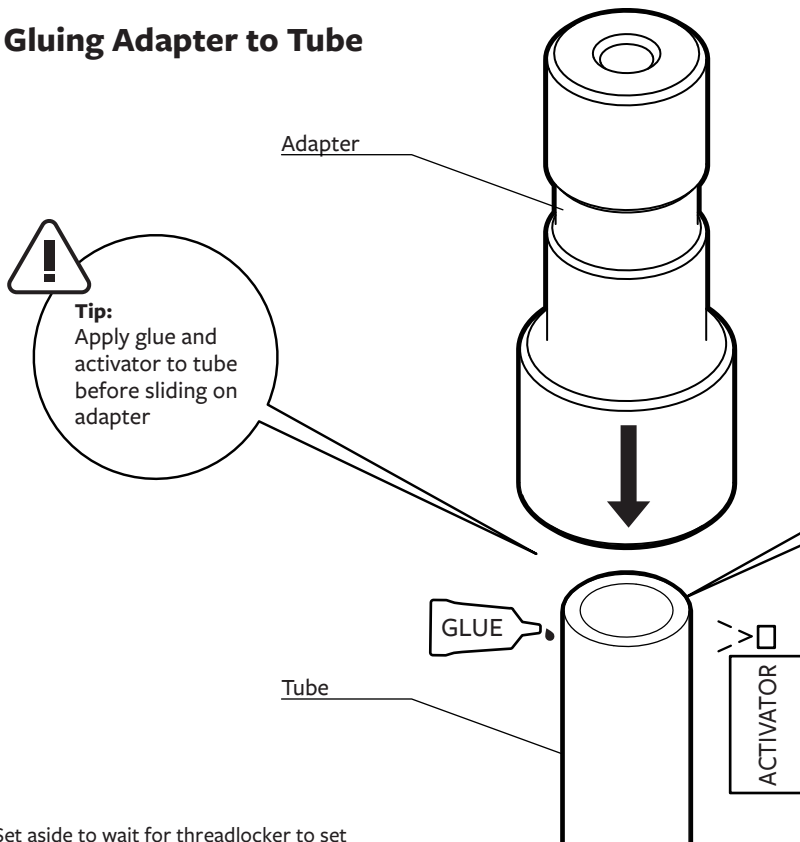
### Screw Brass Nut Onto Threaded Rod



Set aside to wait for threadlocker to set

## 2.

### Gluing Adapter to Tube

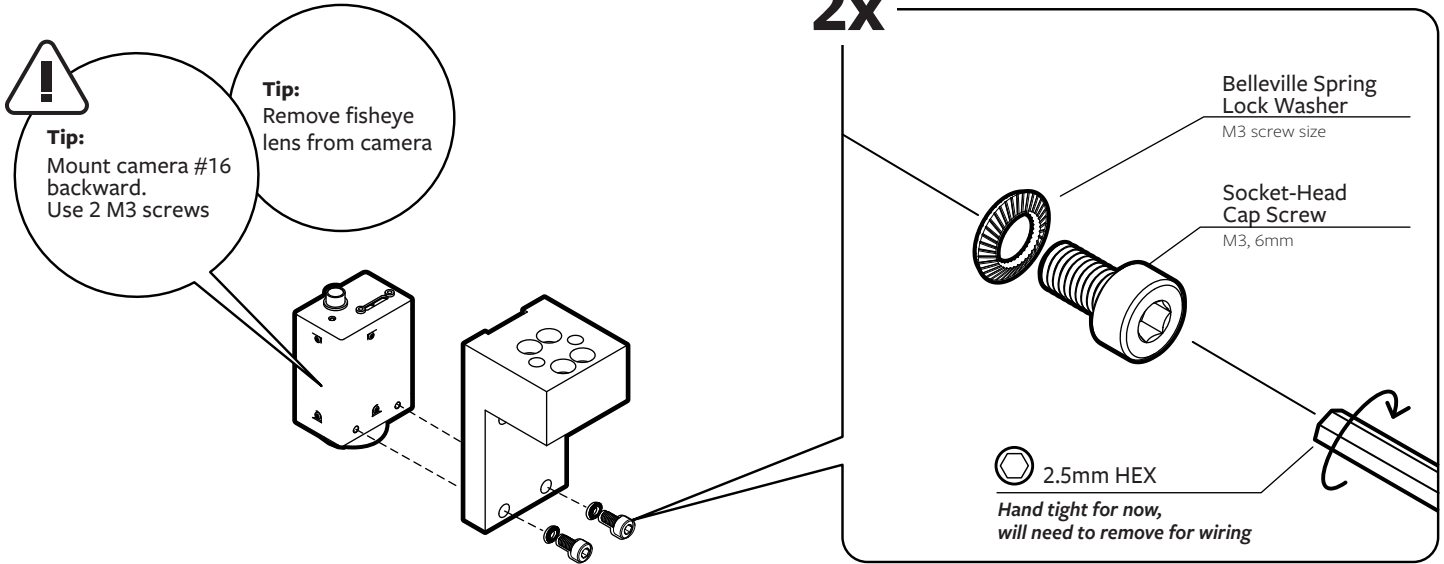


Set aside to wait for threadlocker to set

# 3

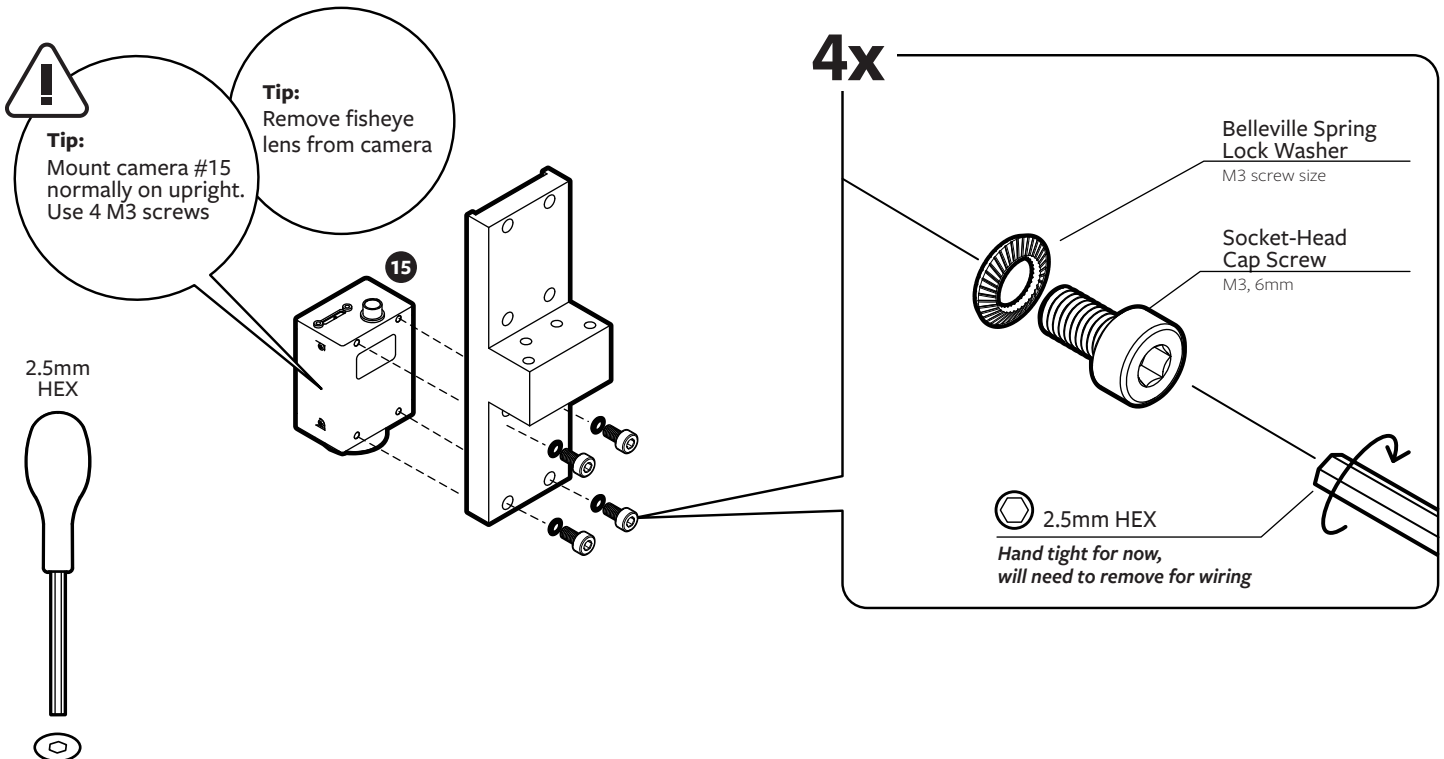
## 3.

### Bottom Camera (#16) & Camera Bracket



## 4.

### Bottom Camera (#15) & Upright



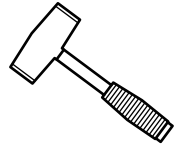
# 3


## 5.

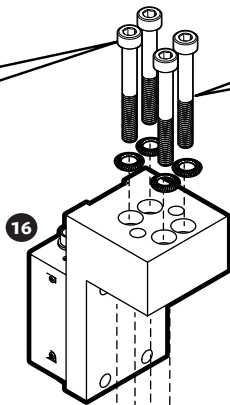
### Camera Bracket & Post

#### Assembly Note

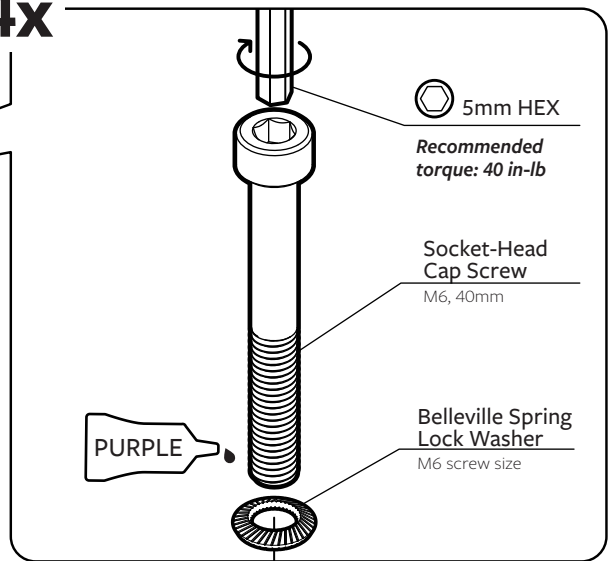
Use a rubber mallet to gently tap upright in place if fitting is too tight




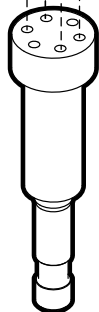
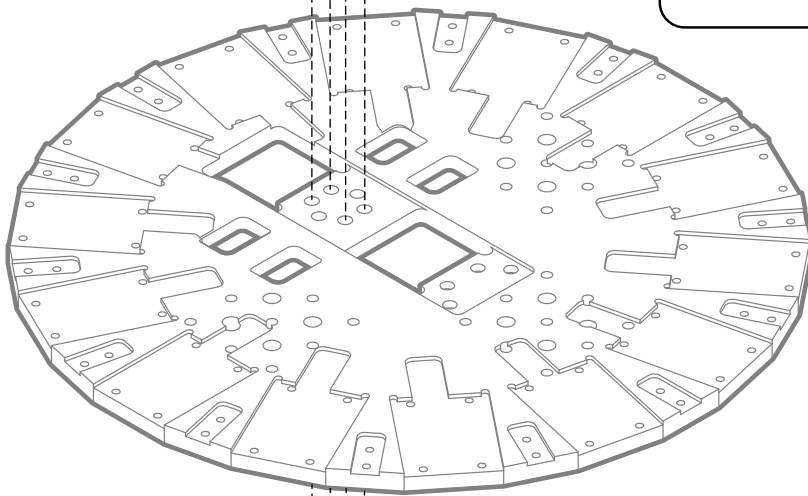
 **Tip:**  
Make sure flat-head screws are flush with top of bracket



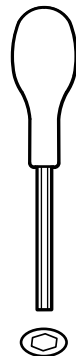
4x



 Wait for threadlocker to set




5mm  
HEX

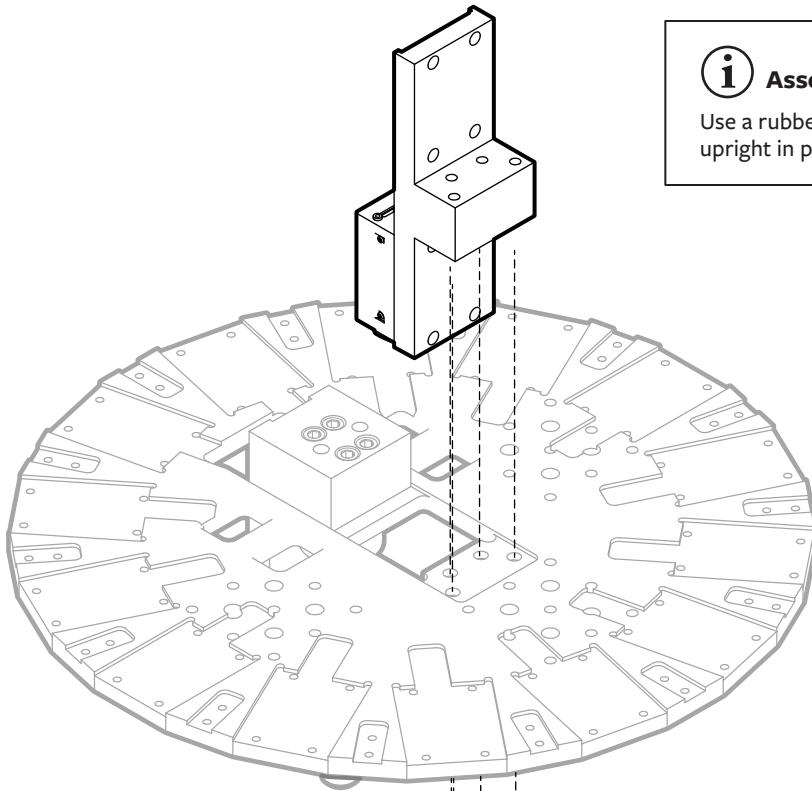


Lockite  
222

# 3

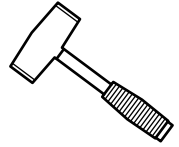
## 6. Upright

**i** **Assembly Note**  Flip 180° to tighten screws

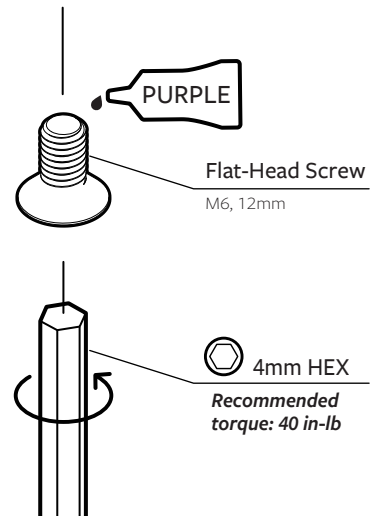


**i** **Assembly Note**

Use a rubber mallet to gently tap upright in place if fitting is too tight



4x

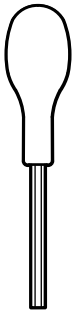


Flat-Head Screw  
M6, 12mm

4mm HEX  
Recommended torque: 40 in-lb

 Wait for threadlocker to set

4mm  
HEX



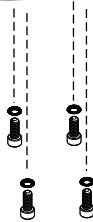
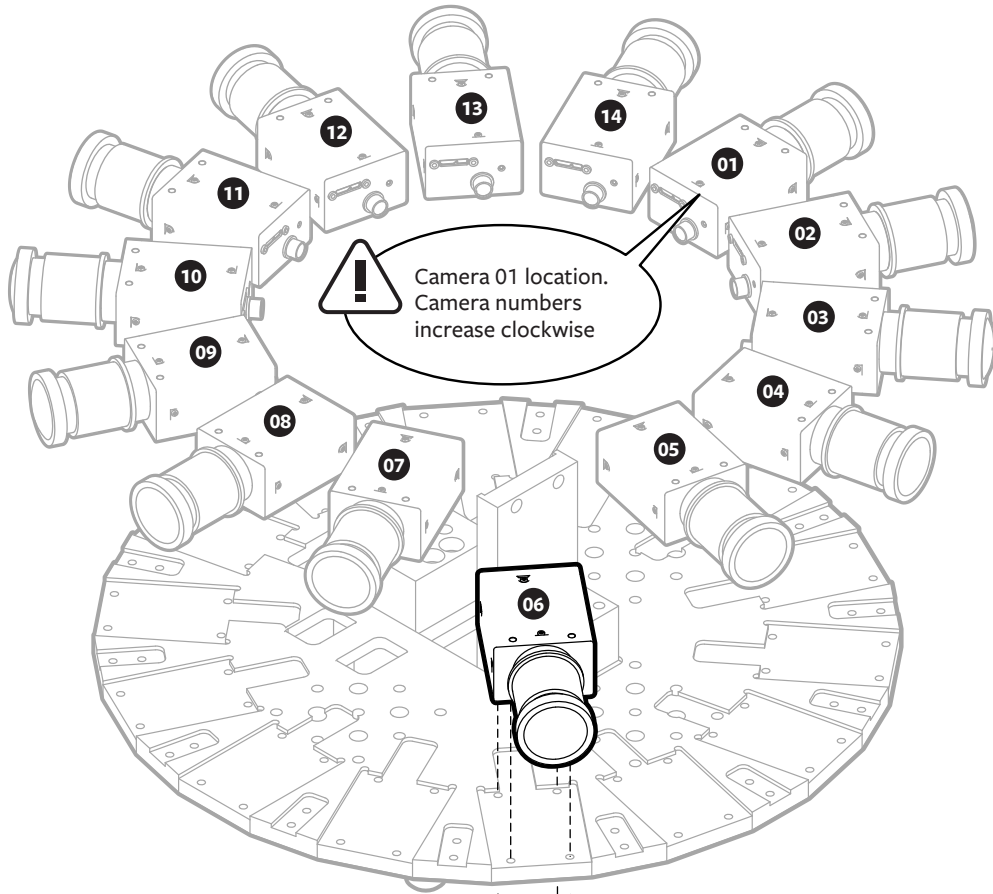
Locktite  
222

# 3

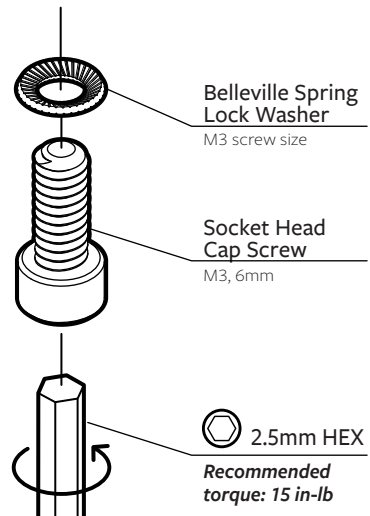
## 7.

