

facebook

SURROUND 360

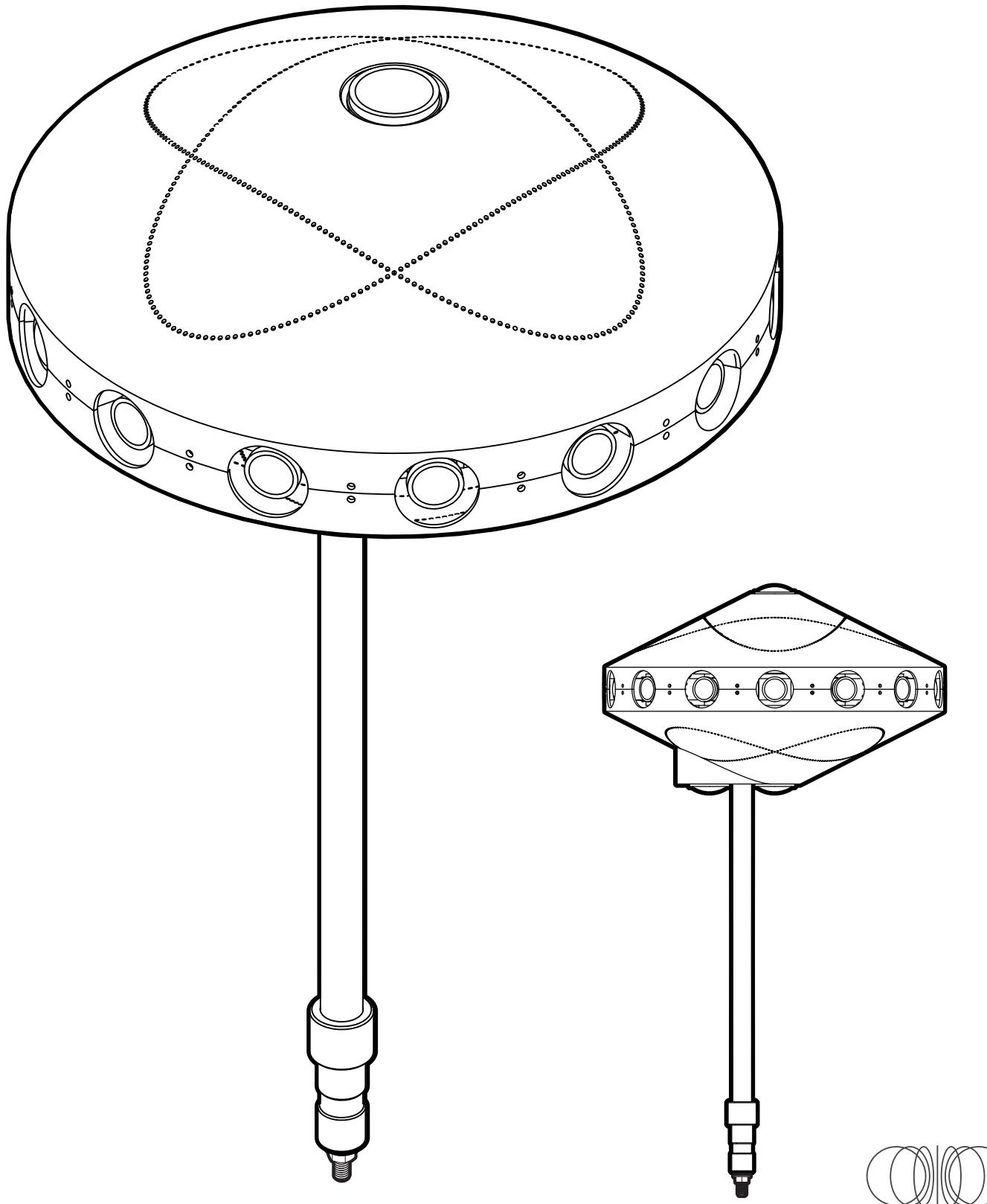


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System Specifications

1

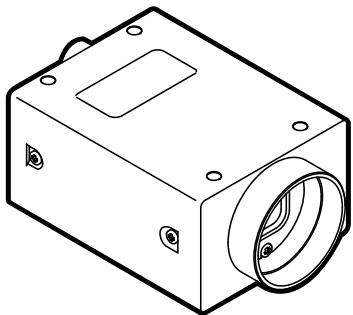
Parts List

1

1.

Camera & Lenses

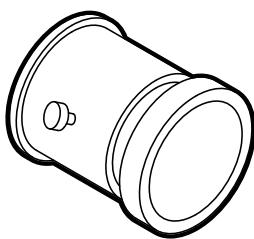
17x



Camera

Point Grey GS3-U3-41C6C-C

14x



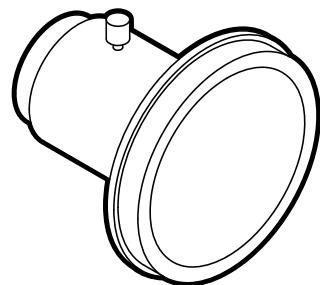
Wide-Angle Lens

with custom focusing barrel
(FB360_V1_05, _33)

Sunex DSL318B-650-F2.4

OPTIONAL:
M3 brass jam nuts (14x)

3x



Fisheye Lens

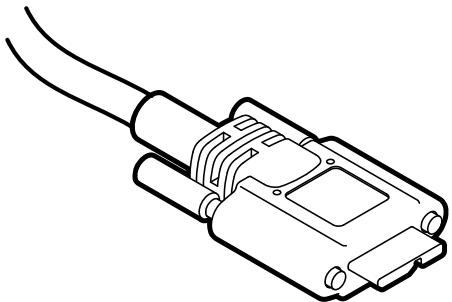
(FB360_V1_06)

Fujinon FE185C086HA-1

2.

Wiring

17x

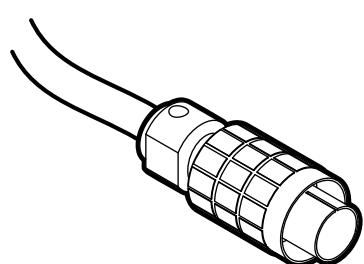


USB Cable

Type A to Micro-B

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

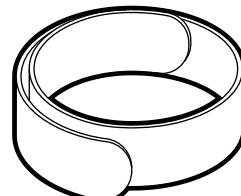
17x



GPIO Cable

(FB360_V1_05, _33)

Hirose HR25 circular connector, 8 pins



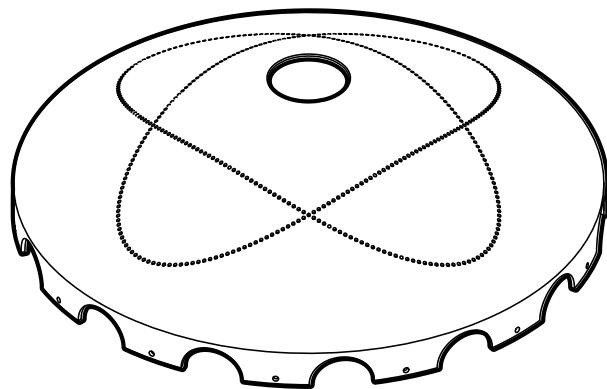
Velcro Straps

1

3.

Machined Parts

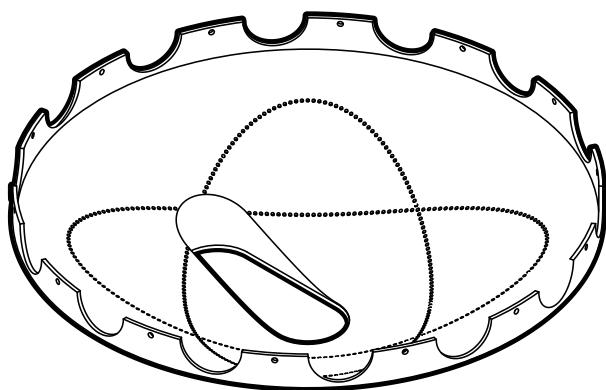
1x



Top Cover
(FB360_V1_30)

mild steel,
painted finish

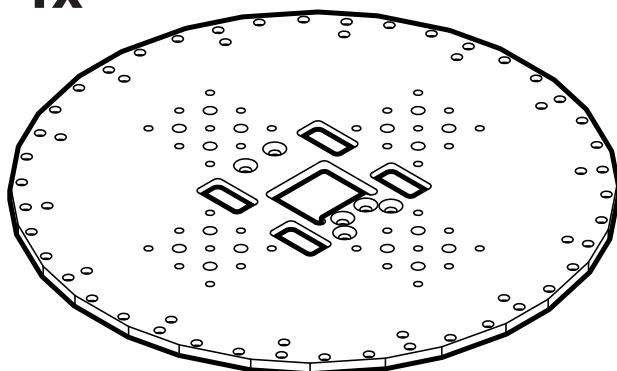
1x



Bottom Cover
(FB360_V1_29)

mild steel,
painted finish

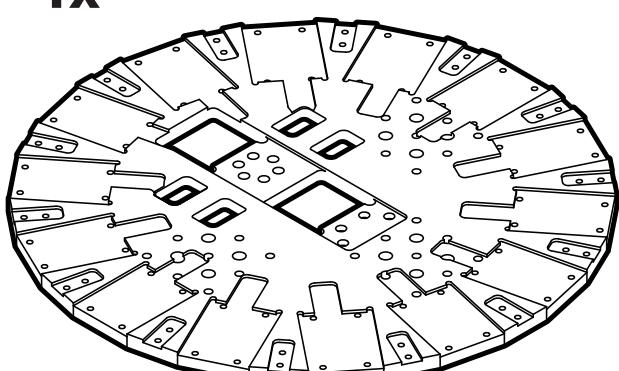
1x



Top Plate
(FB360_V1_22)

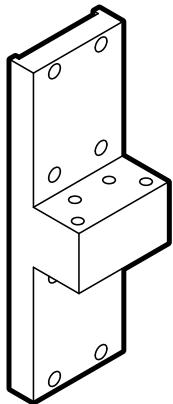
1/4" thick Mic-6 aluminum,
black anodize finish

1x



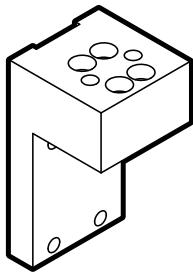
Base Plate
(FB360_V1_21)

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

1**4.****Machined Parts****1x**

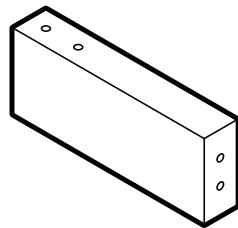
Upright
(FB360_V1_23)

6061 aluminum,
black anodize finish

1x

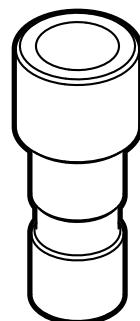
Camera Bracket
(FB360_V1_24)

6061 aluminum,
black anodize finish

14x

Shell Support
(FB360_V1_28)

6061 aluminum,
black anodize finish

1x**1x****1x**

Post
(FB360_V1_25)

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

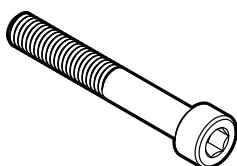
8x



M6 Flat-Head Screw

Type 18-8 stainless steel
M6 thread, 12mm length,
1.0mm pitch

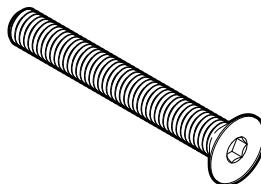
2x



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

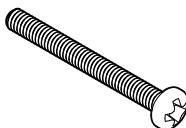
1x



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

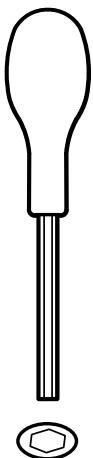


1

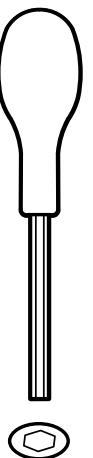
6. Tools

Hand Tools

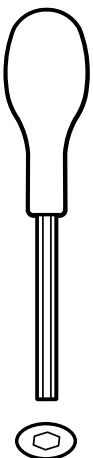
5mm
HEX



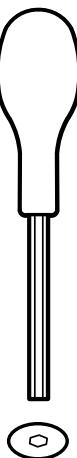
4mm
HEX



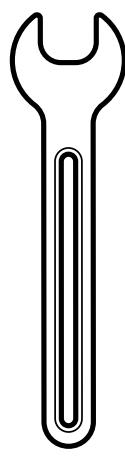
2.5mm
HEX



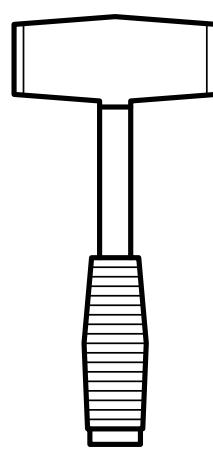
2mm
HEX



9/16"
Wrench

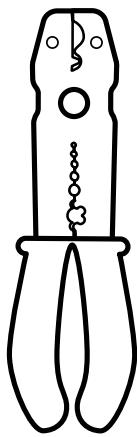


Rubber
Mallet

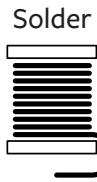
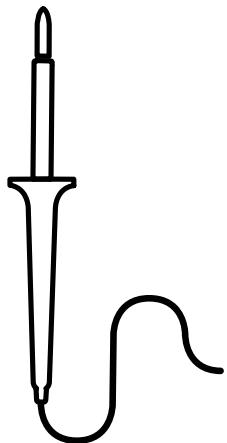