### Side Cameras (Camera #01-14)

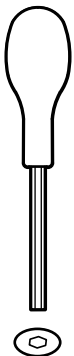
**i** **Assembly Note**  **180°**  
Flip 180° to tighten screws



**56x**



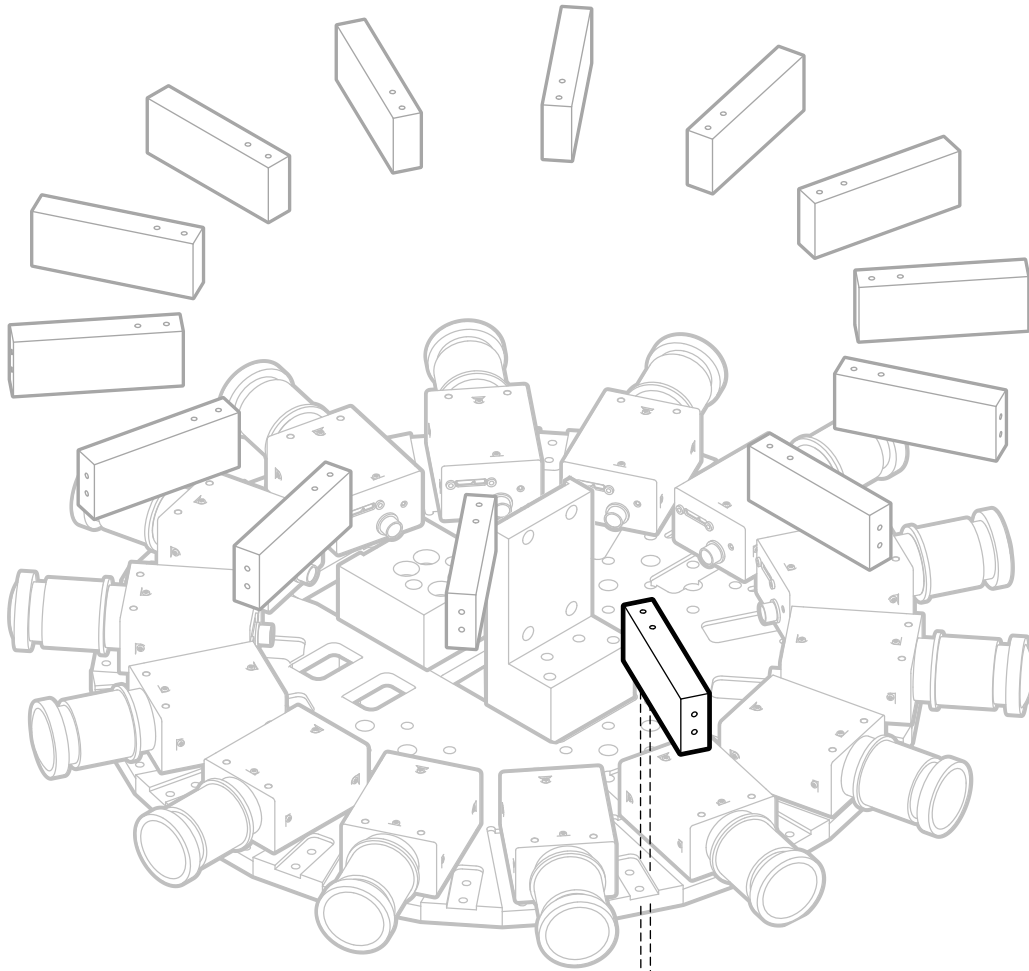
2.5mm  
HEX



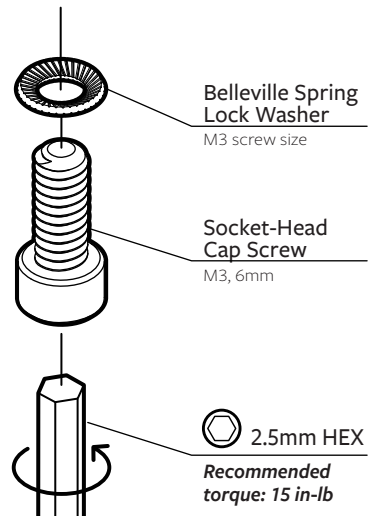
# 3

## 8. Blocks

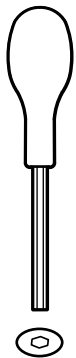
**i** Assembly Note **180°**  
Flip 180° to tighten screws



**28x**



2.5mm  
HEX



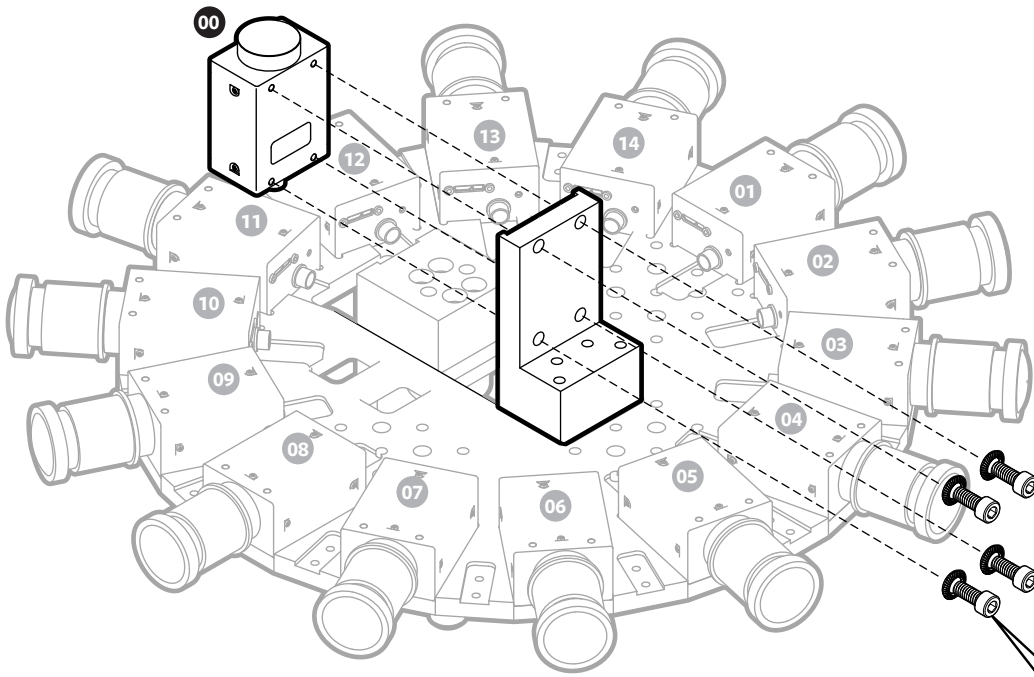
2.5mm HEX  
Recommended  
torque: 15 in-lb



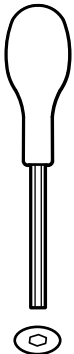
# 3

## 9.

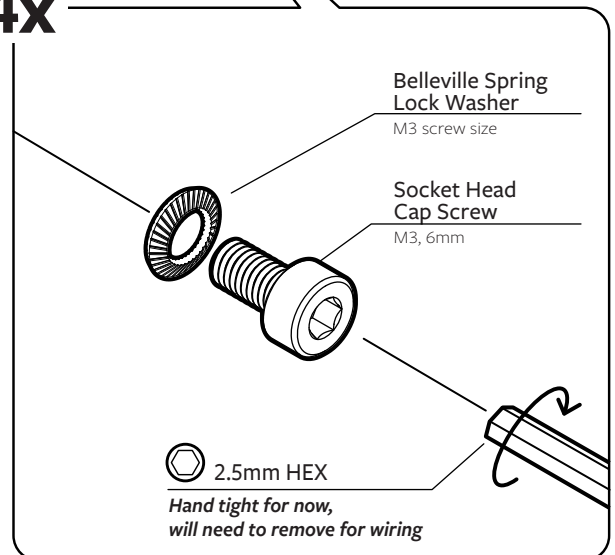
### Top Camera (Camera #00)



2.5mm  
HEX



4x

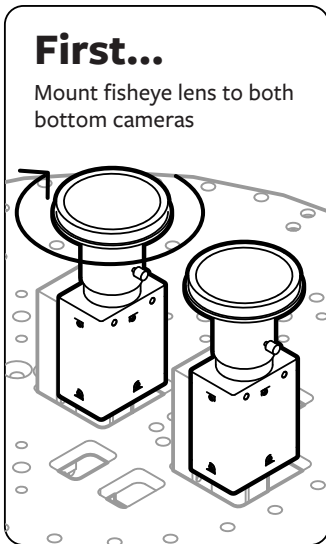


# 3

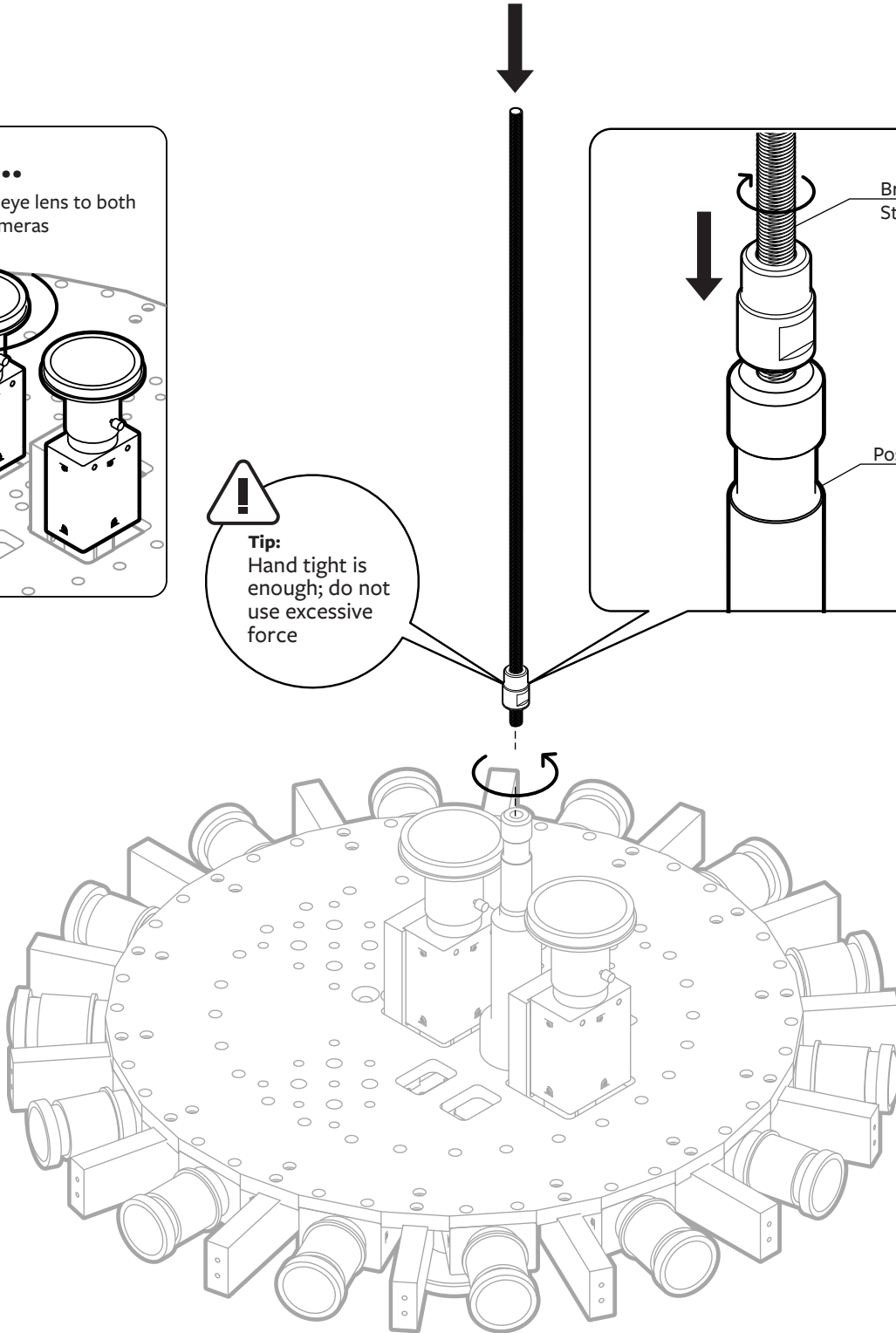
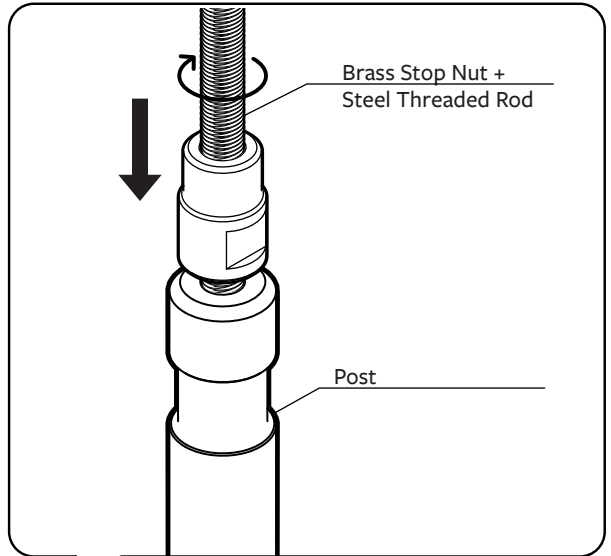
## 10.

### Threaded Rod & Stop Nut

**i** **Assembly Note**  $180^\circ$   
Flip  $180^\circ$  for this step



**Tip:**  
Hand tight is enough; do not use excessive force



# 3

## 11.

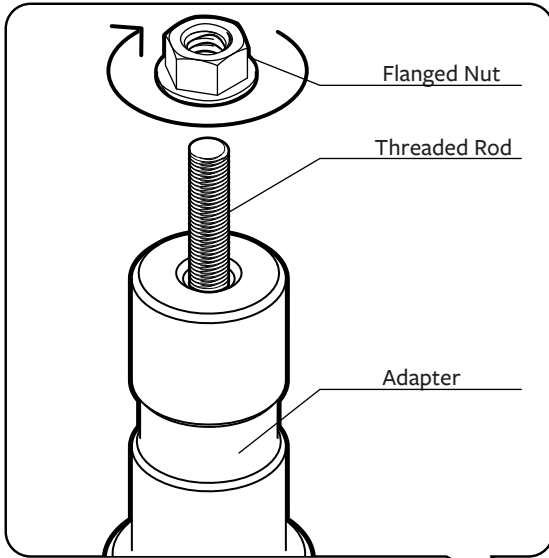
### Tube & Adapter



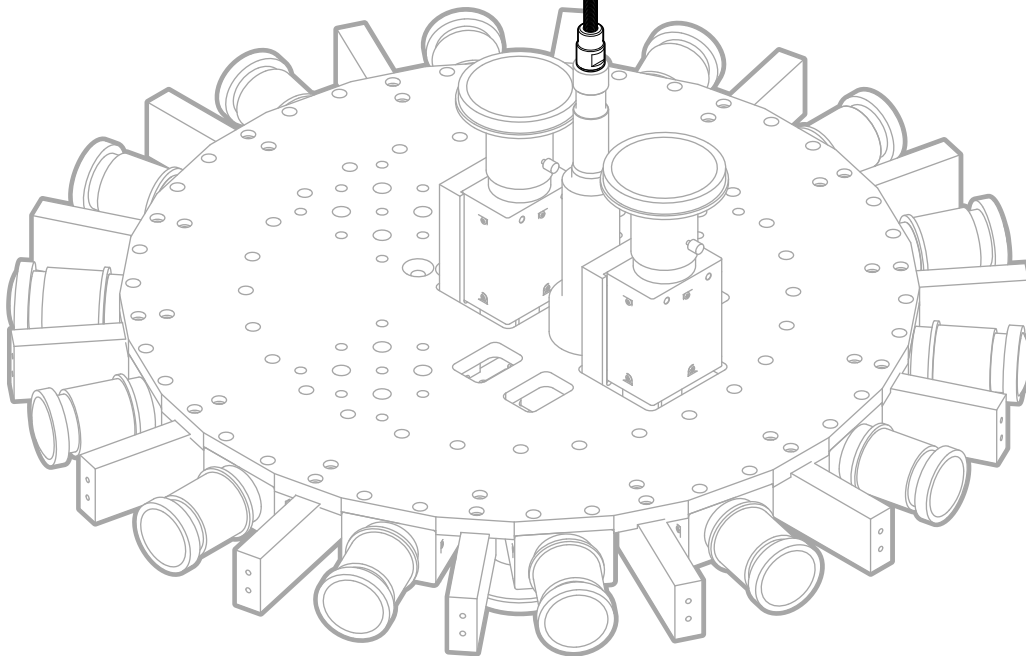
**Assembly Note**

180° ↻

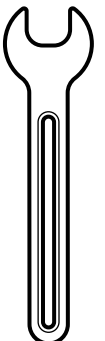
Flip 180° for this step



**Tip:**  
Be careful not to overtighten flange nut



9/16"  
Wrench

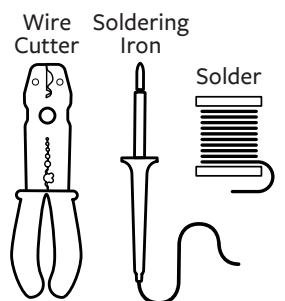
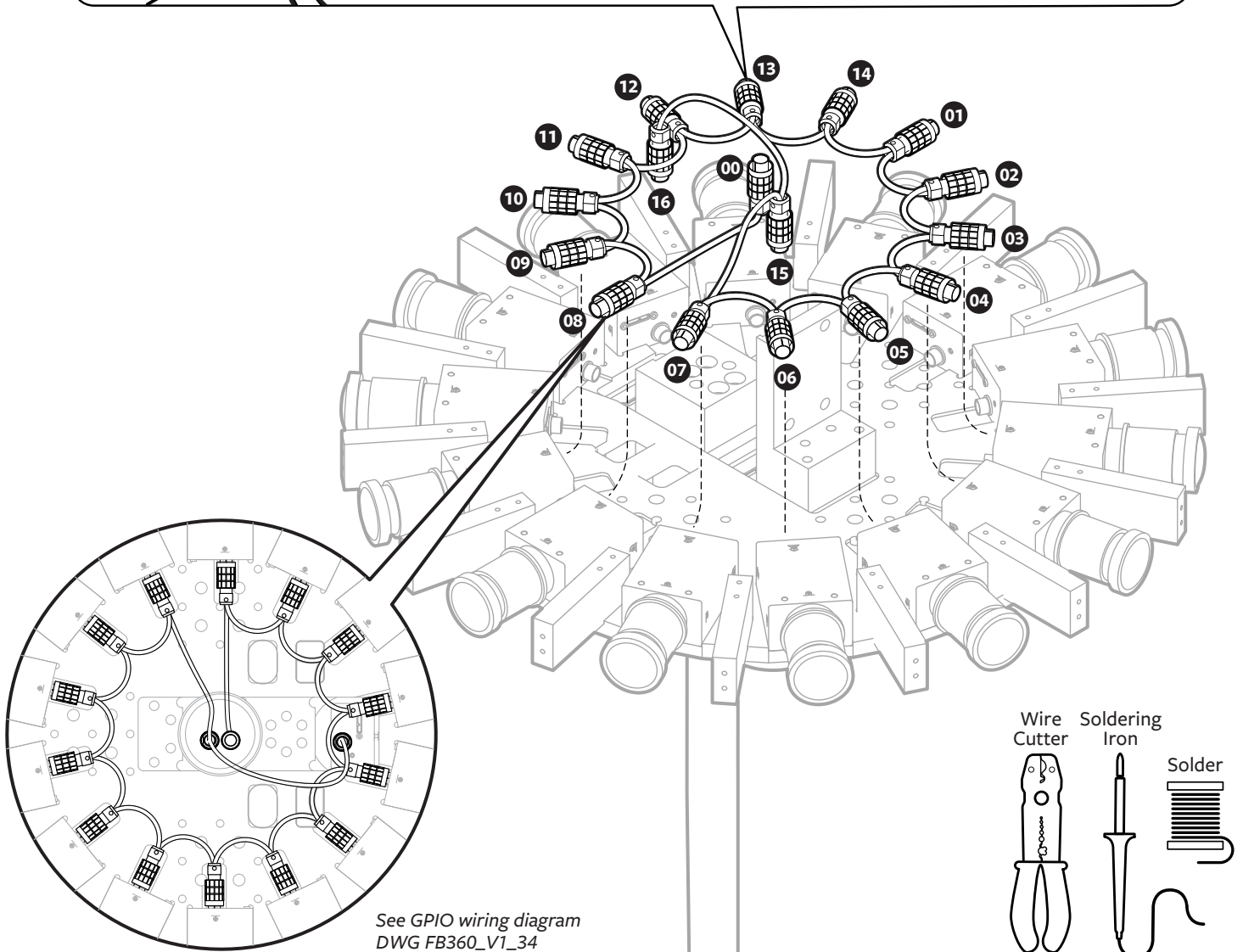
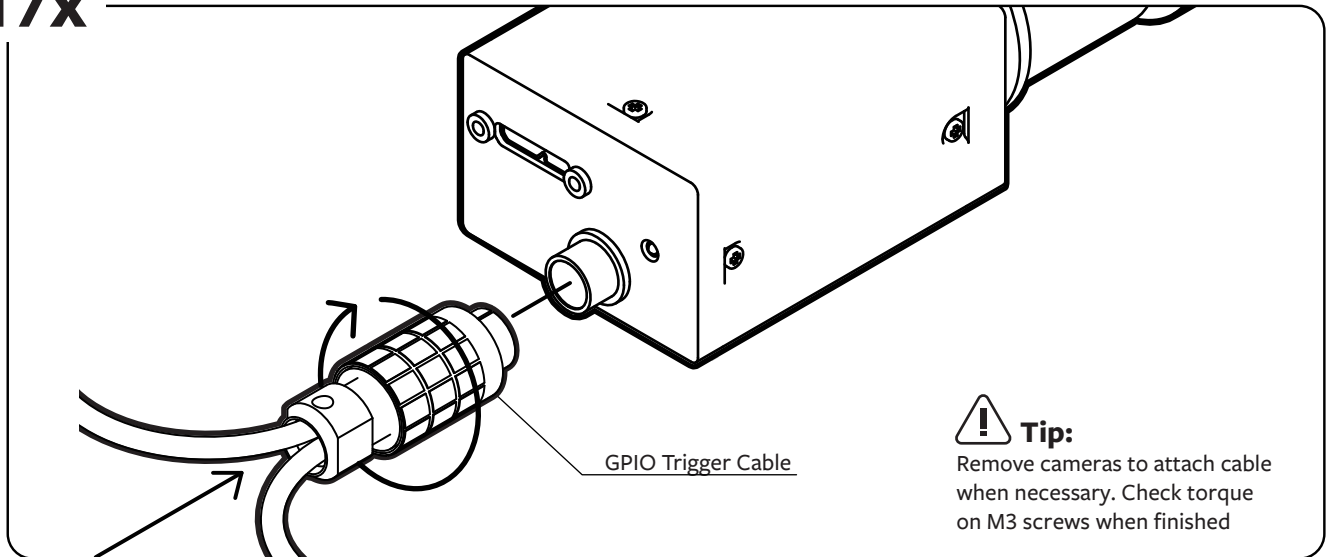