Wiring Tools

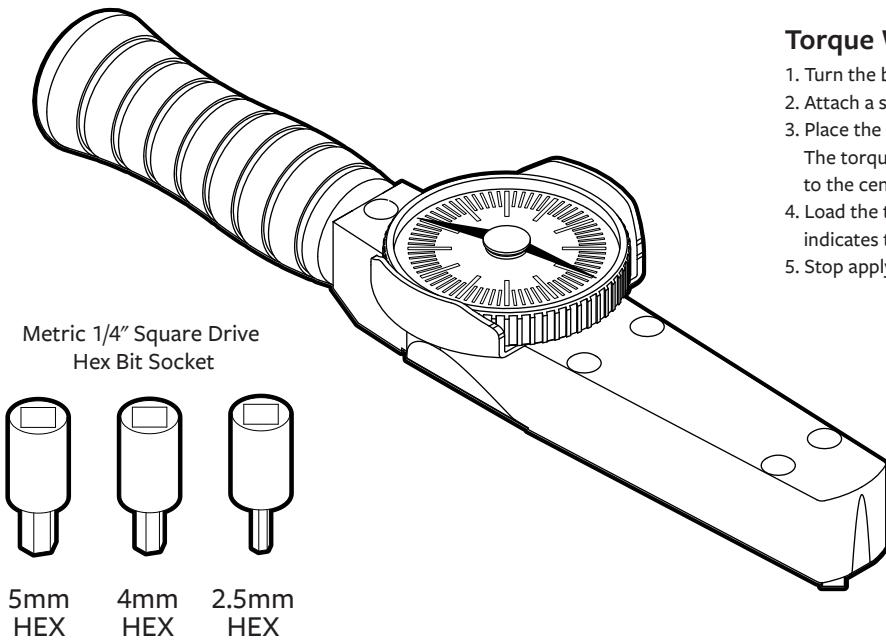
Wire
Cutter



Soldering
Iron



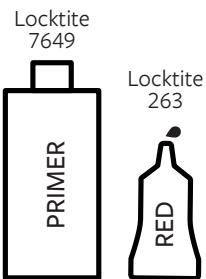
Torque Wrench



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.

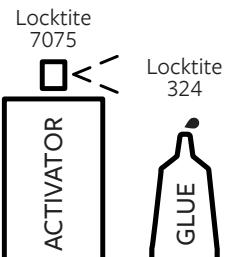
Threadlockers & Adhesive



Permanent Threadlocker



Removable Threadlocker



Cyanoacrylate 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.

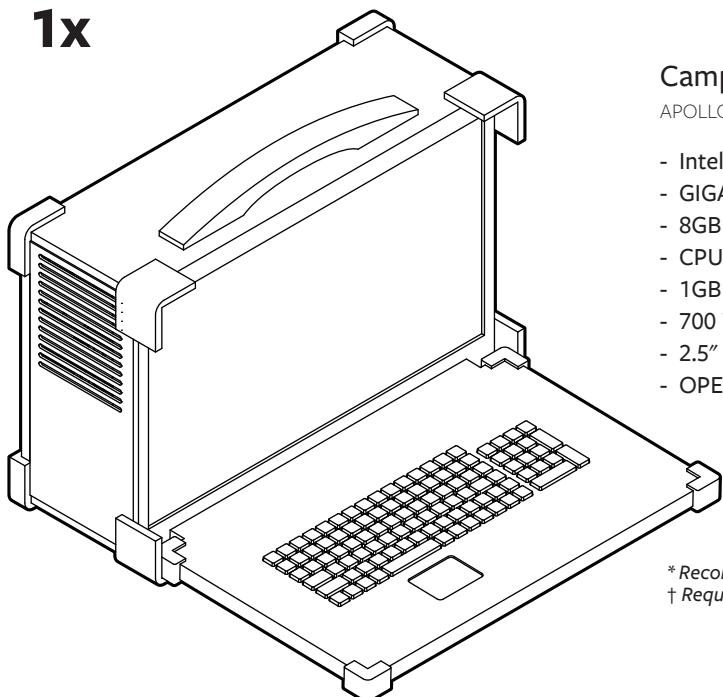
Computer Hardware



Assembly Note

See system setup instructions for details

1x



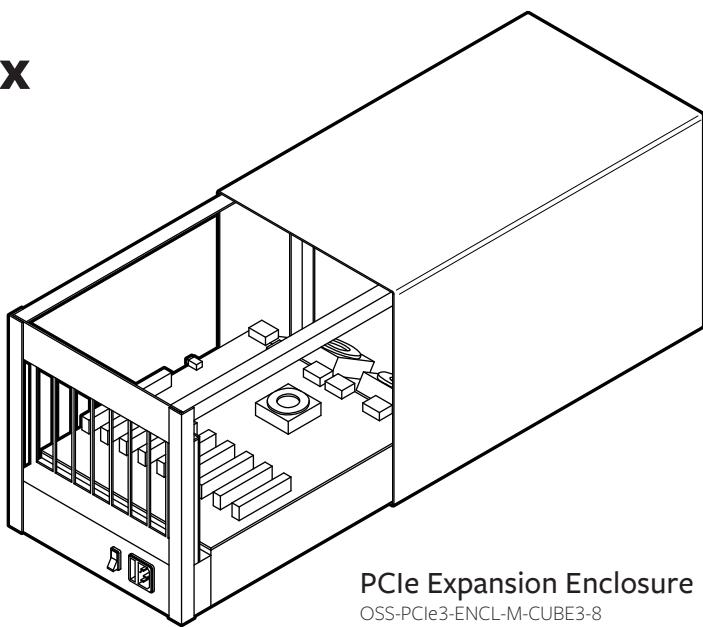
Computer - Ruggedized "Lunchbox" Computer

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

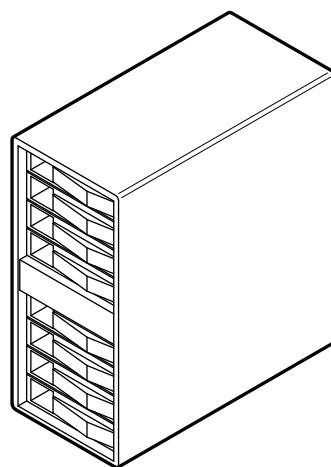
1x



PCIe Expansion Enclosure

OSS-PCIe3-ENCL-M-CUBE3-8

1x



8-bay 12G SAS RAID Tower

ARC-4038

Expansion Backplane

OSS-BP-452

1

9.