# 3

## 12.

### GPIO Trigger Cable

17x

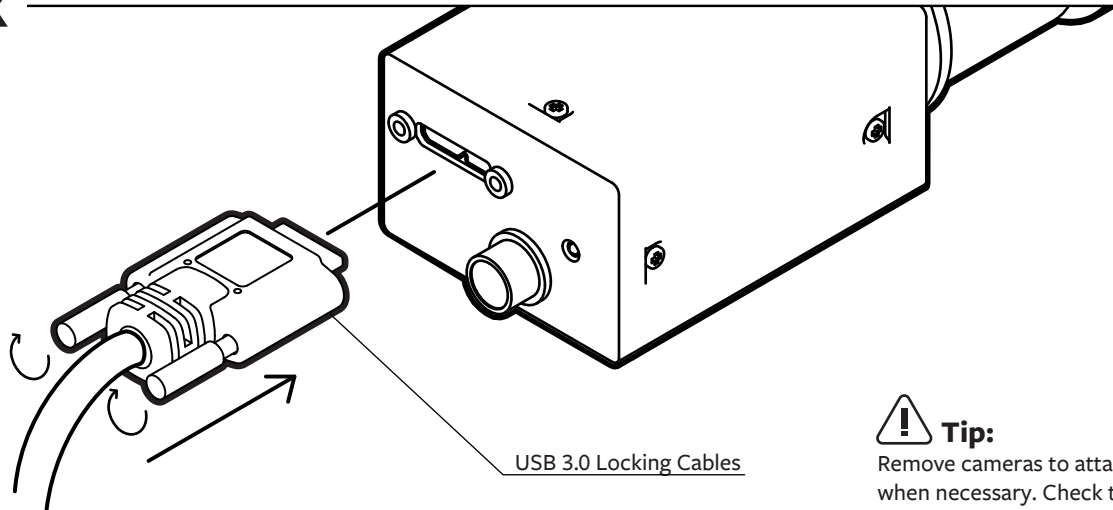


# 3

## 13.

### USB 3.0 Cables

17x



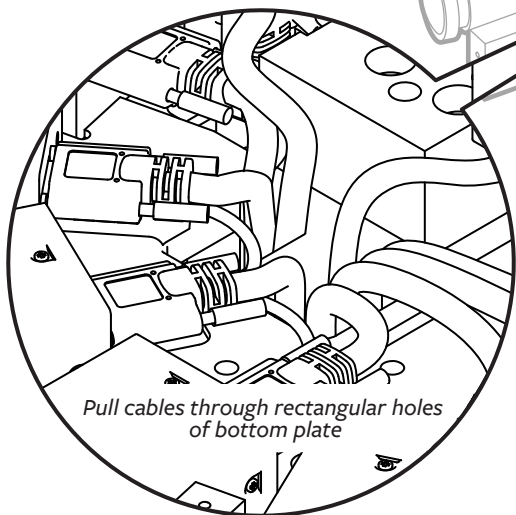
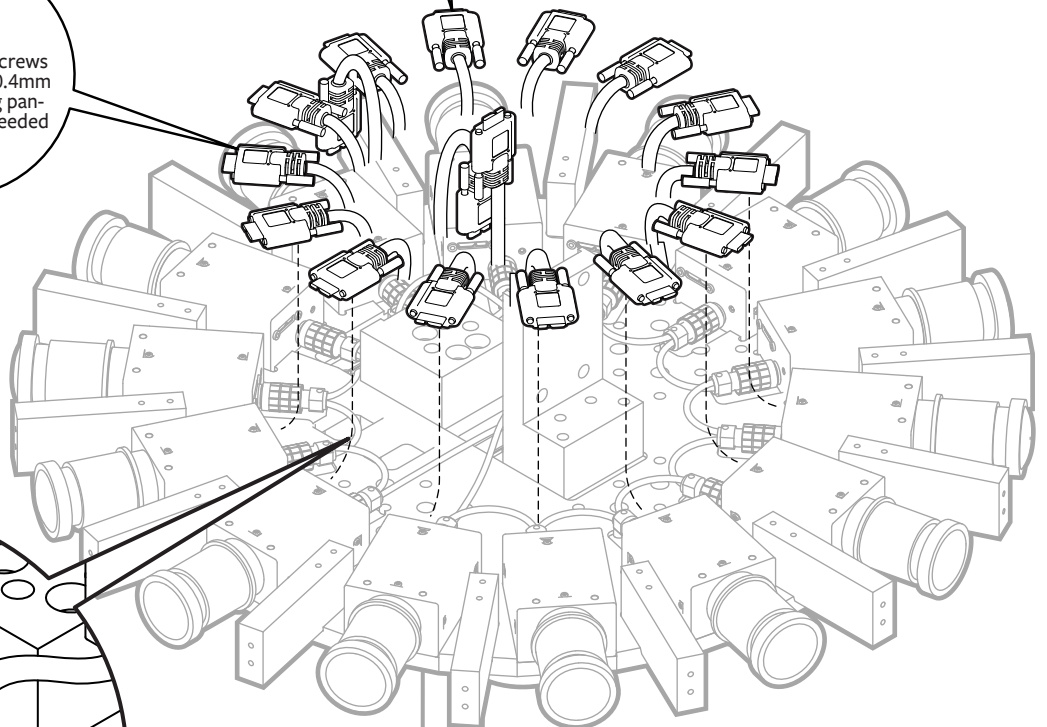
**Tip:**

Remove cameras to attach cable when necessary. Check torque on M3 screws when finished



**Tip:**

Replace locking screws with M2 thread, 0.4mm pitch, 20mm long pan-head screws as needed



**Assembly Note**

Label USB cables with camera number

# 3

## 14.

### Bottom Shell

14x

M3 Flanged  
Button-Head  
Socket Cap Screw  
M3, 10mm

2mm HEX  
Hand tight

**Tip:**

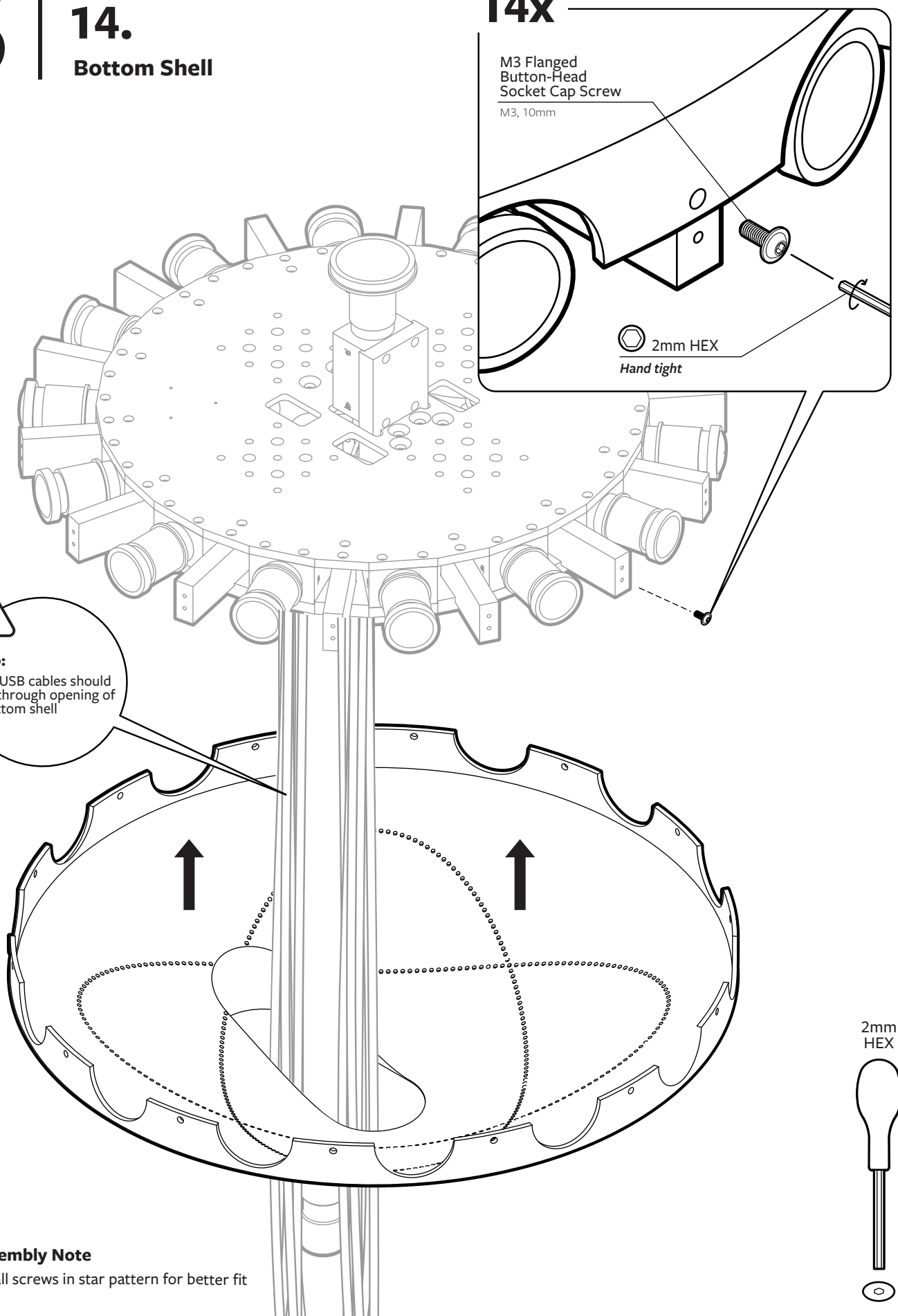
All USB cables should fit through opening of bottom shell

2mm  
HEX



**Assembly Note**

Install screws in star pattern for better fit



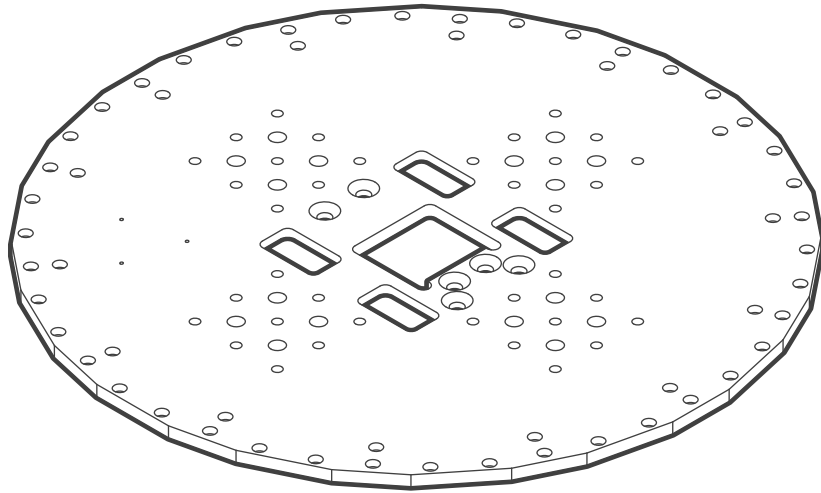
# 3

## 15. Top Plate



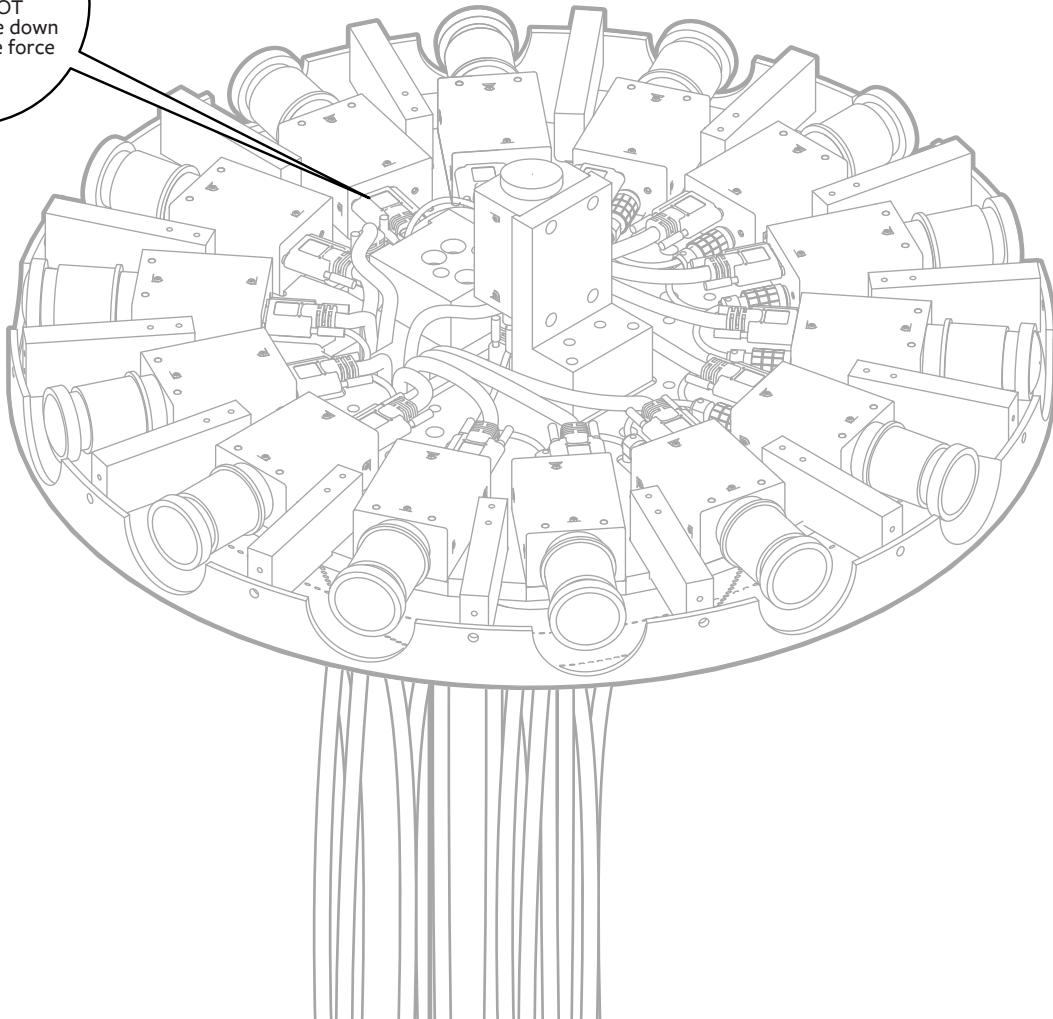
### Assembly Note

Optional: Connect cameras to computer to test first



#### Tip:

Make sure all cables fit well. DO NOT push top plate down with excessive force



# 3

## 16.

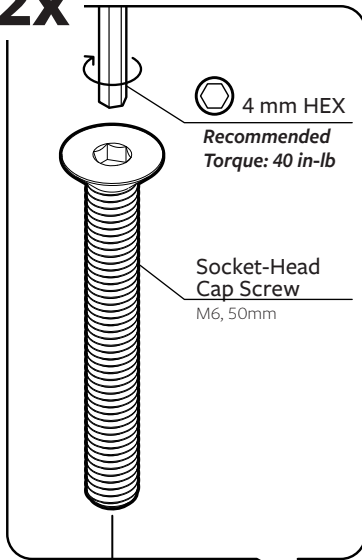
### Top Plate Hardware



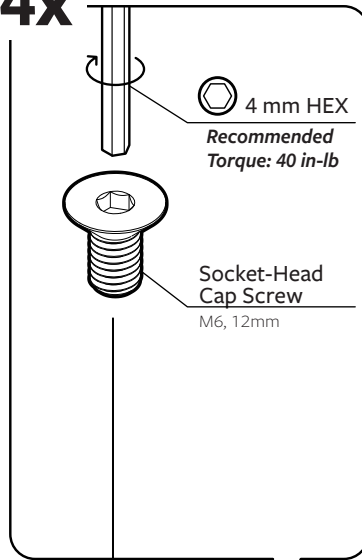
#### Assembly Note

Install M3 socket-head cap screws in star pattern for better fit

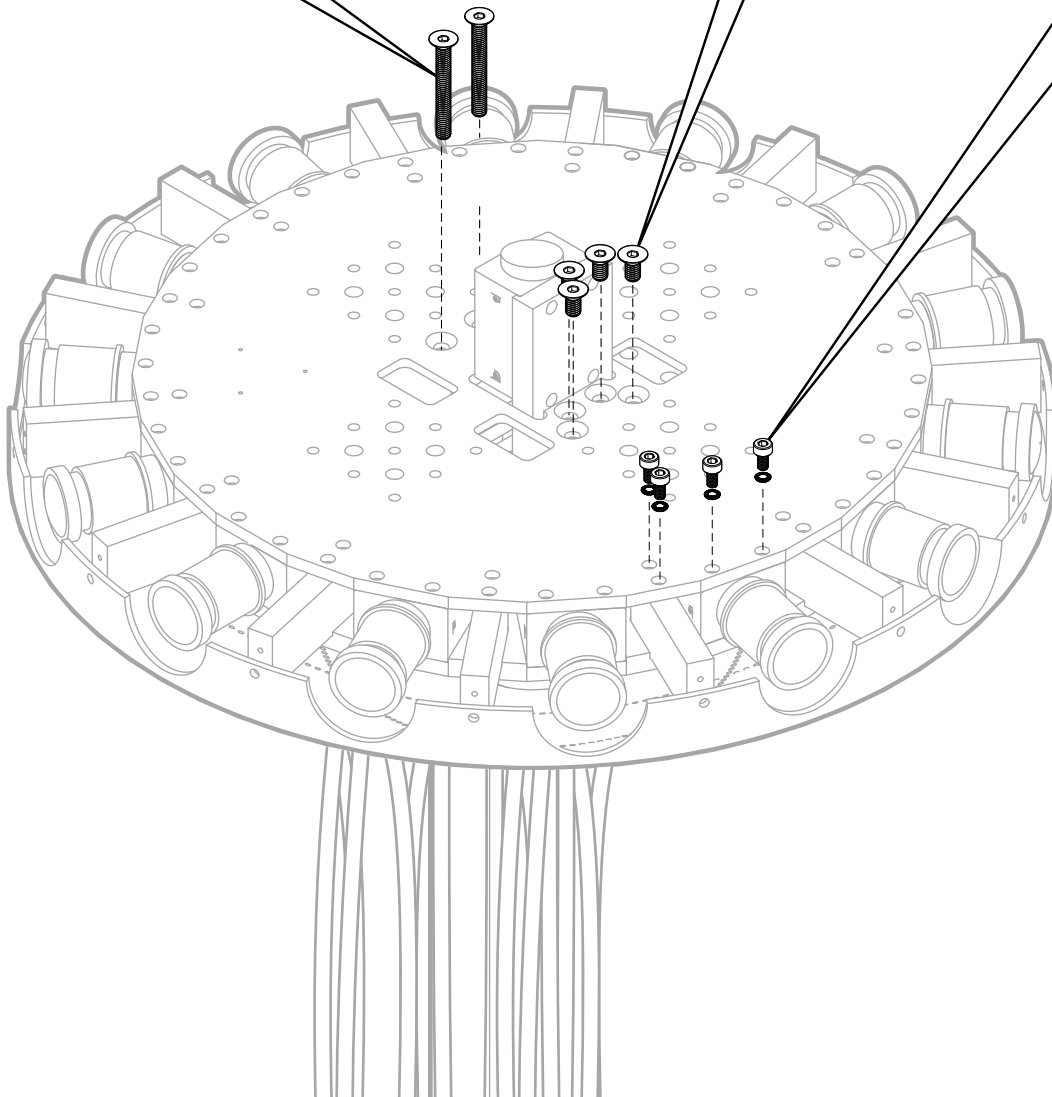
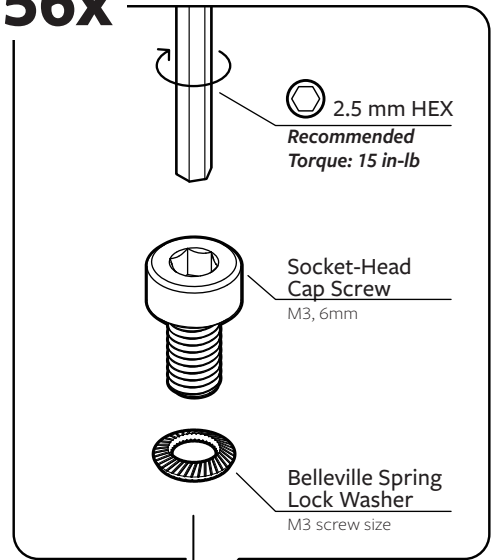
2x



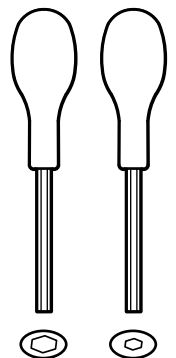
4x



56x



4mm HEX    2.5mm HEX





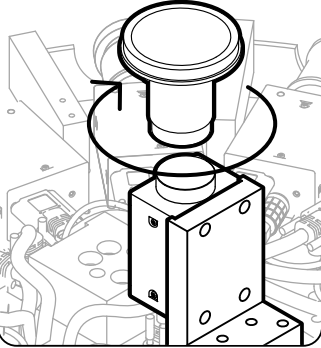
# 3

## 17. Top Shell

**i** **Assembly Note**  
Install screws in star pattern for better fit

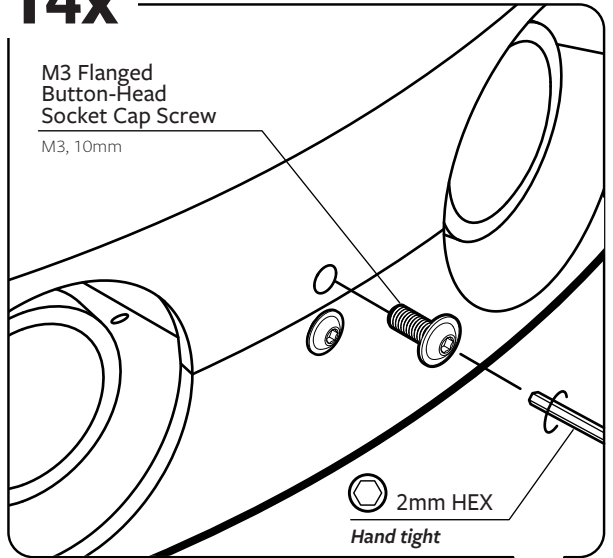
### First...

Mount fisheye lens to top camera before putting shell on

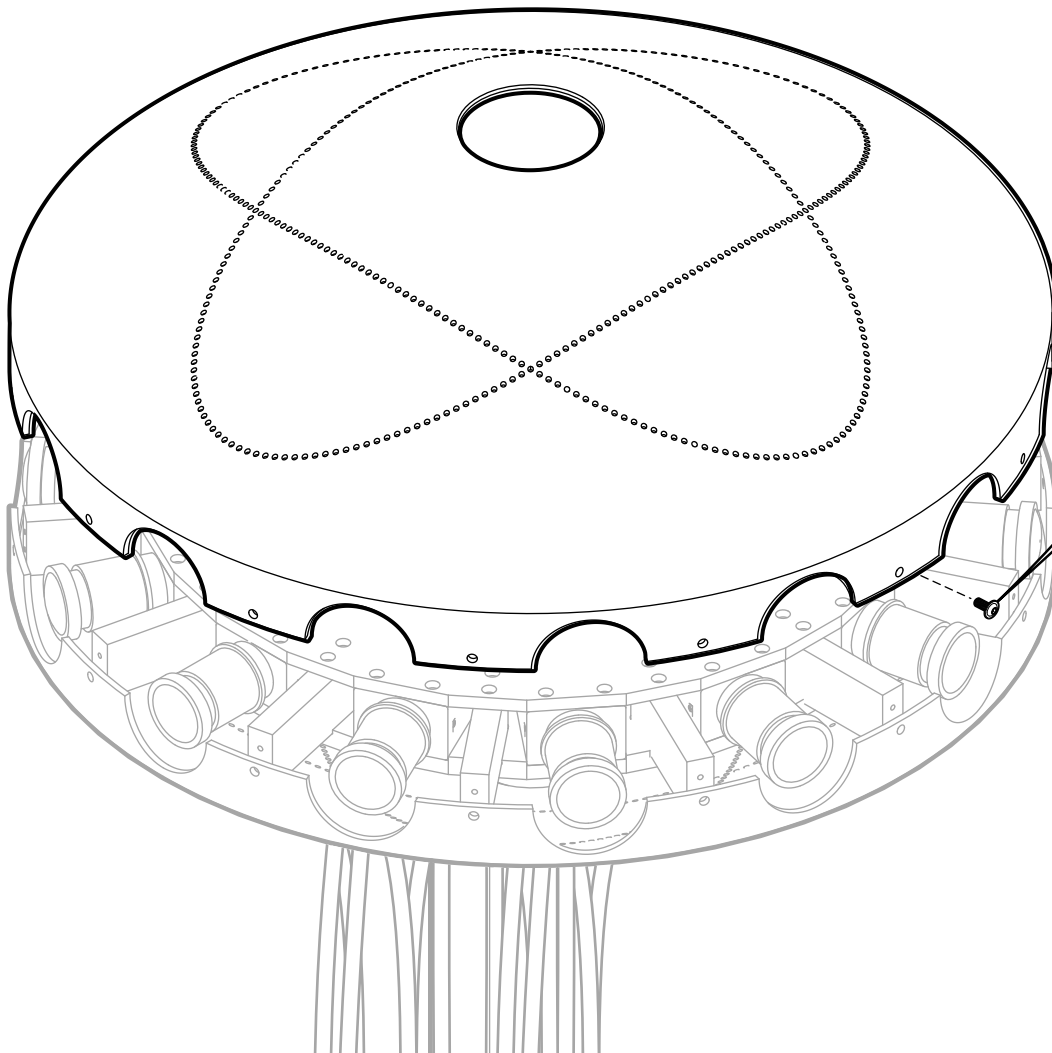


### 14x

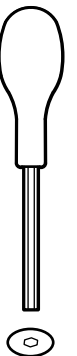
M3 Flanged  
Button-Head  
Socket Cap Screw  
M3, 10mm



2mm HEX  
Hand tight



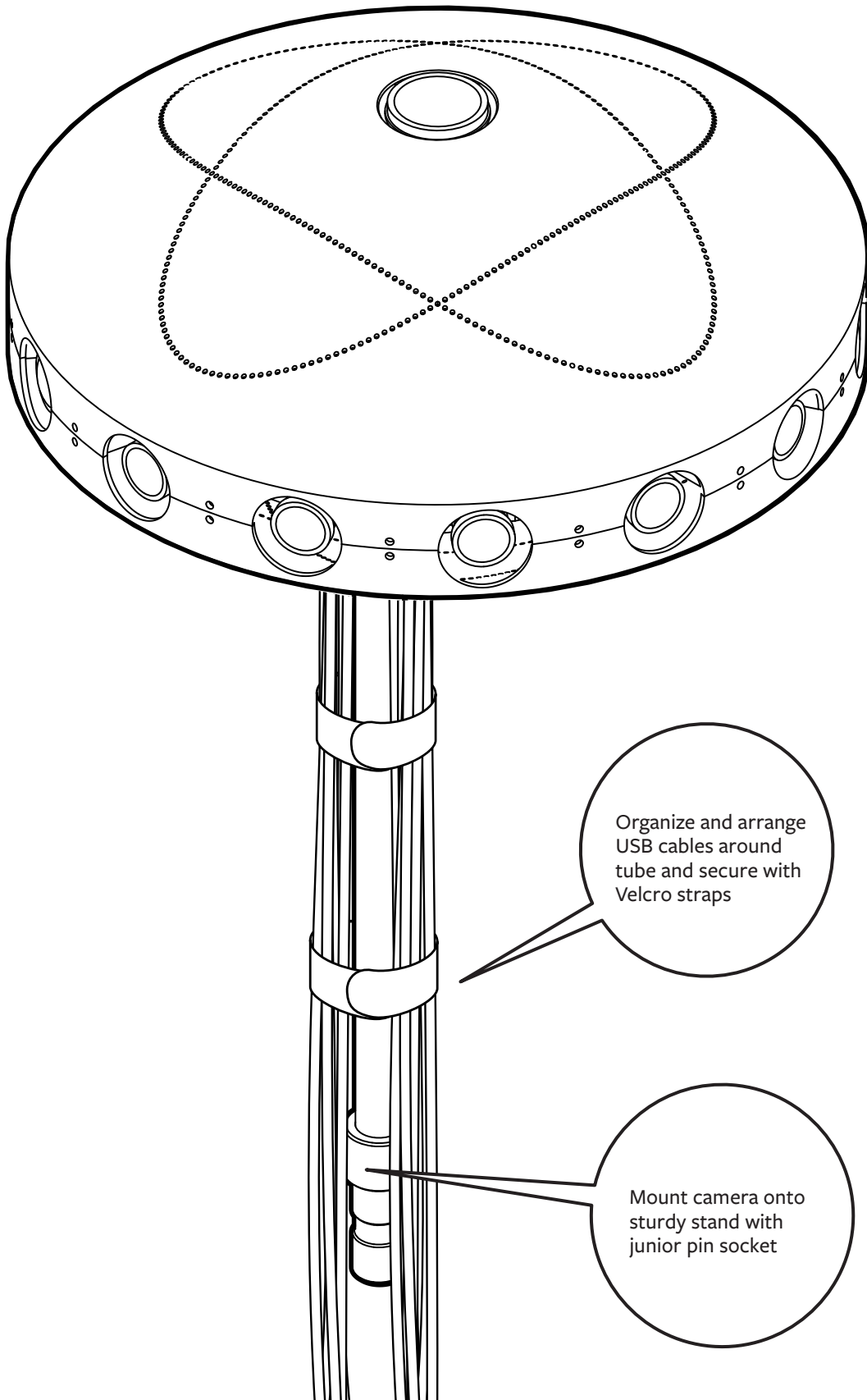
2mm  
HEX



# 3

## 18.

### Cable Management & Stand



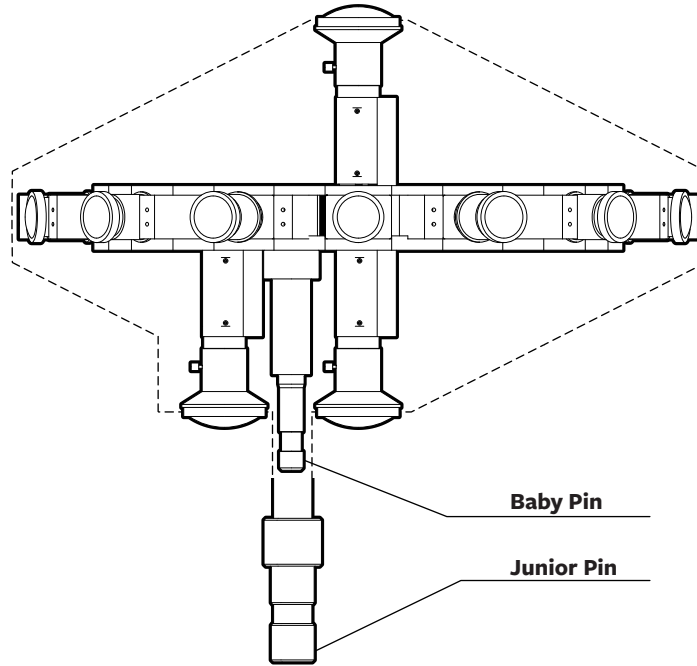
**4**

**Camera Info**

# 4

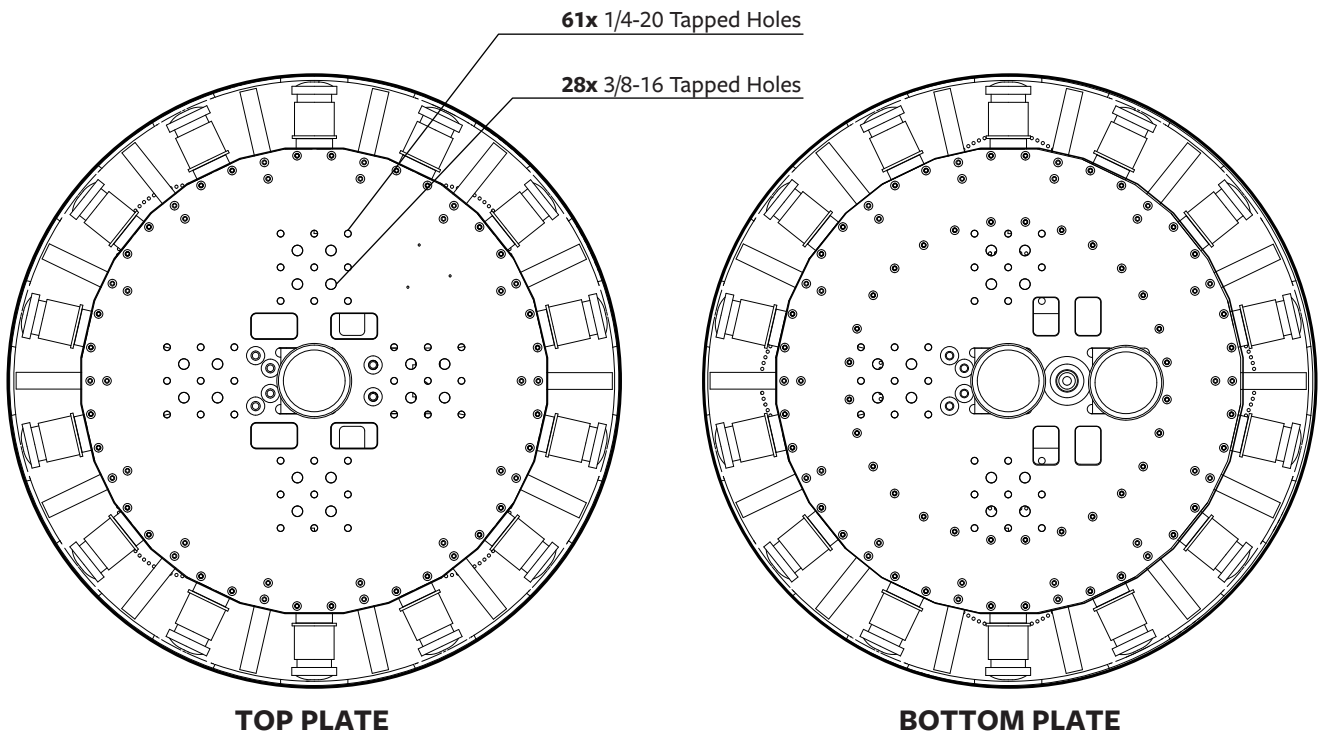
## 1a.

### Mounting the Camera to Standard Grip Equipment



## 1b.

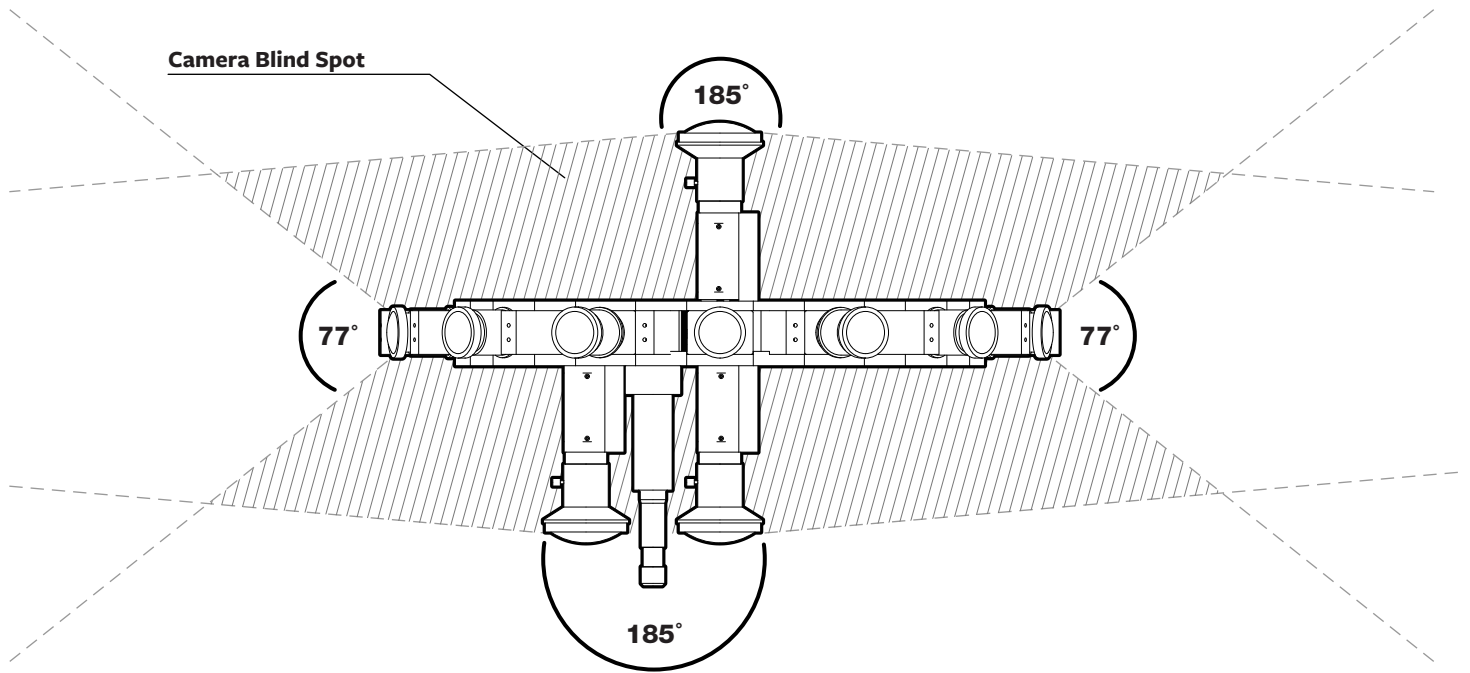
### Attachment Options 89 MULTIPURPOSE MOUNTING HOLES



# 4

## 2a.

### Blind Spot for Mounting Accessories



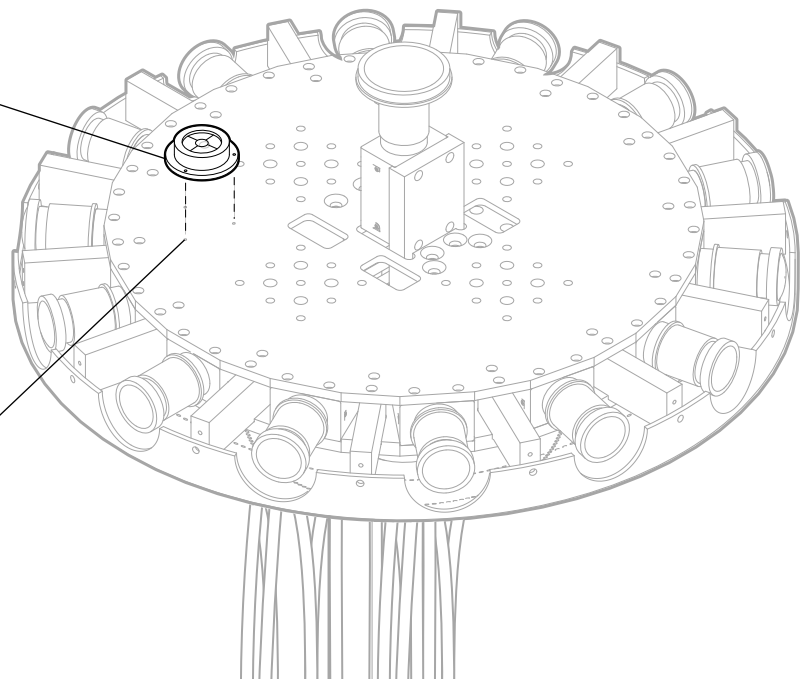
## 2b.