Computer Hardware



Assembly Note

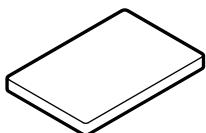
See system setup instructions for details

1x



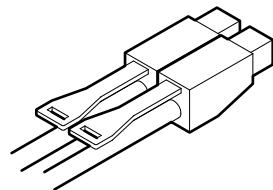
**Shunt
Jumper**
390088-1

8x



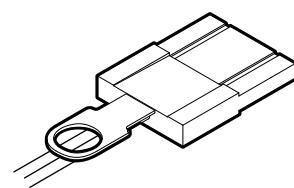
1TB SSD
MZ 7KE1TOBW

2x



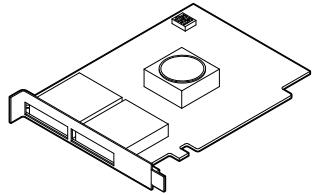
External 4x HD Mini-SAS Cable
SFF-8644 to SFF-8644

1x



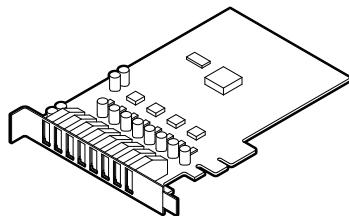
PCIe x8 Active Optical Cable
OSS-PCIe3-CBL-ACT-x8-50M-1x

2x



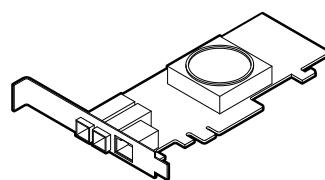
PCIe x8 Gen 3 Cable Adapter
OSS-PCIe-HIB38-x8-DUAL

5x



USB 3.0 Expansion Card
UE-1008 or UE-1004

1x



PCIe 3.0 x8 SAS RAID Adapter
ARC-1883X

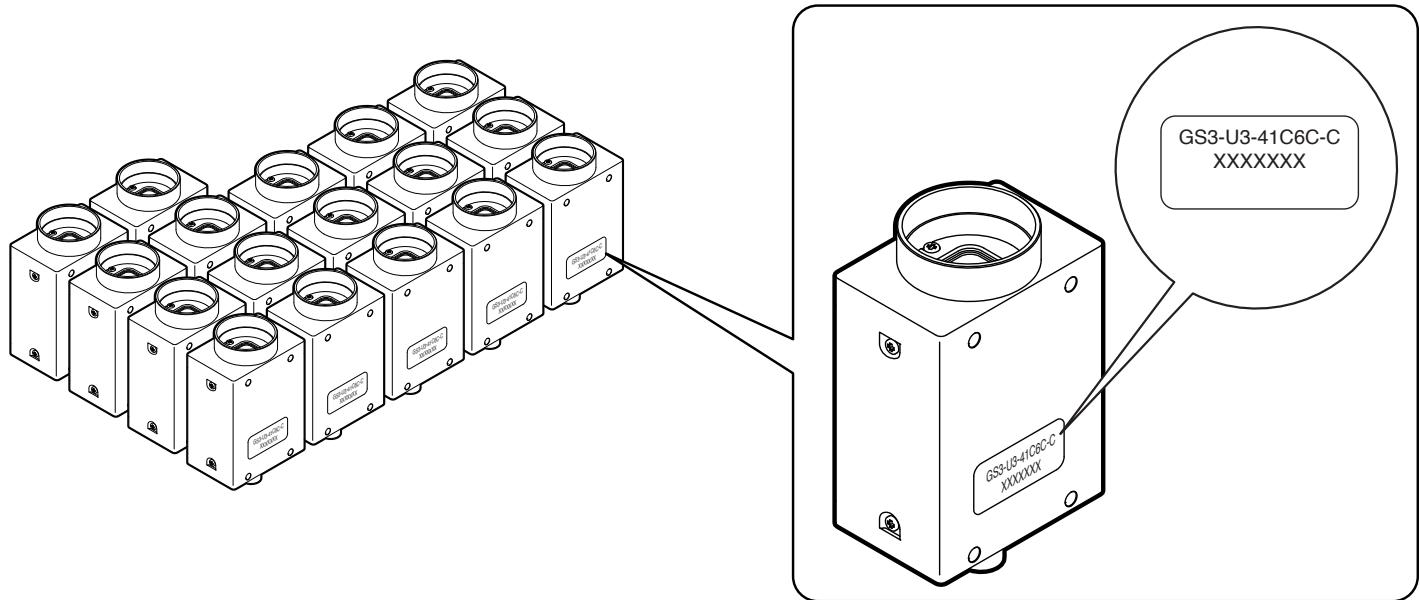
2

Before You Start

2

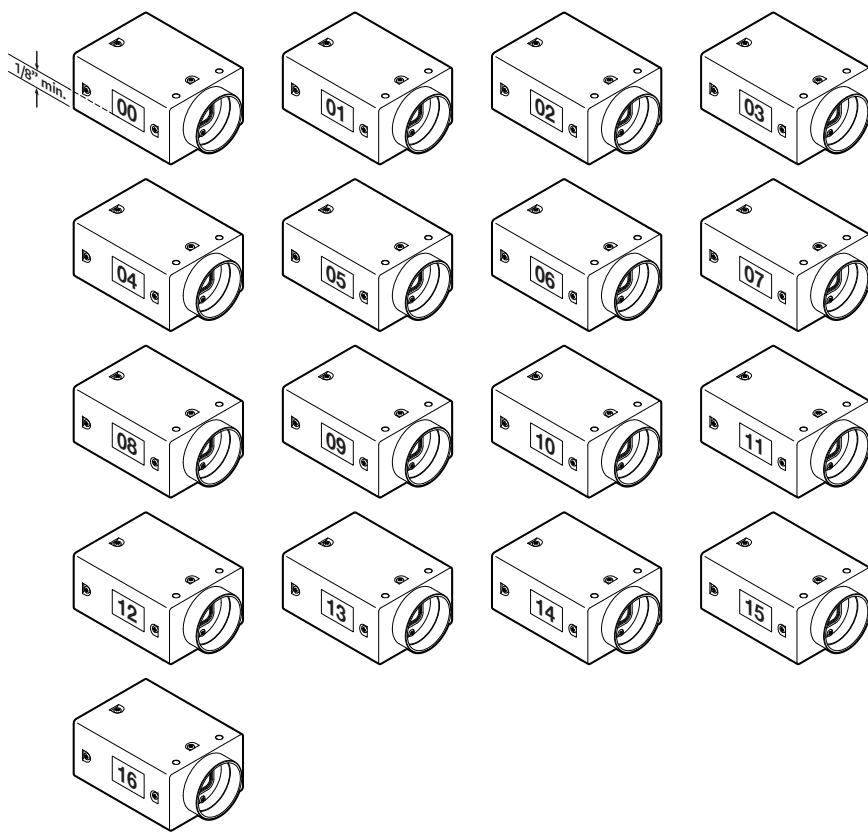
1.