### Bull's-Eye Level (Optional)

#### Surface mount bull's-eye level

1-3/4" Base Diameter (McMaster-Carr #2198A87)

Tapped Holes - M2 Thread, 0.4 pitch



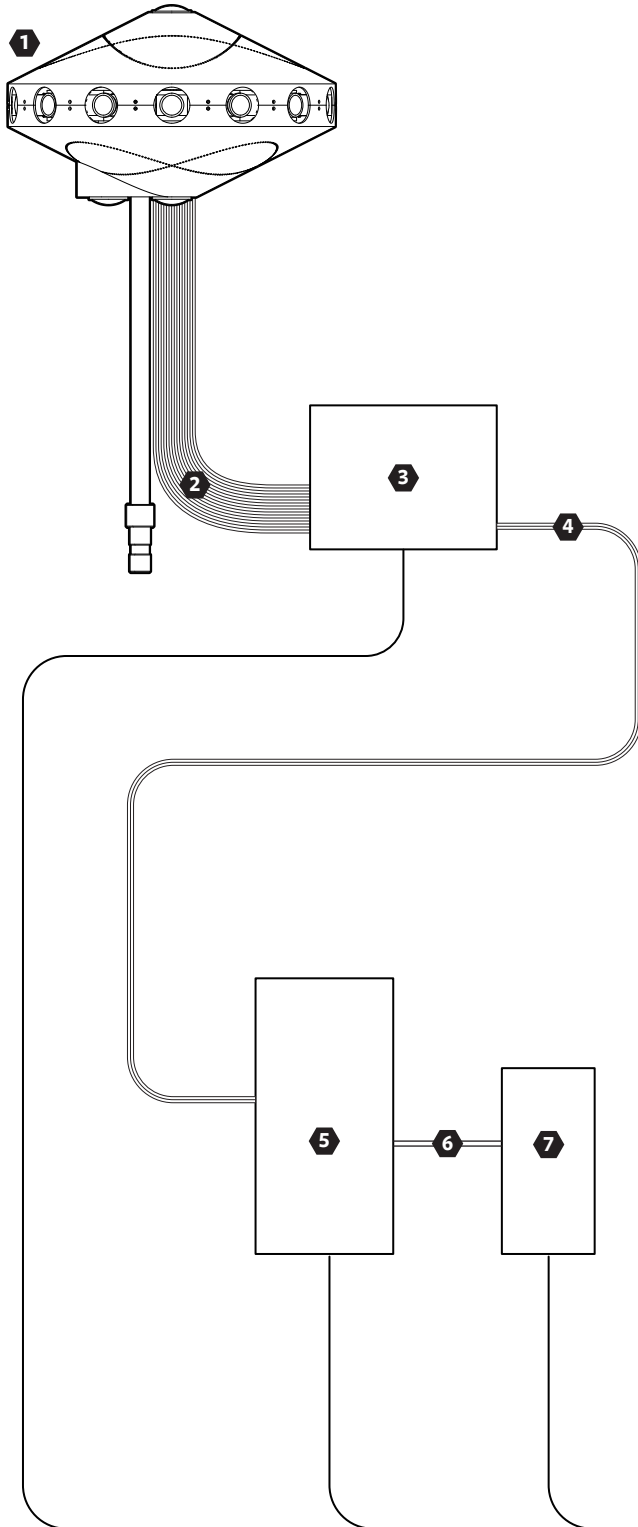
# 5

## System Set Up Instructions

# 5

## 1.

### Surround 360 System Overview



#### SURROUND 360 SYSTEM with Fiber Optic Extension

- 1 Surround 360 Camera
- 2 USB 3.0 High Speed Type A to Micro-B Cables x17
- 3 Fiber Optic Breakout Box
- 4 PCIe x8 Active Optical Cable
- 5 Lunchbox Computer (Computer)
- 6 SFF-8644 to SFF-8644 MiniSAS Cable x2
- 7 Raid Tower
- 8 Power Supply

#### 1 SURROUND 360 Camera

- 17x Point Grey Grasshopper Cameras
- 14x Wide-Angle Lenses
- 3x Fisheye Lenses
- GPIO Trigger Cable

#### 3 FIBER OPTIC BREAKOUT BOX

- 1x Backplane With Power Supply
- 5x PCIe x4, 4 Ports USB 3.0 Expansion Card
- 1x PCIe x16 Host Interface Card

#### 5 COMPUTER SPECIFICATIONS

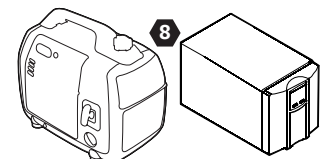
- Intel Core i7-5960X Haswell-E 8-Core 3.0 GHz LGA 2011-v3\*
- GIGABYTE GA-X99P-SLI (rev. 1.0) LGA 2011-v3 Intel X99 Motherboard\*
- 8GB DDR4 2400 288-PIN Memory ± (64GB of Memory Installed)\*
- CPU COOLING FAN FOR LGA 2011-v3\*
- 1GB NVIDIA PCIe x16 VIDEO CARD\*
- 700 WATT POWER SUPPLY\*
- 2.5" 128GB SSD\*
- OPERATING SYSTEM - UBUNTU 14.04 LTS†

#### 7 RAID TOWER SPECIFICATIONS

- 8 x 1TB SSD RAID: 1 Hour of Continuous Raw Video Capture (Bandwidth: 2.1 GB/s)

#### 8 POWER SUPPLY

- 110V AC
- 350W max.
- Alternative Options: UPS Backup Battery or Quiet Generator



\* Recommended  
† Required

# 5

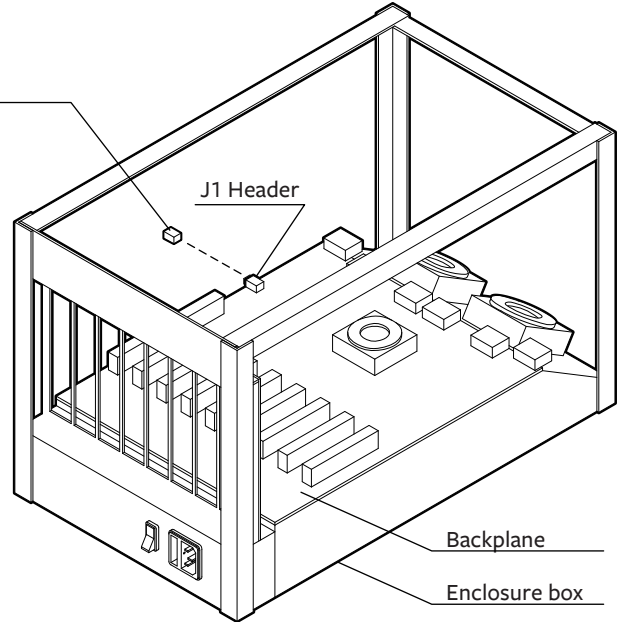
## 2a.

### Fiber Optic Breakout Box

#### STEP 1

Insert jumper to a header on the backplane labeled J1

**Shunt Jumper**  
0.196" x 0.247"(w x h)  
0.100" Pitch  
Au(30) over Ni(50)  
RoHS Compliant

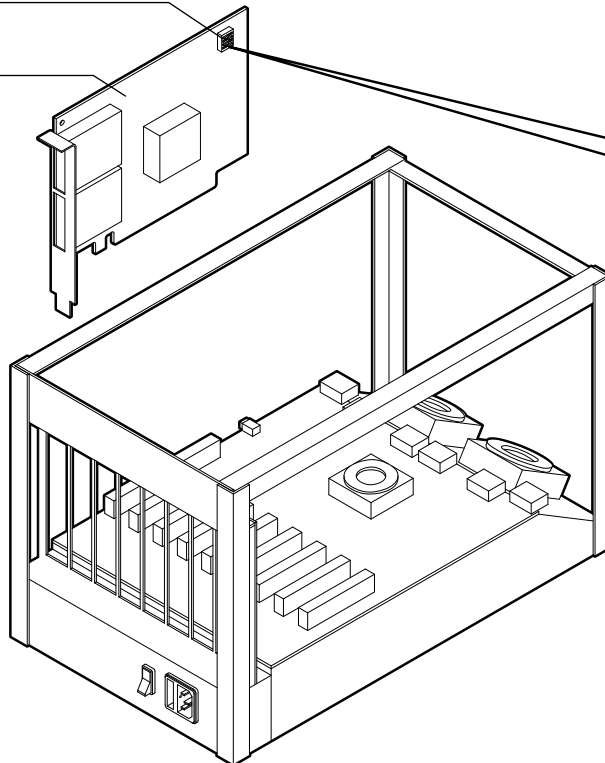


#### STEP 2

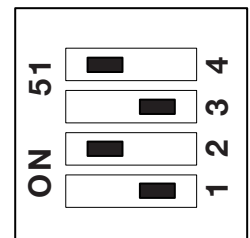
Insert PCIe x8 Gen 3 cable adapter and set dip switch setting

Dip Switch

Cable Adapter



#### Dip Switch Setting





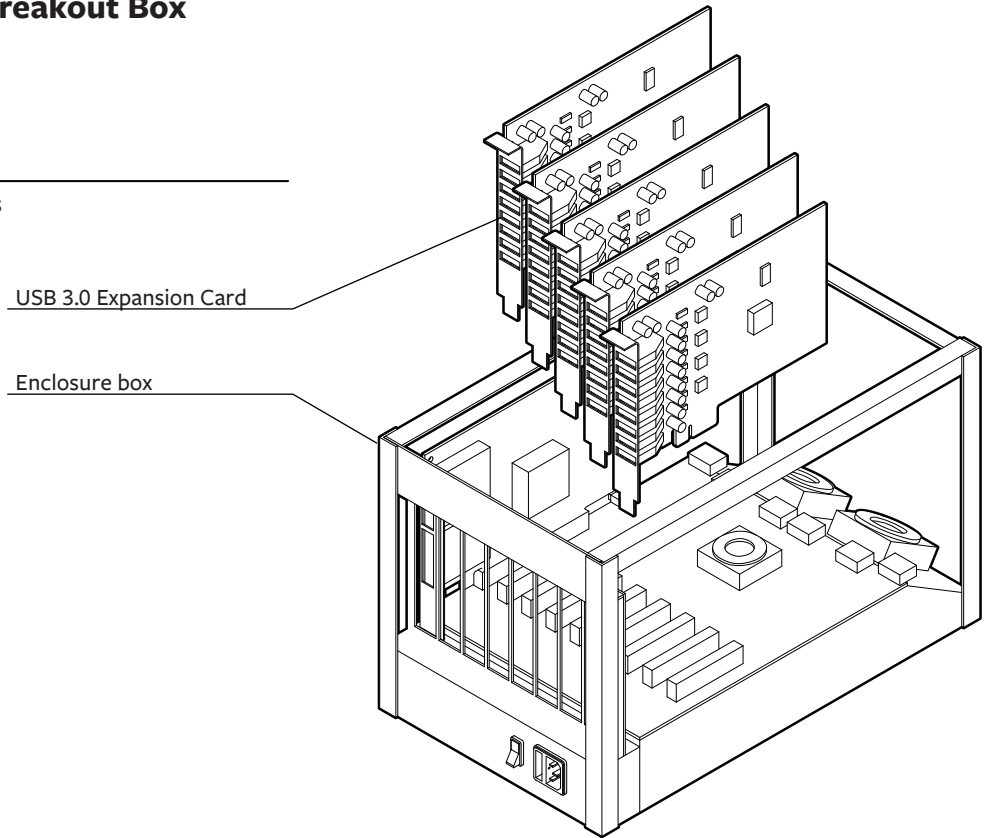
# 5

## 2b.

### Fiber Optic Breakout Box

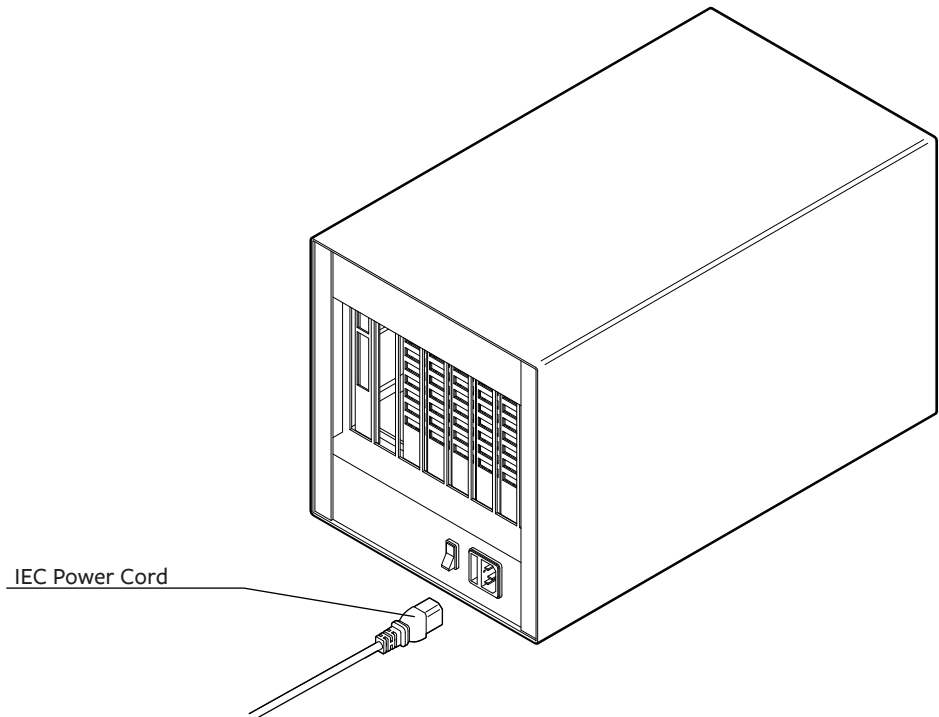
#### STEP 3

Insert 5 PCIe x4 USB 3.0 Expansion Cards



#### STEP 4

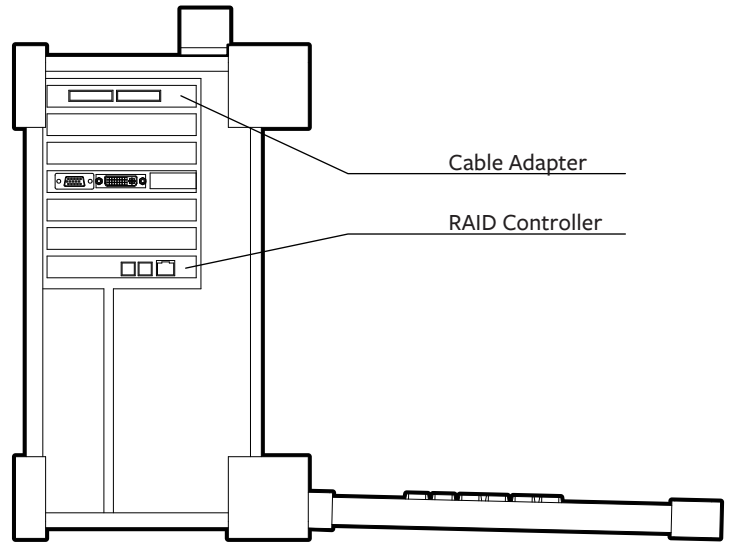
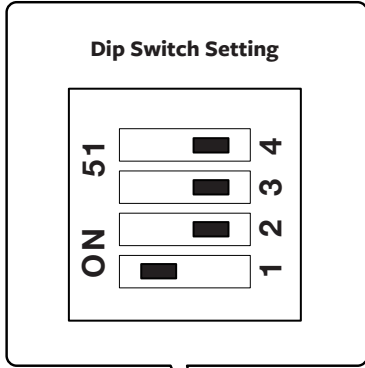
Close enclosure and connect power cable



# 5

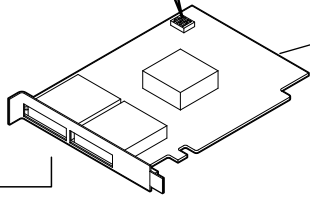
## 3.

### Computer - Lunchbox PC



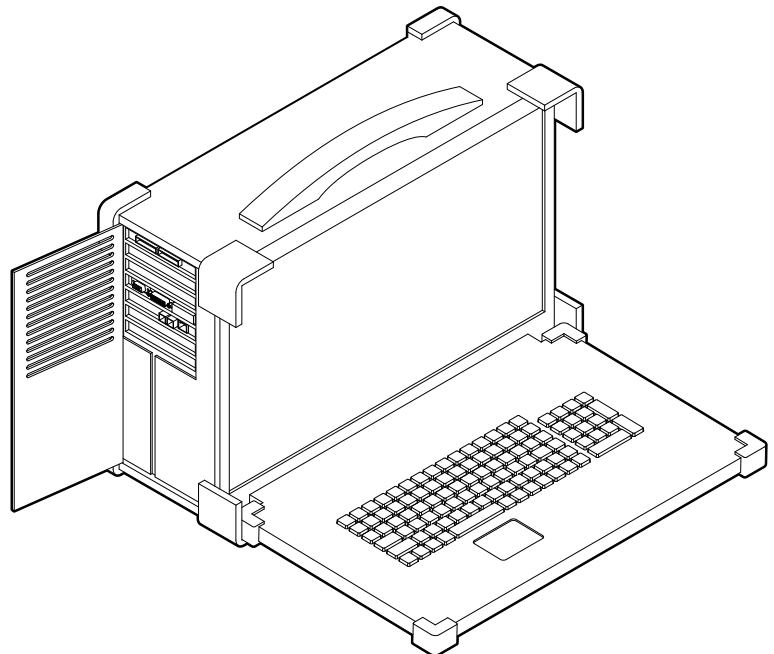
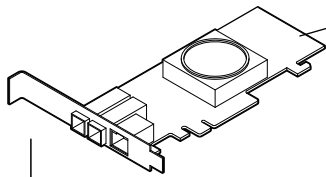
#### STEP 1

Insert PCIe x8 Gen 3 cable adapter and set dip switch setting



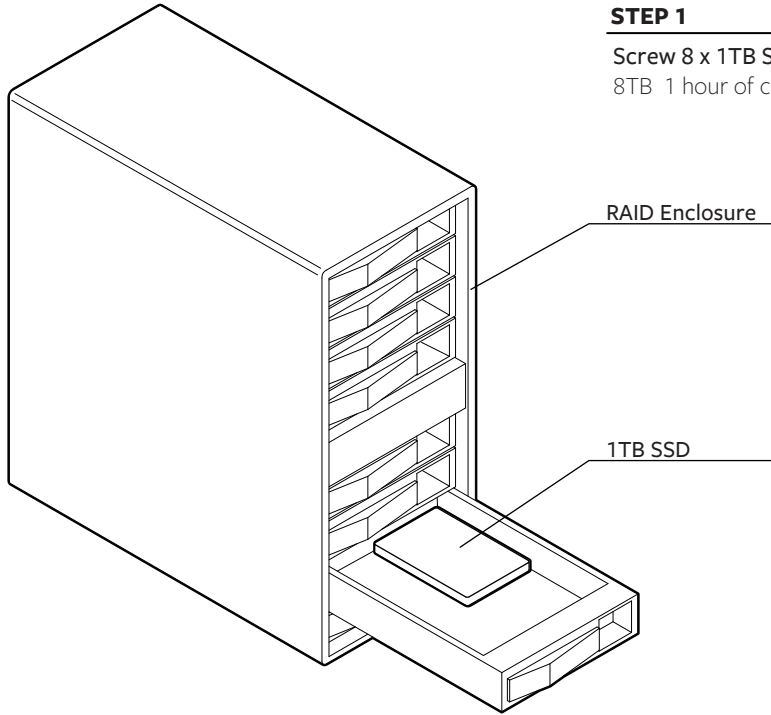
#### STEP 3

Insert PCIe x8 Gen3 SAS RAID controller



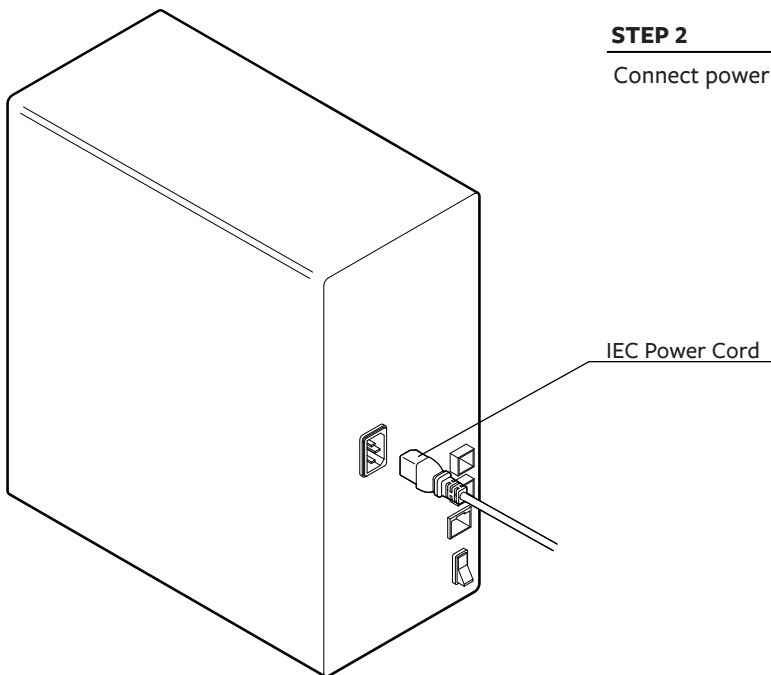
# 5

## 4. RAID Tower



### STEP 1

Screw 8 x 1TB SSDs into enclosure  
8TB 1 hour of continuous raw video capture



### STEP 2

Connect power cable

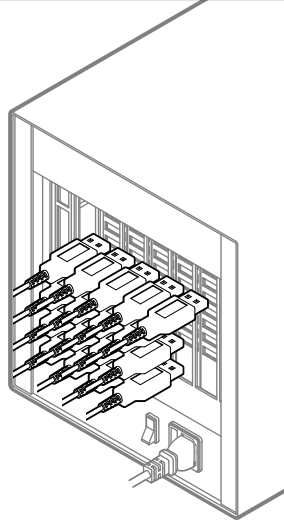
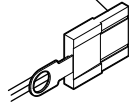
# 5

## 5. Cable Connections

### Fiber Optic Breakout Box

#### PCIe x8 Active Optical Cable

Connect TARGET end to adapter card top slot (furthest from backplane)

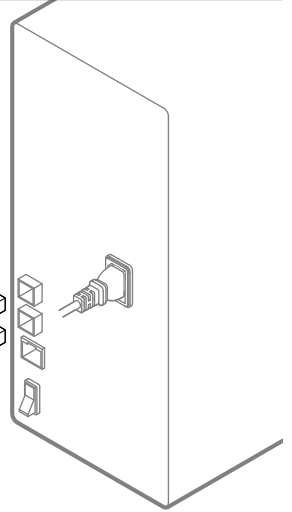
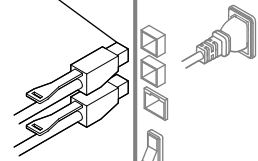


#### 17 x USB 3.0 Cables

Plug camera USB 3.0 cables:  
4 per adapter, every other slot,  
extra one any slot on remaining card

### RAID Enclosure

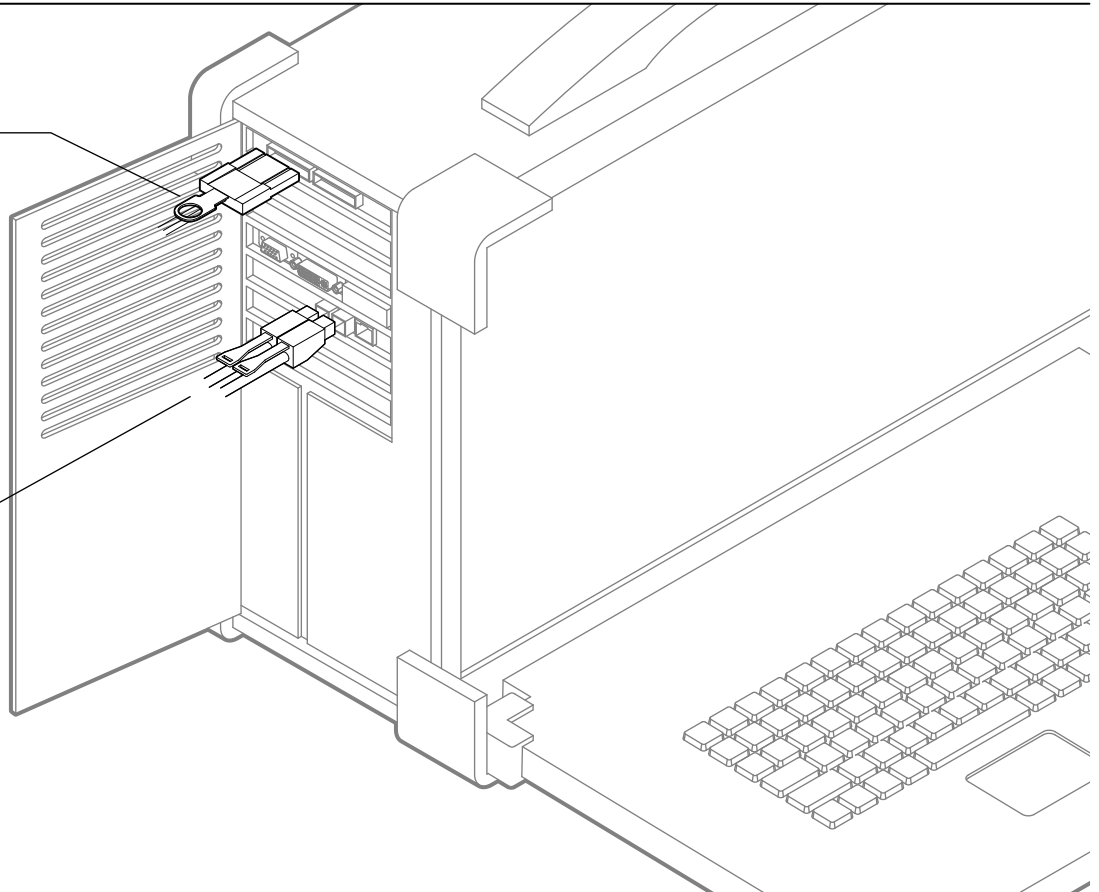
#### External 4x HD Mini-SAS Cable



### Computer

#### PCIe x8 Active Optical Cable

Connect HOST end to adapter card left slot (furthest from display)



#### External 4x HD Mini-SAS Cable

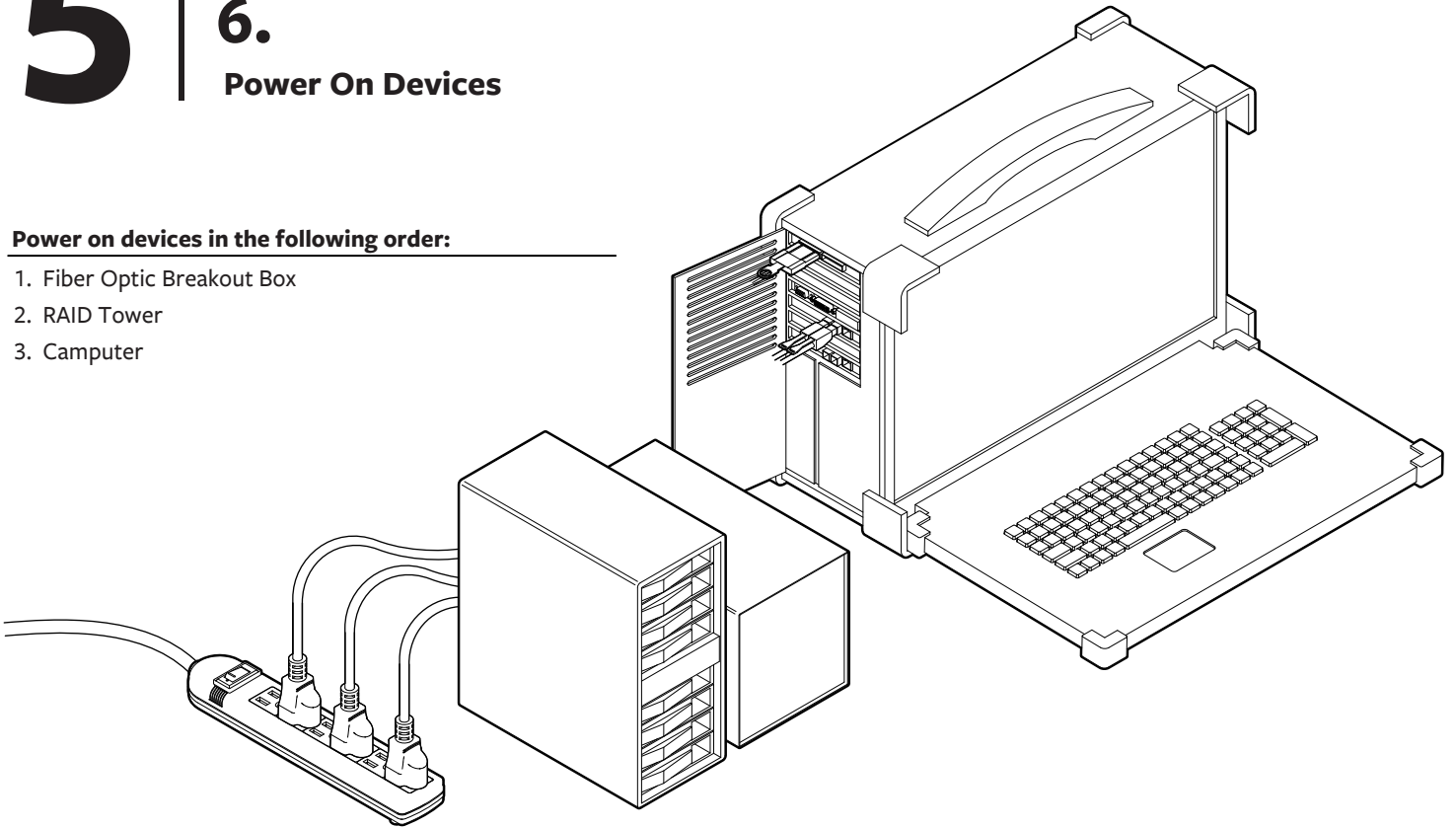
# 5

## 6.

### Power On Devices

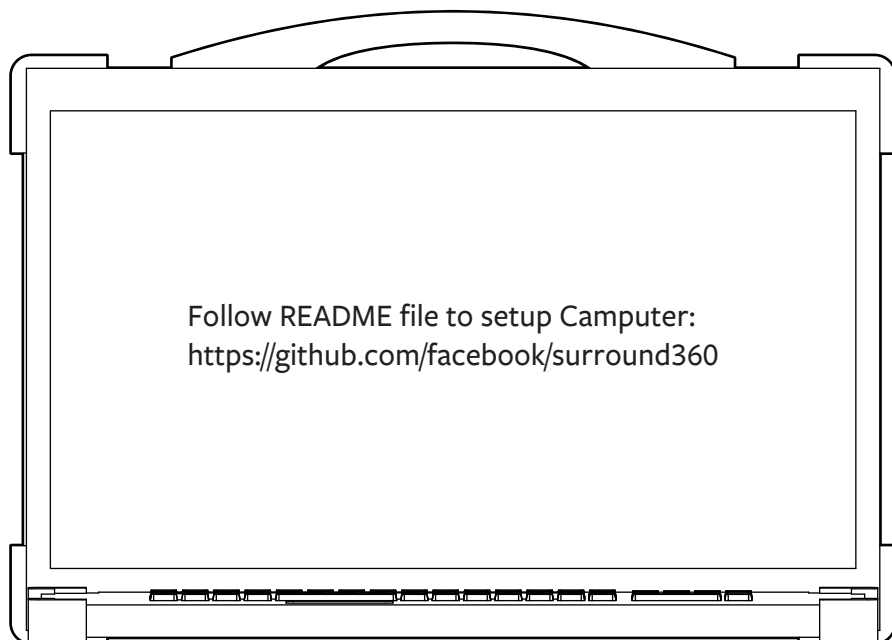
**Power on devices in the following order:**

1. Fiber Optic Breakout Box
2. RAID Tower
3. Computer



## 7.

### Set Up Surround 360 Camera Control Software



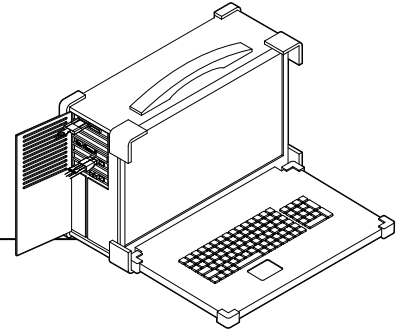
# 6

## Capturing & Rendering Instructions

# 6

## 1a.

### How to Capture with Web GUI



#### Step 1. Start Preview

To access the web GUI, open a browser (Chrome preferred; no Safari) and navigate to <http://localhost>

The web capture GUI provides all of the controls necessary to operate the Surround 360 and preview live images from any 4 of its 17 camera

The screenshot shows a web browser window at <http://localhost>. The main interface is titled "Record Video" and includes several control sections:

- Actions:** Two buttons, "Start Preview" and "Reset Params", are located at the top right of the "Record Video" section.
- Label:** A text input field containing the value "146888778".
- Duration of Capture:** A time selection interface with "0 min" and "30 sec" displayed, and a "20.000 ms" input field.
- Shutter Speed:** A slider and an input field showing "20.000 ms".
- Gain:** A slider and an input field showing "0.000 dB".
- Preview:** A section titled "Choose 4 cameras:" with a grid of checkboxes for cameras 0 through 16. Cameras 1, 2, 3, and 4 are selected.
- Preview Panels:** A 2x2 grid of panels, each labeled "PREVIEW IMAGE FROM CAMERA 1" through "CAMERA 4".

Callout boxes provide additional information:

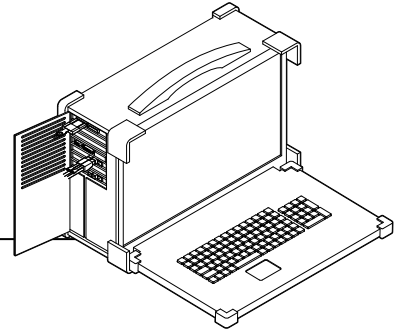
- Actions:** - Start preview  
- Reset previously set parameters
- Label:** - Folder & file prefix (must be unique)
- Duration of Capture:** - in milliseconds  
- DO NOT go longer than 20 ms (1/50 second)  
- for a 180° shutter angle at 30 fps, target 16.7 ms
- Shutter Speed:** - in milliseconds  
- DO NOT go longer than 20 ms (1/50 second)  
- for a 180° shutter angle at 30 fps, target 16.7 ms
- Gain - in dB:** - in general, use 0dB  
- try hard not to go above 3dB
- Select Preview Cameras:** Up to 4 cameras
- Preview Panels:** (points to the 2x2 grid)

At the bottom of the page, there are sections for "Latest Video Stats" and "Latest Previews".

# 6

## 1b.

### Start Recording



#### Step 2. Start Recording

GUI control changes once you hit the start program button.

You will be able to stop the capture and update the live preview while the camera is capturing.

Record Video

Label

min  sec

Shutter  20.000 ms

Gain  0.000 dB

**Actions :**

- Stop preview
- Start recording
- Update preview with new parameters

**Preview**

Choose 4 cameras:

<input type="checkbox"/> 0	<input checked="" type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input checked="" type="checkbox"/> 3
<input checked="" type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7
<input type="checkbox"/> 8	<input type="checkbox"/> 8	<input type="checkbox"/> 10	<input type="checkbox"/> 11
<input type="checkbox"/> 12	<input type="checkbox"/> 17	<input type="checkbox"/> 14	<input type="checkbox"/> 15
<input type="checkbox"/> 16			

PREVIEW IMAGE FROM CAMERA 1	PREVIEW IMAGE FROM CAMERA 2
PREVIEW IMAGE FROM CAMERA 3	PREVIEW IMAGE FROM CAMERA 4

Latest Video Stats

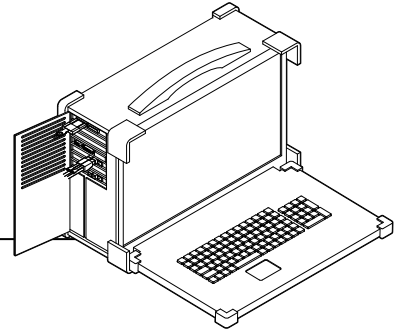
Latest Previews



# 6

## 1c.

### Stop recording



#### Step 3. Recording in Progress

GUI control changes once you hit the start program button. You will be able to stop the capture and update the live preview while the camera is capturing.

http://localhost

### Record Video

Stop Recording

Action: - Stop recording

Elapsed time: 00 m 20 s, FPS: 29.9, Dropped frames so far: 0

Progress Info - Elapsed time, frames per second and drop frames

Shutter 20.000 ms

Gain 0.000 dB

### Preview


Choose 4 cameras:

<input type="checkbox"/> 0	<input checked="" type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input checked="" type="checkbox"/> 3
<input checked="" type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7
<input type="checkbox"/> 8	<input type="checkbox"/> 8	<input type="checkbox"/> 10	<input type="checkbox"/> 11
<input type="checkbox"/> 12	<input type="checkbox"/> 17	<input type="checkbox"/> 14	<input type="checkbox"/> 15
<input type="checkbox"/> 16			

PREVIEW IMAGE FROM CAMERA 1	PREVIEW IMAGE FROM CAMERA 2
PREVIEW IMAGE FROM CAMERA 3	PREVIEW IMAGE FROM CAMERA 4

Latest Video Stats

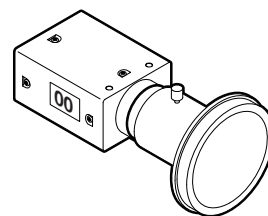
Latest Previews

**Tips**  
It is safe to stop capture midway

# 6

## 2.

### How to Verify Camera Connections (Optional)



#### Open FlyCapture (Point Grey capturing software)

```
| flycap
```

- Confirm all connections are USB 3.0 and total of 17 cameras detected

Serial #	Model	Interface	IP Address
15355848	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A
15636785	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A
15636826	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A
15636828	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A
15636829	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A
15636830	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A
15636831	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A
15636832	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A
15636834	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A

**Camera Information**

Serial Number: 16130496  
Model: Grasshopper3 GS3-U3-41C6C  
Vendor: Point Grey Research  
Sensor: CMOSIS CMV4000 (1" Color CMOS)  
Resolution: 2048x2048  
Interface: USB 3.0  
Bus Speed: S5000  
IIDC Version: 1.32  
Firmware Version: 2.14.3.0  
Firmware Build Time: Tue Apr 21 18:51:25 2015  
Driver: None

Buttons: Auto Force IP, Refresh, OK, Configure Selected, Cancel

#### Optional : Check focus by clicking on individual camera

All cameras are pre-focused, but critical focus should be checked before capturing. To check the focus of each lens, open a live preview by double clicking on the camera. Manually adjust the focus of the camera.



**Make sure ALL 17 cameras are recognized as USB 3.0**



#### Tips

If a camera is not connected, or a camera says it is connected using USB 2.0, unplug cables from the breakout box and re-seat them in different buses until all 17 cameras are connected as USB 3.0. Remember that each camera must be alone in a USB 3.0 port pair in order to satisfy the requirement that there is only 1 camera per bus.

If this doesn't resolve the problem, try the following steps:

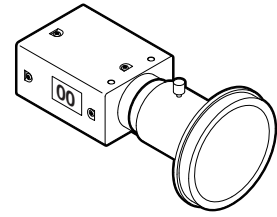
1. quit flycap
2. reset physical USB connections
3. run the following USB reset command:

```
| /home/facebook1/vr_camera_hw/scripts/usbreset.sh
```

# 6

## 3a.

### How to use Flycapture to Preview (Optional)



#### Step 1. Select a camera to preview

Camera are arranged in ascending sequential order starting with top camera (# 00).

Camera # 00

Sort Serial #

Serial #	Model	Interface	IP Address
15355848	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A
15636785	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A
15636826	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A
15636828	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A
15636829	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A
15636830	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A
15636831	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A
15636832	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A
15636834	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A

Camera Information

Serial Number: 16130496  
Model: Grasshopper3 GS3-U3-41C6C  
Vendor: Point Grey Research  
Sensor: CMOSIS CMV4000 (1" Color CMOS)  
Resolution: 2048x2048  
Interface: USB 3.0  
Bus Speed: 55000  
I2C Version: 1.32  
Firmware Version: 2.14.3.0  
Firmware Build Time: Tue Apr 21 18:51:25 2015  
Driver: None

Auto Force IP Refresh OK Configure Selected Cancel

#### Step 2. Go to setting panel from preview panel

Set the following values:

- shutter speed in milliseconds
- gain (usually 0)
- framerate (usually 30)

Camera Settings

Trigger / Strobe

FPS : Usually 30 fps

Shutter: Max 20 ms for 30 fps

Gain: Usually 0 dB

Camera Settings

Standard Video Modes

Custom Video Modes

Camera Information

Camera Registers

Trigger / Strobe

Advanced Camera Settings

High Dynamic Range

Look Up Table

Frame Buffer

Data Flash

System Information

Bus Topology

Help/Support

Camera Settings

Absolute mode

Brightness 5.078 %

Exposure 0.170 EV

Sharpness 1024

Hue 0.000 deg

Saturation 100.000 %

Gamma 1.250

Iris

Focus

Zoom

Pan

Tilt

Shutter 20.002 ms

Gain 0.000 dB

Frame Rate 30.000 fps

W.B. (Red) 482

W.B. (Blue) 762

Power

Temperature 309.5K / 36.4C / 97.4F

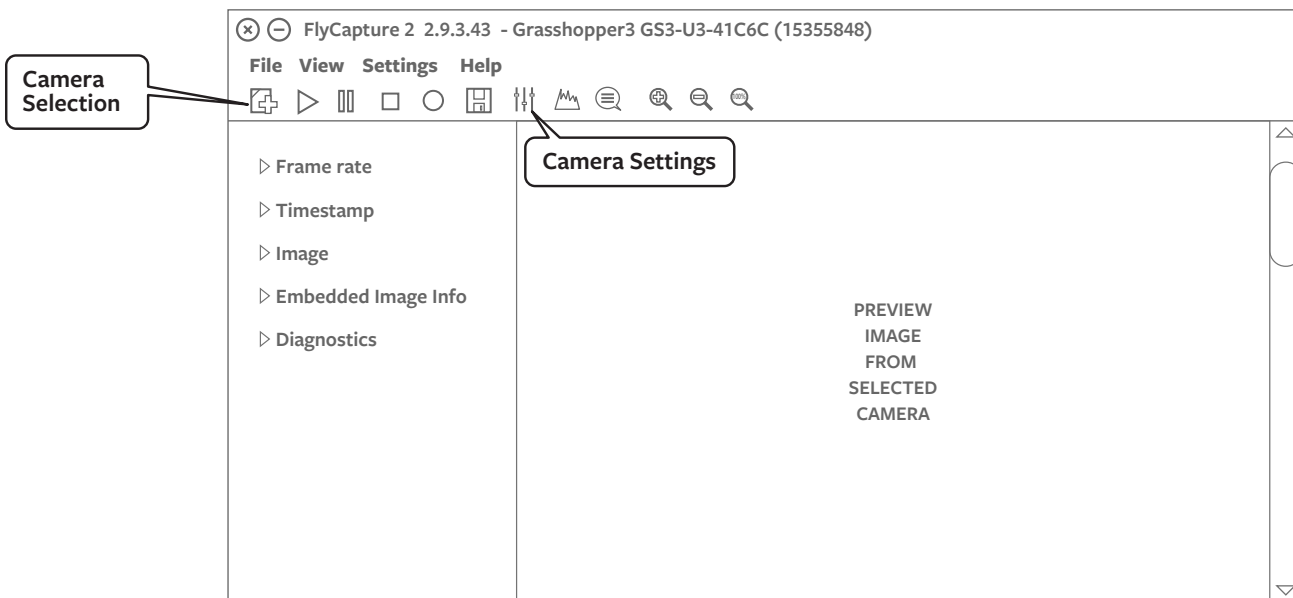
# 6

## 3b.

### How to use Flycapture to Preview (Optional)

#### Step 3. Back to preview panel to check focus

All cameras are pre-focused, but critical focus should be checked before capturing. To check the focus of each lens, open a live preview by double clicking on the camera. Manually adjust the focus of the camera.