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

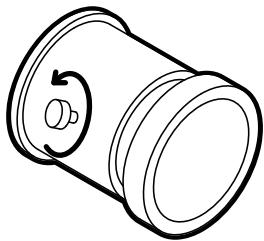
2

3.

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

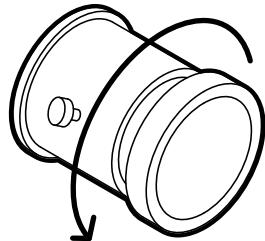
Step 1:

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):

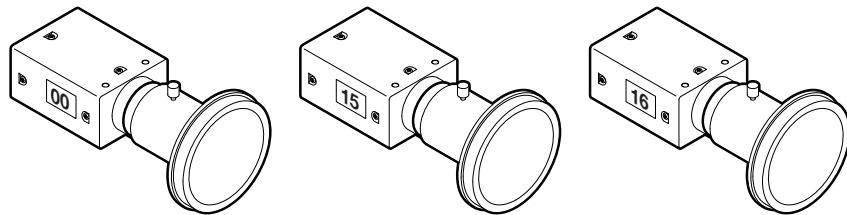
Tighten optional lock nuts (M3 brass jam nuts)

* Refer to DWG FB360_V1_33

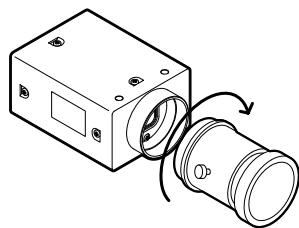
4.

Mount Lenses

Fujinon Fisheye - # 00, 15, 16

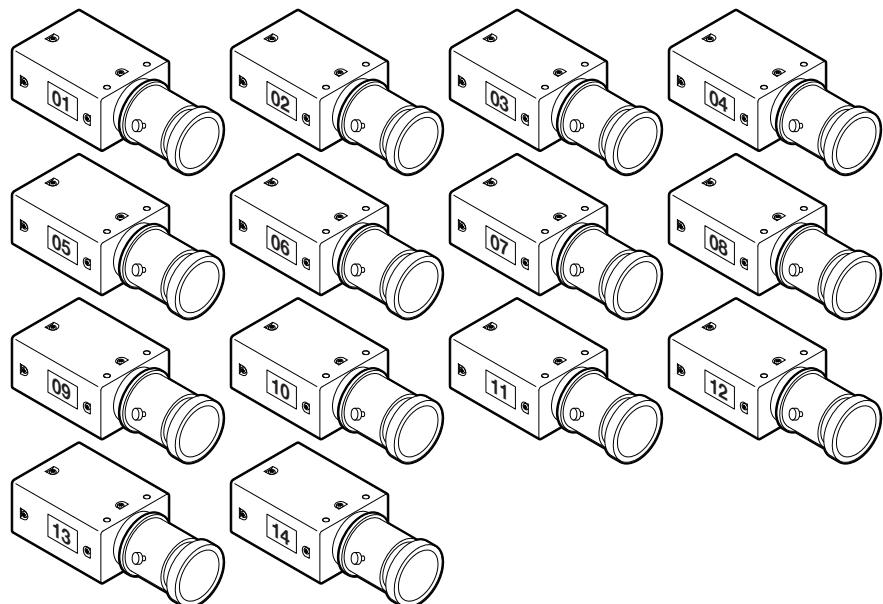


Sunex Wide-Angle - # 01 - 14



Tip:

Screw lens onto camera
clockwise till its snudge



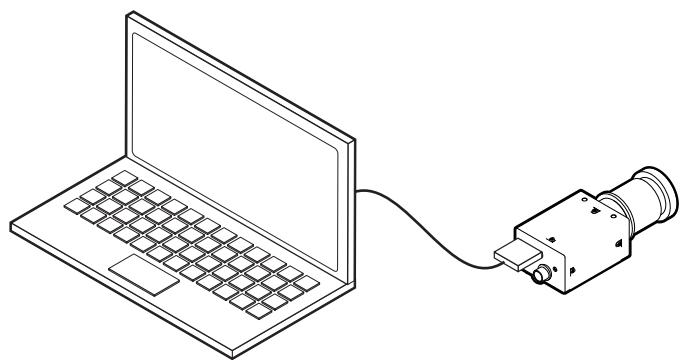
2

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:

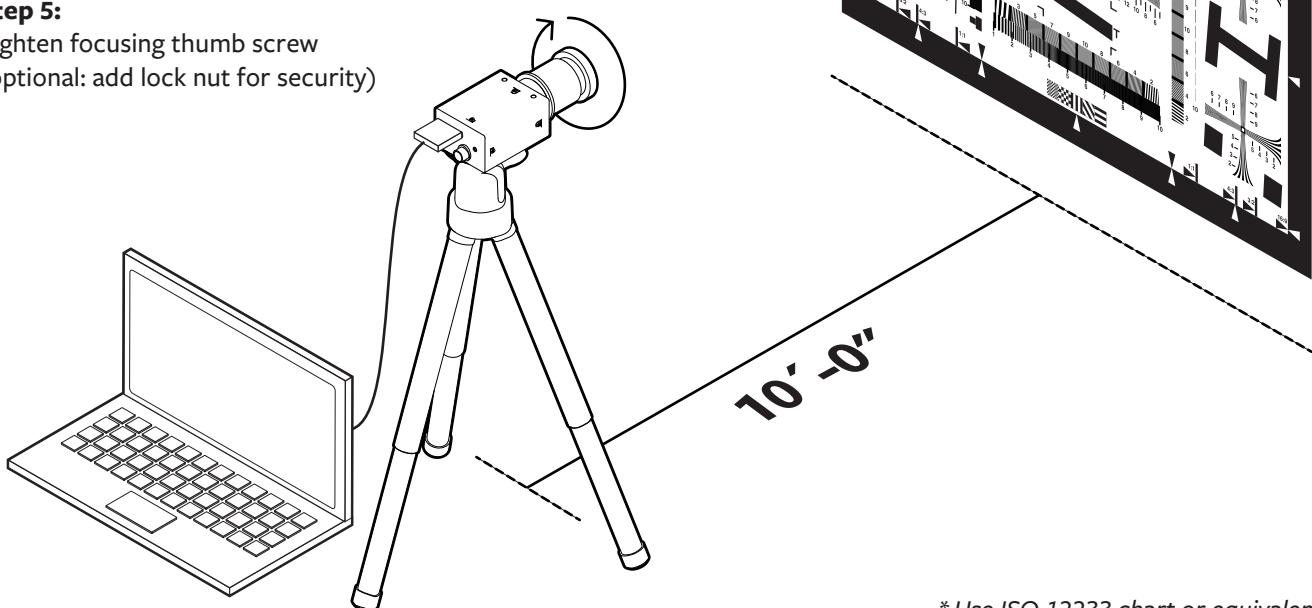
Set camera on a tripod about 10 feet away from chart* on wall