#### Tips

Each time you capture using the Surround 360, all camera settings are set to capture settings, and preview is disabled. When you load flycap (e.g., to change settings), you'll see the Point Grey logo instead of a preview. To re-enable preview, find the "Trigger/Strobe" settings and uncheck "Trigger Control."

# 6

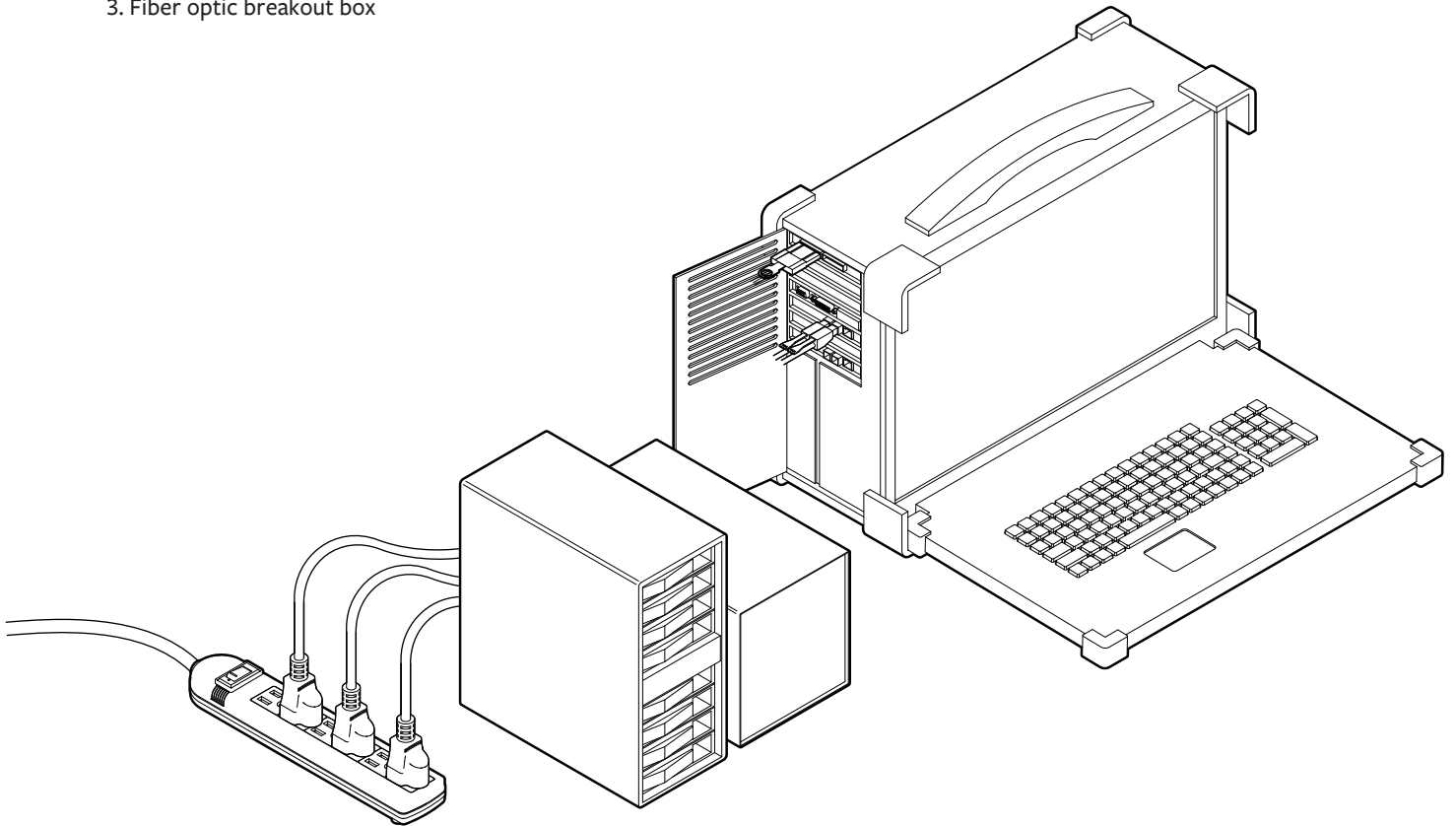
## 4.

### Shutting Down System

**Power down devices in the following order:**

---

1. Computer
2. RAID Tower
3. Fiber optic breakout box



#### **Tips**

Never disconnect the RAID before unmounting it. The safest way to unmount the RAID is to shut the computer down.

# 6

## 5.

### How to Render

#### To start the rendering process

Run the following script

```
| cd <path_to_surround360>/surround360_render && python scripts/run_all.py
```

Surround 360 - Process Dataset

Settings  
Surround 360 - Process Dataset

Required Arguments

**Location of captured data**  
Default - NONE

Data Directory  
directory containing .bin files

**Destination Directory**  
destination directory

Optional Arguments

**Quality**  
final output quality

Options: 3K, 4K, 6K & 8K  
Default - 6K

**Start Frame**  
start frame

First frame to render  
Default - 0

**Frame Count**  
0 = all

Number of frames to render  
Default - 0 = all frames

**Cubemap Face Resolution**  
0 = no cubemaps

Cubemap output  
Default - 0 = No cubemap

**Cubemap Format**  
photo or video

Cubemap Format  
Default - video

**Steps**  
[unpack, arrange, color\_adjust, isp, render, ffmpeg, all]

Rendering steps  
Default - 0 = all steps

**Flow Algorithm**  
optical flow algorithm

Options: Low, med, ultra  
Default - pixflow\_low

**Camera to ISP Mappings File**  
camera to isp config file

**Pole Masks Directory**  
diretory containing pole masks

**Intrinsic Parameters File**  
intrinsic parameter files

**Rectification File**  
rectification file [or NONE]

**Rig Geometry File**  
json file with rig geometry info

**enable\_top**  
 enable top camera

Render with top camera  
Default - unchecked

**enable\_bottom**  
 enable bottom camera

Render with bottom camera  
Default - unchecked

**enable\_pole\_removal**  
 False = use primary bottom camera

Render with pole removal  
Default - unchecked

**save\_debug\_images**  
 save debug images

Save debug image  
Default - unchecked

**dryrun**  
 do not execute steps

Dryrun  
Default - unchecked

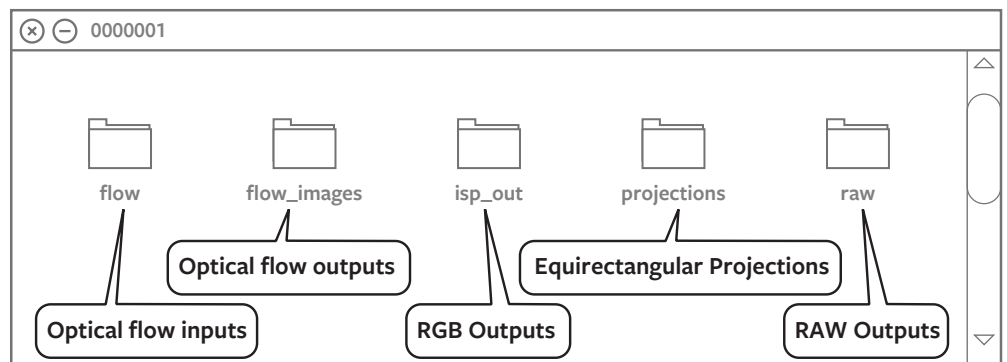
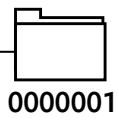
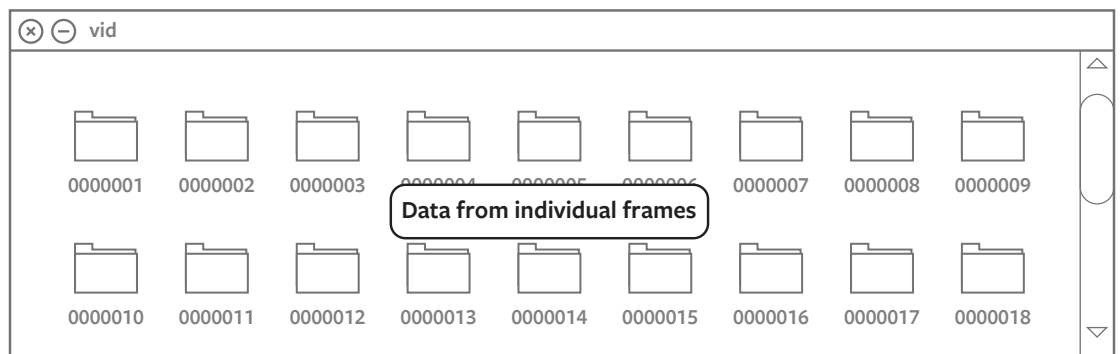
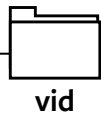
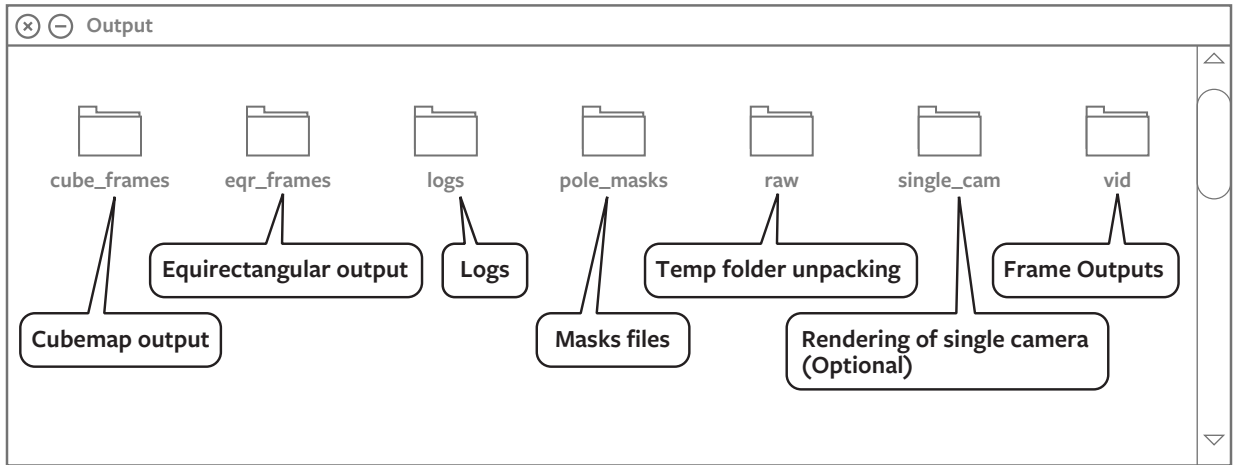
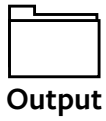
**verbose**  
 increase output verbosity

Increase output verbosity  
Default - unchecked

# 6

## 6.

### Output Directory



# 7

**Pro Tips**

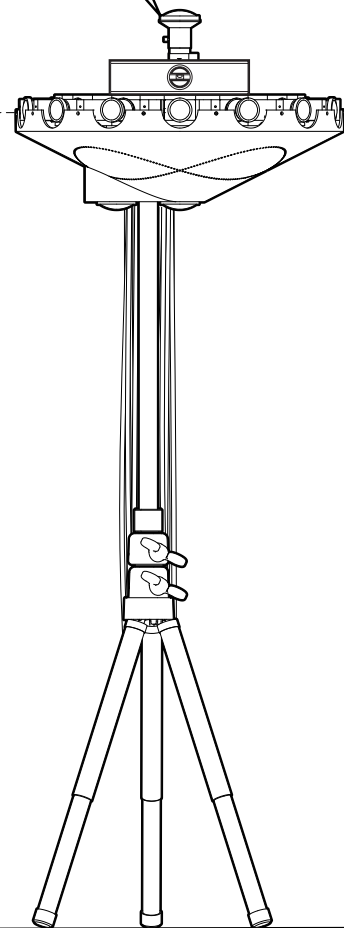
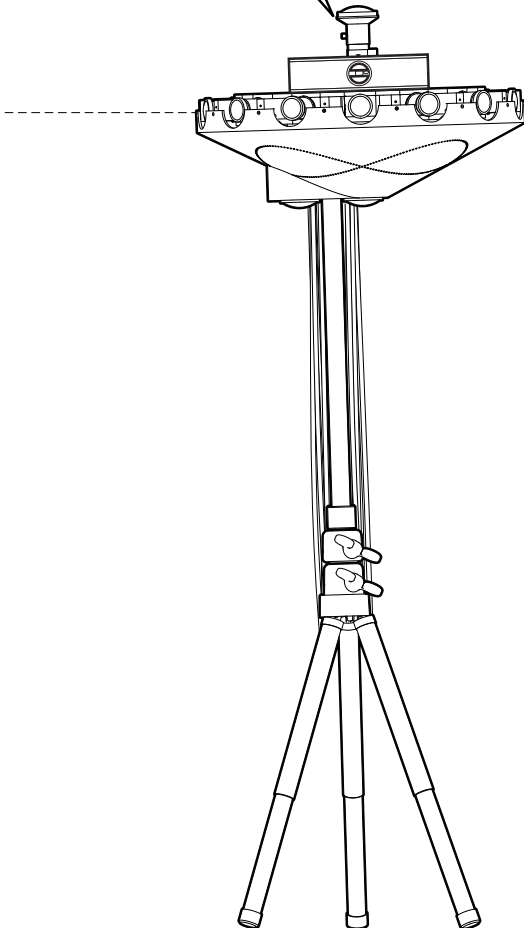
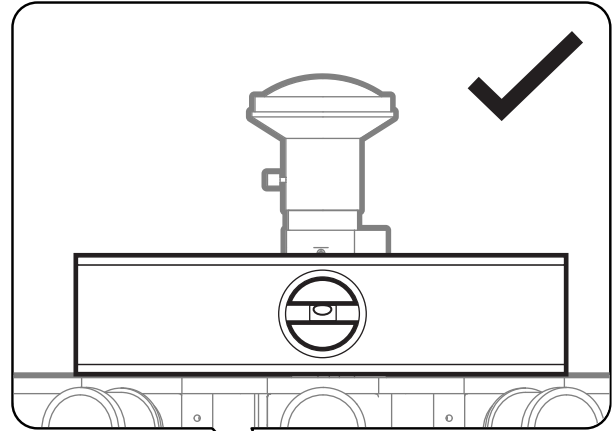
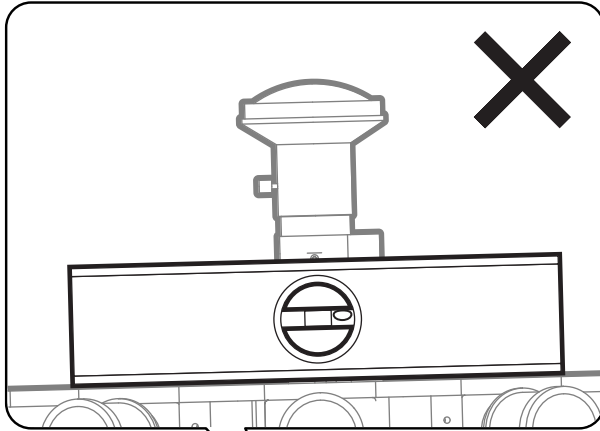


# 7

## 1.

### Level Camera for Level Horizon Line

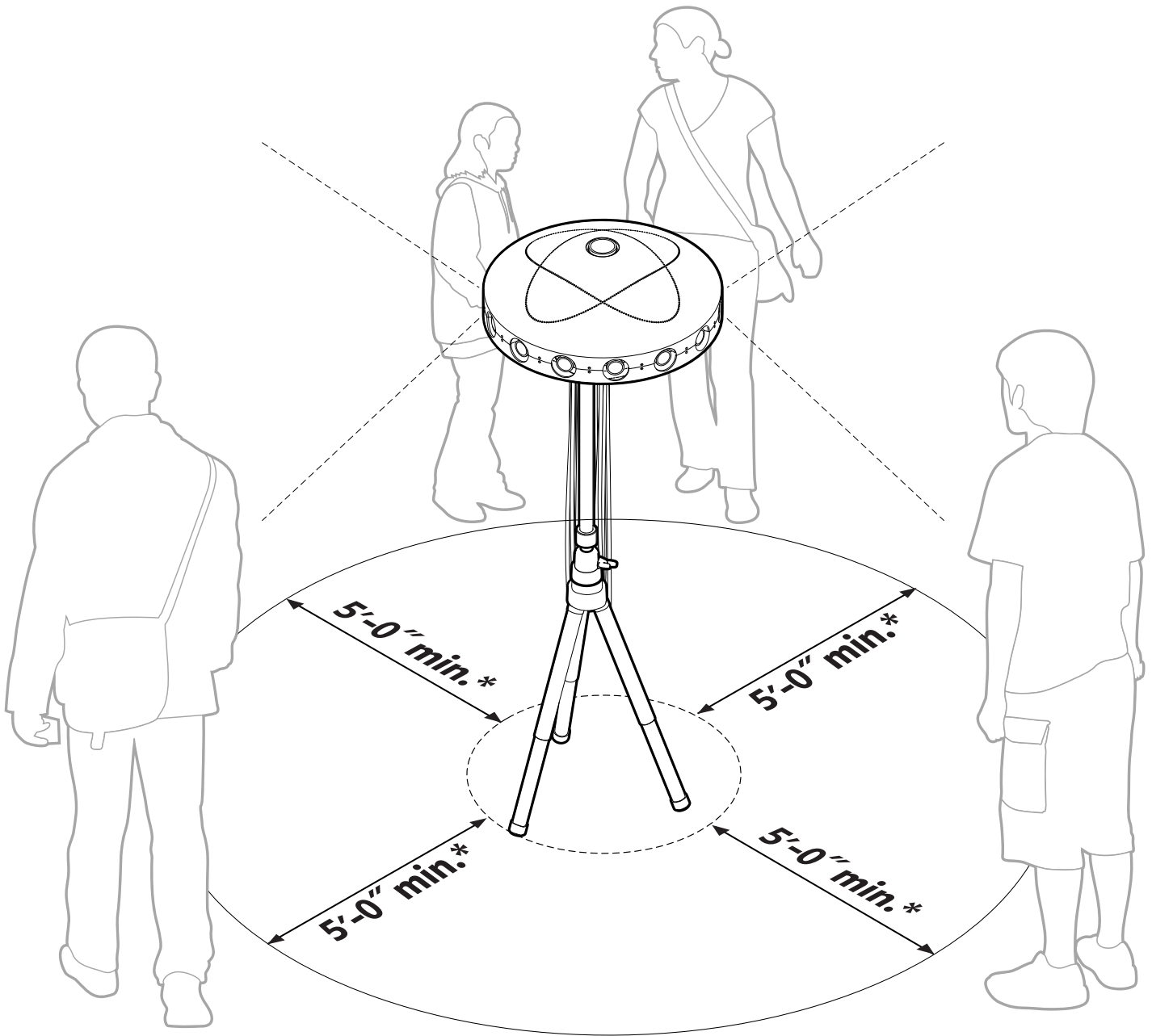
! Remove top shell first!