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)



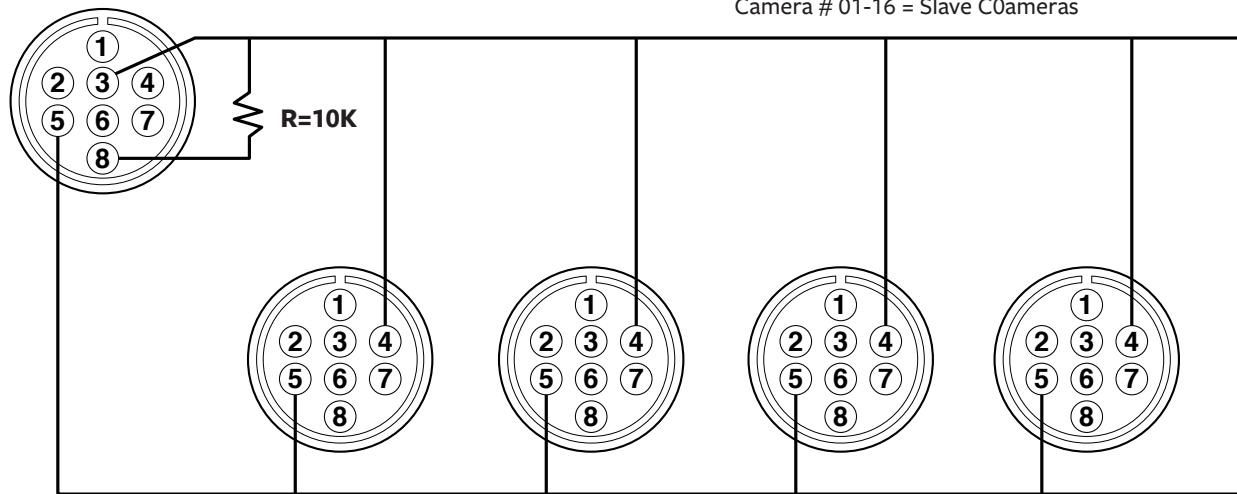
* Use ISO 12233 chart or equivalent

2

7. GPIO Trigger Cable

A - Wiring Diagram

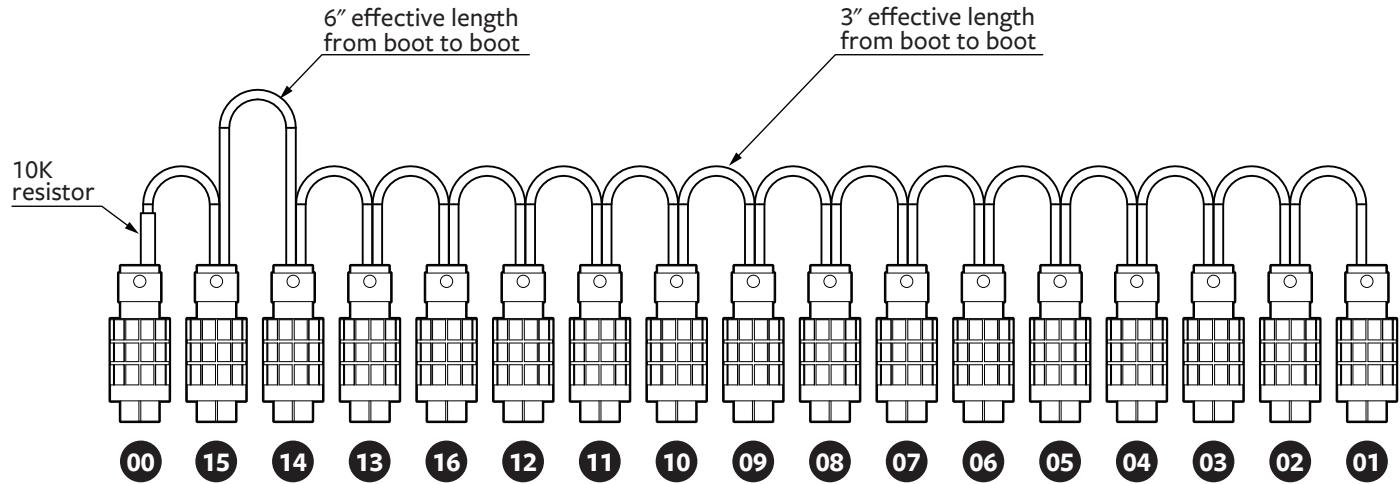
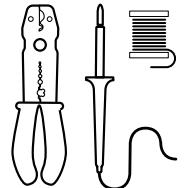
Camera # 00 (Top) = Master Camera
Camera # 01-16 = Slave Cameras



- 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

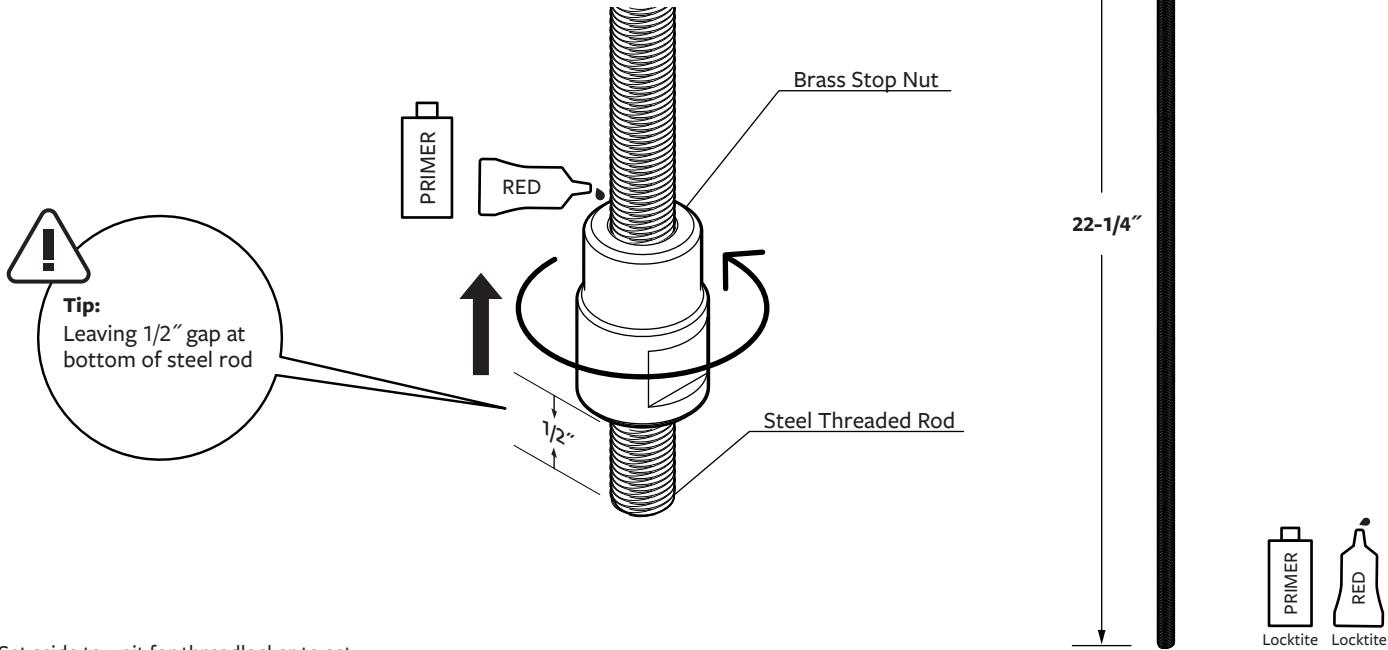
3

Camera Assembling Instructions

3

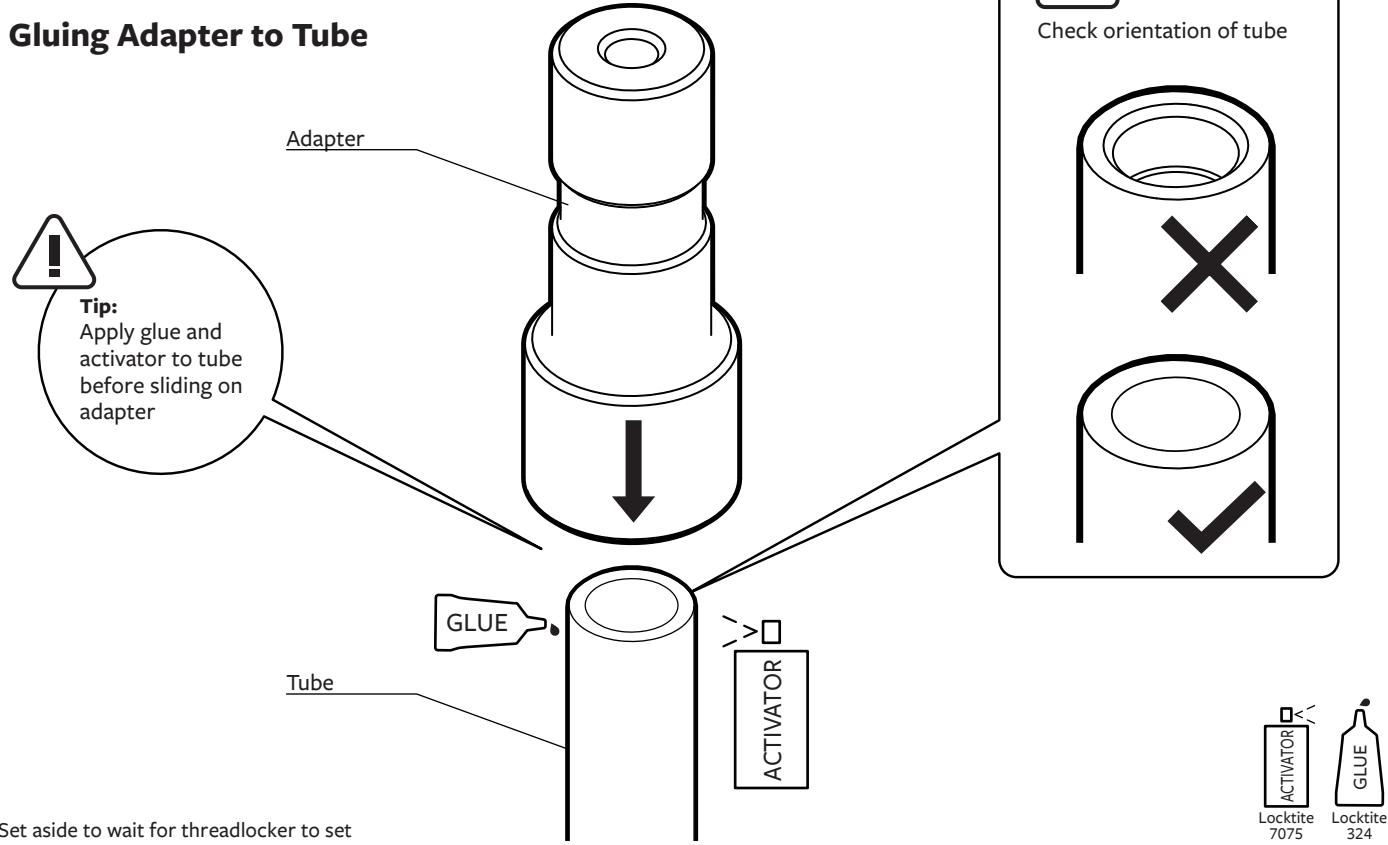
1.

Screw Brass Nut Onto Threaded Rod



2.

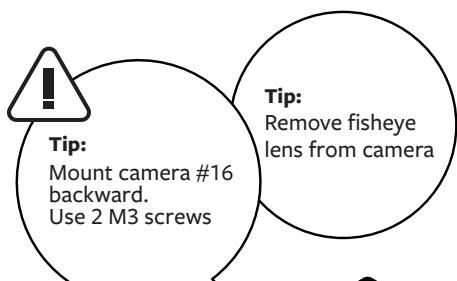
Gluing Adapter to Tube



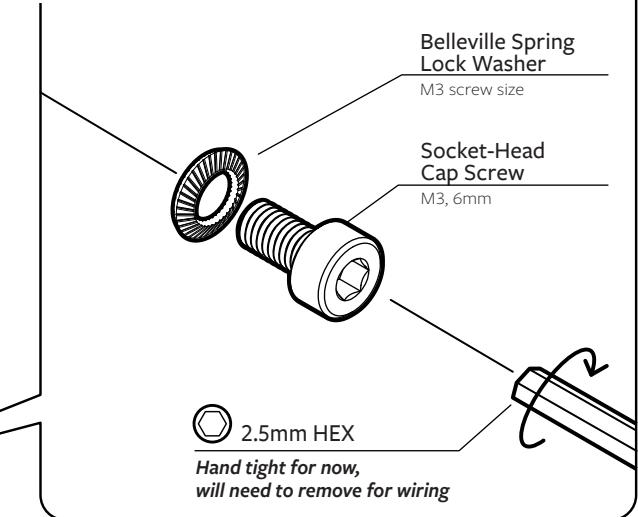
3

3.