# 7

## 2.

### Avoid Close Objects

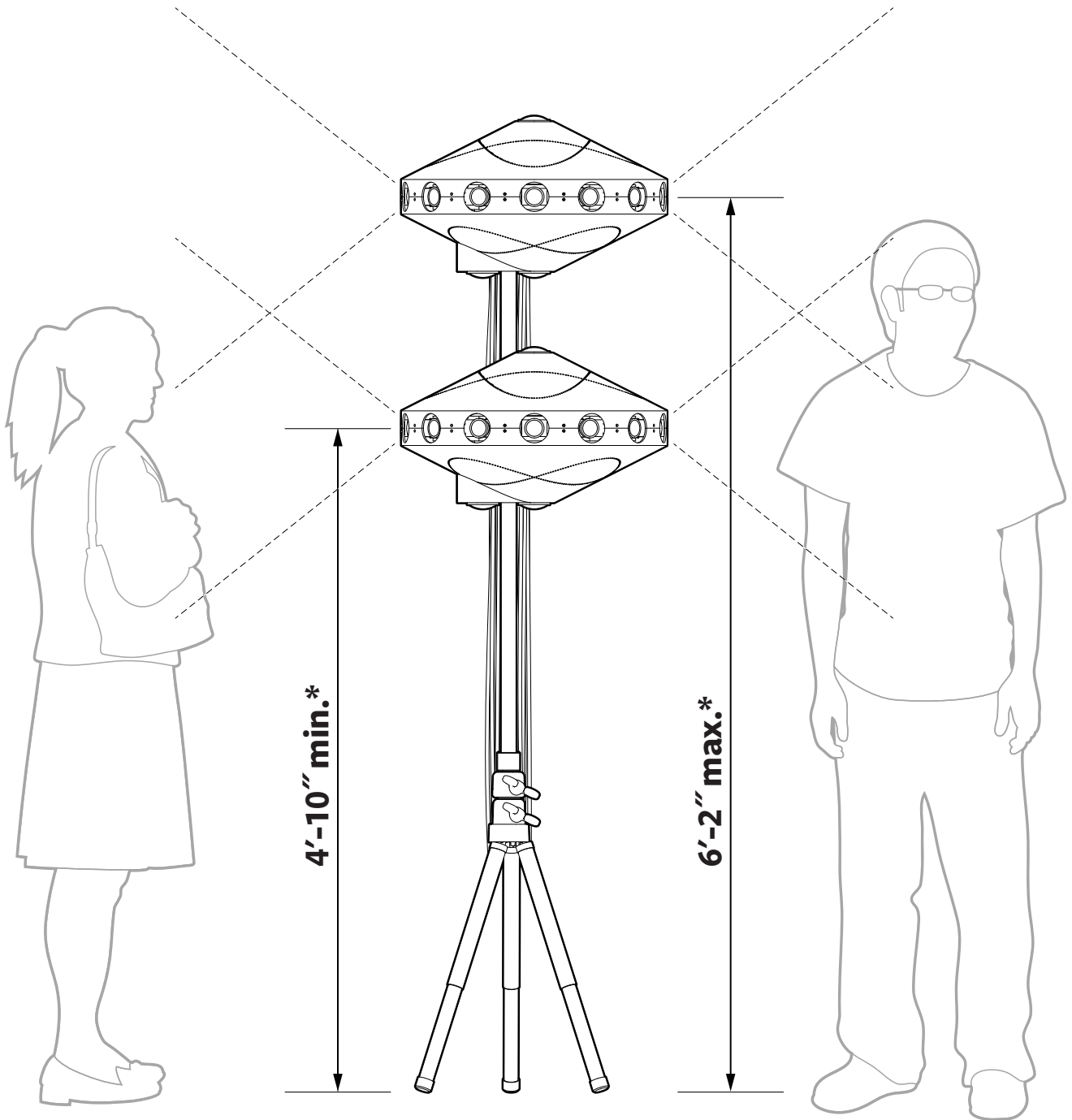


\* recommendation only

# 7

## 3.

### Be Aware of Camera Height for Better VR Experience

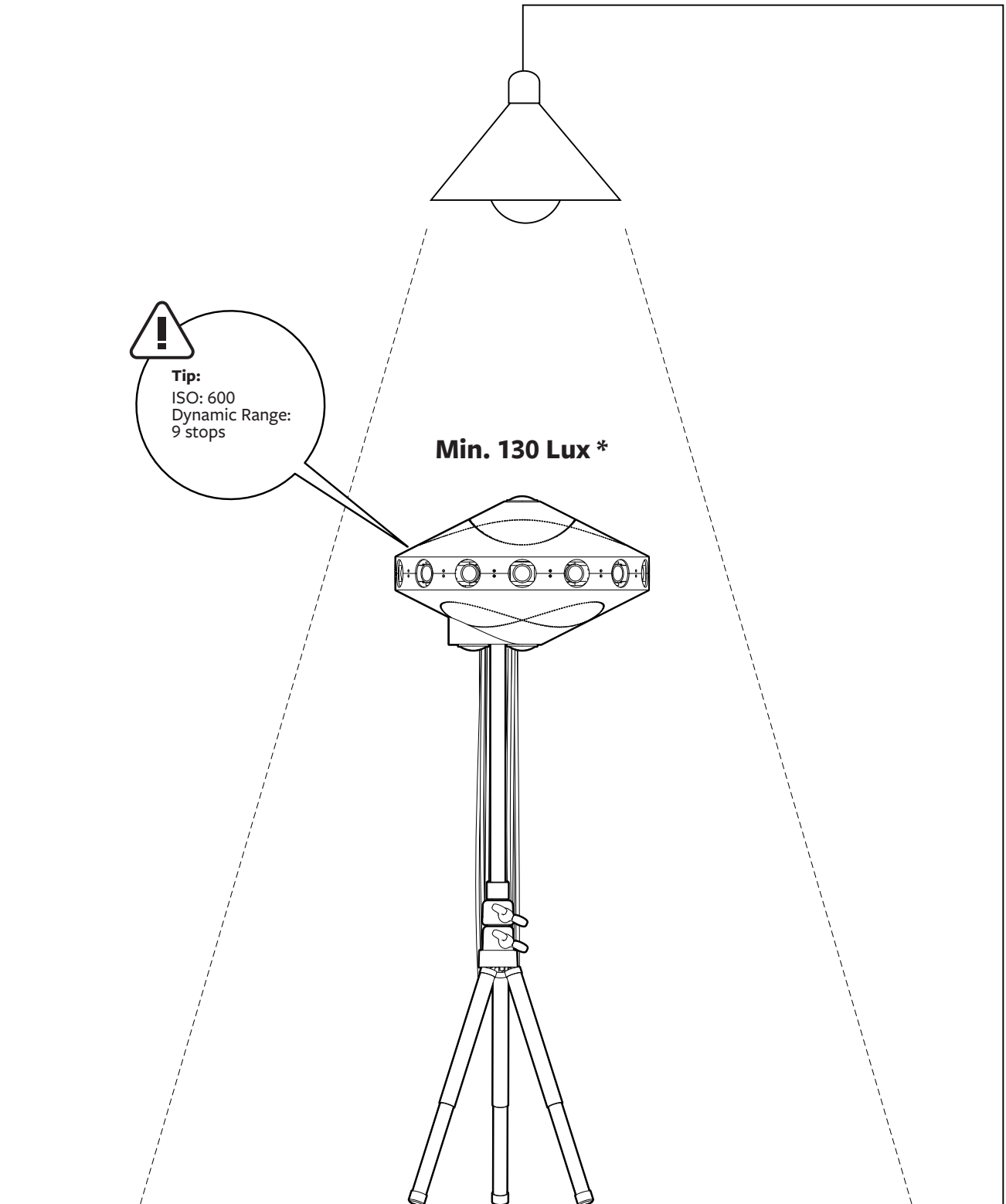


\* recommendation only

# 7

## 4.

### Avoid Low Light Condition to Minimize Noise in Footage

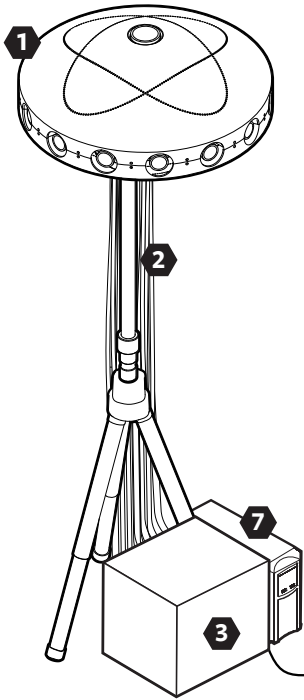


\* recommendation only

# 7

## 5a.

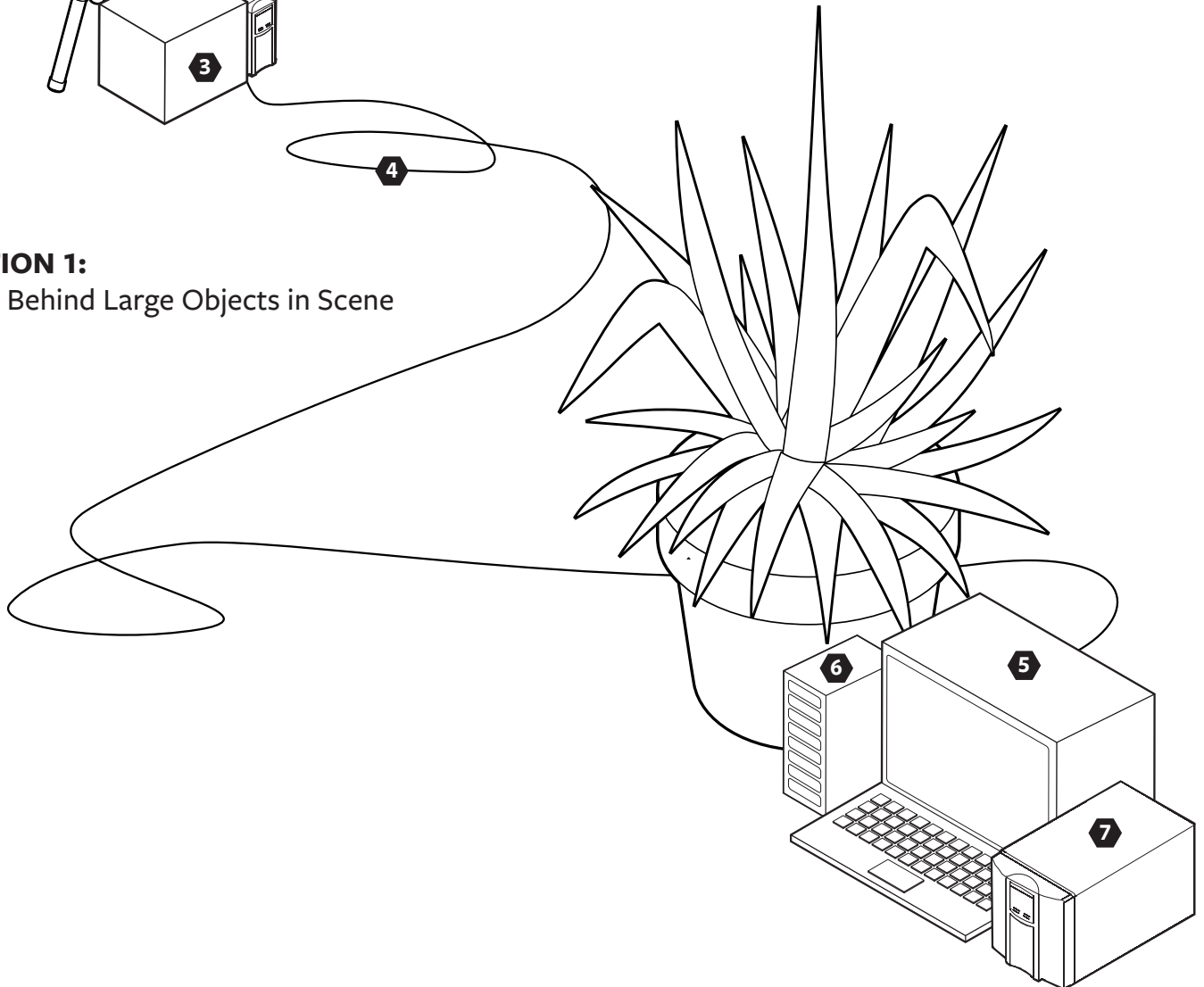
### Placement of Surround 360



#### LEGEND

- 1** SURROUND 360
- 2** USB 3.0 Cables
- 3** Fiber Optic Breakout Box
- 4** Optical Cable
- 5** Computer
- 6** Raid Tower
- 7** Power Supply

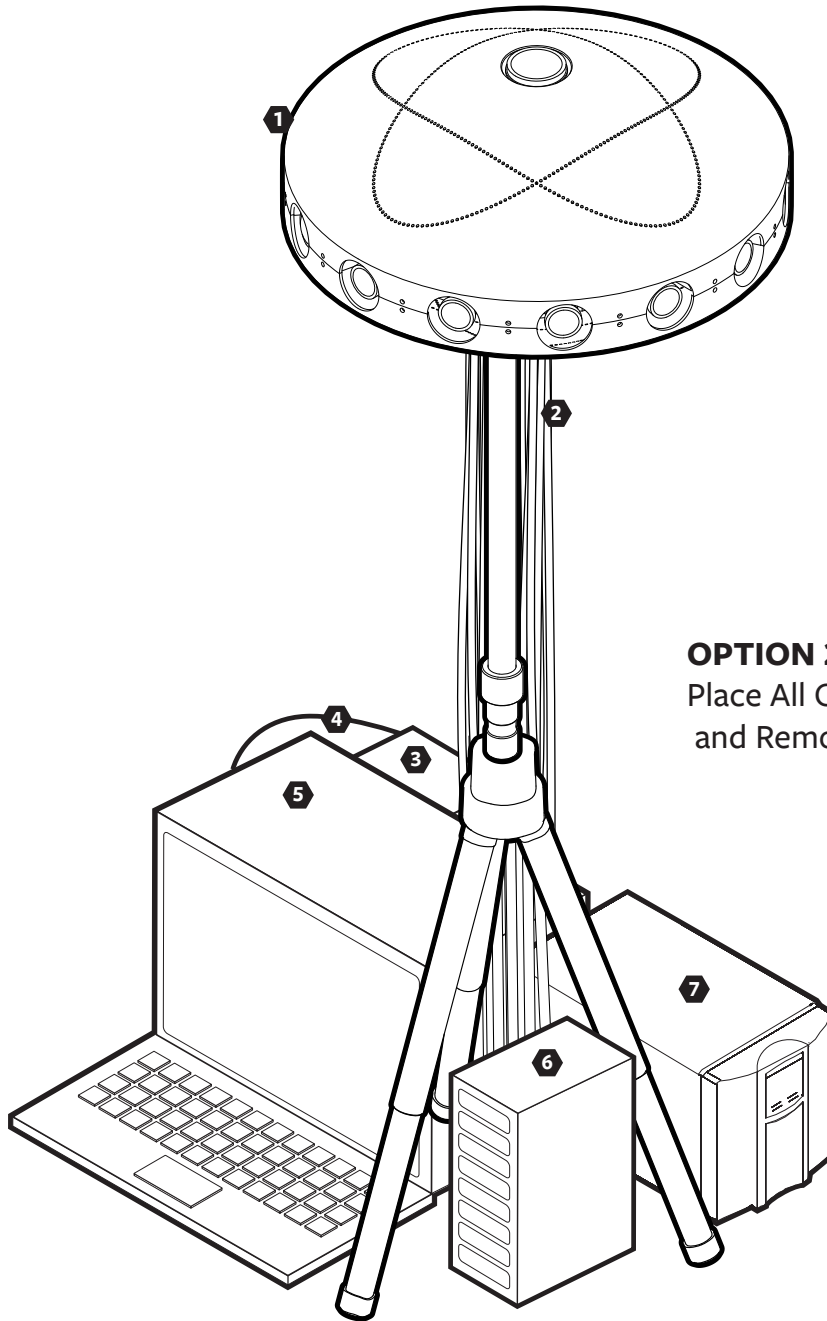
#### OPTION 1: Hide Behind Large Objects in Scene



# 7

## 5b.

### Placement of Surround 360



#### LEGEND

- 1 SURROUND 360
- 2 USB 3.0 Cables
- 3 Fiber Optic Breakout Box
- 4 Optical Cable
- 5 Computer
- 6 Raid Tower
- 7 Power Supply

#### OPTION 2:

Place All Components Beneath Camera and Remove in Post-Production

# 8

## Camera Specifications

# 8

## 1. Specifications

Type	Spherical and stereoscopic video capture
Sensor Type	CMOS, global shutter
Sensor Name	CMOSIS CMV4000-3E5
Sensor Array	17 synchronized 1" sensors
Pixel Size	5.5 $\mu\text{m}$
ADC	10 bit
ISO	600
Dynamic range	9 stops
Coverage Area	Full spherical, 360 x 180 degrees
Stereoscopic Coverage	Centerline +/- 144(h), 77(v) degrees
Lens Angle of View	77 degrees diagonal (center), 185 degrees (top and bottom)
Relative Aperture	f/2.4 (wide-angle lens), f/1.8
Lens Mount	C mount
Resolution	8192 x 4096 per eye equirect * 2 = 8192 x 8192
Interface	USB 3.0
Capture Format	RAW
Capture Frame Rate	30 fps (max 60 fps)
Bandwidth	17 Gb/s (@ 30 fps)
Dimensions - camera only	460 x 460 x 307.65mm
Dimensions - with mount	460 x 460 x 796.60mm
Total Weight - camera only	16 kgs
Construction	Milled aluminum alloy & steel
Color	Black
Operating Temperature	0° to 50°C
Storage Temperature	-30° to 60°C
Operating Humidity	20% to 80% (no condensation)
Storage Humidity	20% to 95% (no condensation)
Power Consumption	350 watts max



# 8

## 2a.

### Bill of Material

#### CAMERA & LENSES

Point Grey Camera Body	GS3-U3-41C6C-C	17
Sunex Lens	DSL318	14
Fujinon Fisheye Lens	FE185Co86HA-1	3

#### MACHINED PART

Base Plate	FB360_V1_21	1
Top Plate	FB360_V1_22	1
Upright	FB360_V1_23	1
Camera Bracket	FB360_V1_24	1
Post	FB360_V1_25	1
Support Tube	FB360_V1_26	1
Adapter	FB360_V1_27	1
Shell Support	FB360_V1_28	14
Bottom Cover	FB360_V1_29	1
Top Cover	FB360_V1_30	1
Stop Nut	FB360_V1_31	1
Threaded Rod	FB360_V1_32	1
Lens Mounts/Barrels	FB360_V1_33	14

#### FASTENER

M3 X 6 SHCS 18-8	152
M3 Lockwasher	152
M6 X 14 FHCS 18-8	8
M6 X 50 FHCS 18-8	2
M6 X 35 SHCS 18-8	4
M3 X 8 BHCS	28
5/16-18 Flange Nut	1
M3 Jam Nut (Optional)	14
M2 x 20 PHCS (Optional)	10

# 8

## 2b.

### Bill of Material

#### COMPUTER

Ruggedized "Lunchbox" Computer	APOLLO-A1 MODEL	1
- Intel Core i7-5960X Haswell-E 8-Core 3.0 GHz LGA 2011-v3		
- GIGABYTE GA-X99P-SLI (rev. 1.0) LGA 2011-v3 Intel X99 Motherboard		
- 8GB DDR4 2400 288-PIN Memory ± (64GB of Memory Installed)		
- CPU COOLING FAN FOR LGA 2011-v3		
- 1GB NVIDIA PCI-EX16 VIDEO CARD		
- 700 WATT POWER SUPPLY		
- SAMSUNG 850 Pro Series 2.5" 128GB SSD		
- OPERATING SYSTEM - UBUNTU 14.04 LTS		

PCIe x8 Gen 3 Cable Adapter	OSS-PCIe-HIB38-x8-DUAL	1
PCIe 3.0 x 8 SAS RAID Adapter	ARC-1883X	1

#### FIBER OPTIC BREAKOUT BOX

PCIe Expansion Enclosure	OSS-PCIe3-ENCL-M-CUBE3-8	1
Expansion Backplane	OSS-BP-452	1
PCIe x8 Gen 3 Cable Adapter	OSS-PCIe-HIB38-x8-DUAL	1
USB 3.0 Expansion Card	UE-1008 / UE-1004	5
Shunt Jumper	390088-1	1

#### RAID TOWER

8-bay 12G SAS RAID Tower	ARC-4038	1
1TB SSD	MZ 7KE1ToBW	8

#### CABLES

HR25 GPIO connector	FB360_V1_34	17
USB3 type A to micro B locking cables		17
External 4x HD Mini-SAS Cable	SFF-8644 to SFF-8644	2
PCIe x8 Active Optical Cable	OSS-PCIe3-CBL-ACT-x8-50M-1x	1





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