Bottom Camera (#16) & Camera Bracket

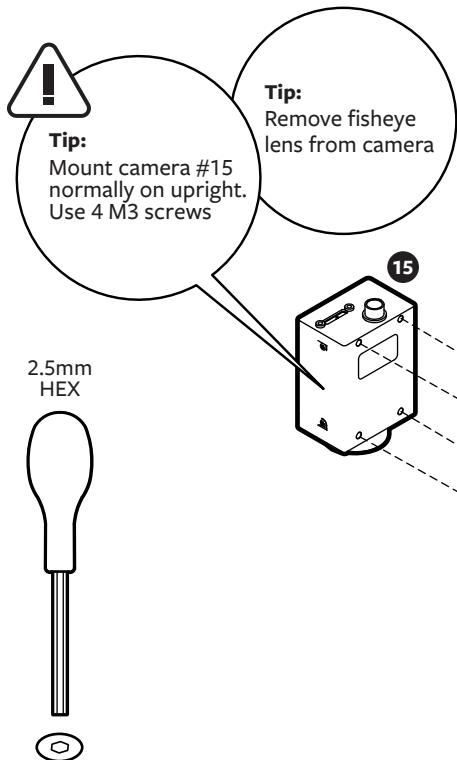


2x

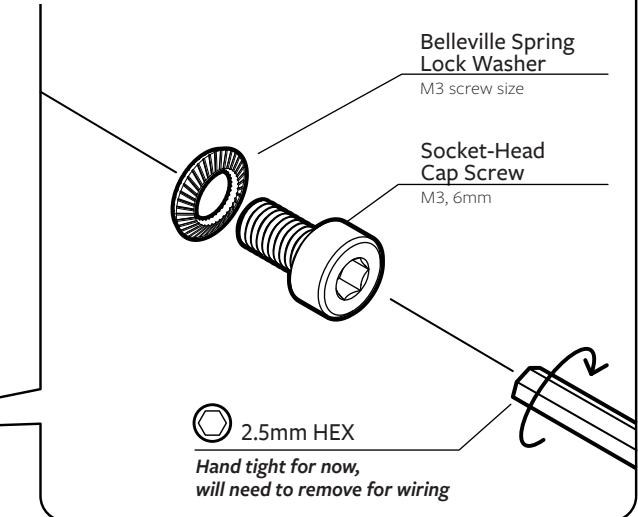


4.

Bottom Camera (#15) & Upright



4x

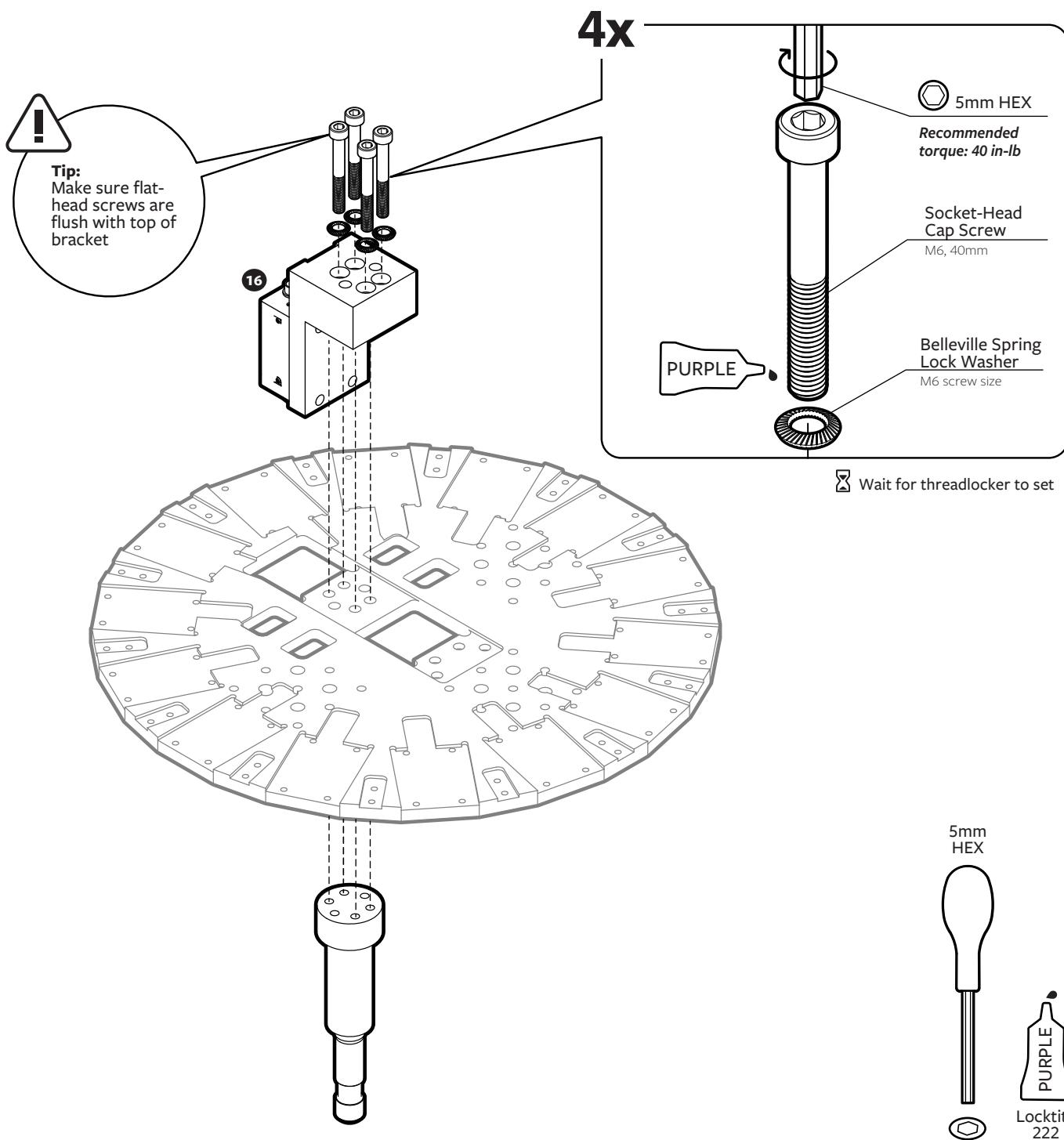
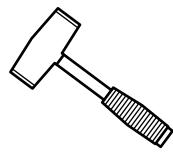


3

5. Camera Bracket & Post

Assembly Note

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



3

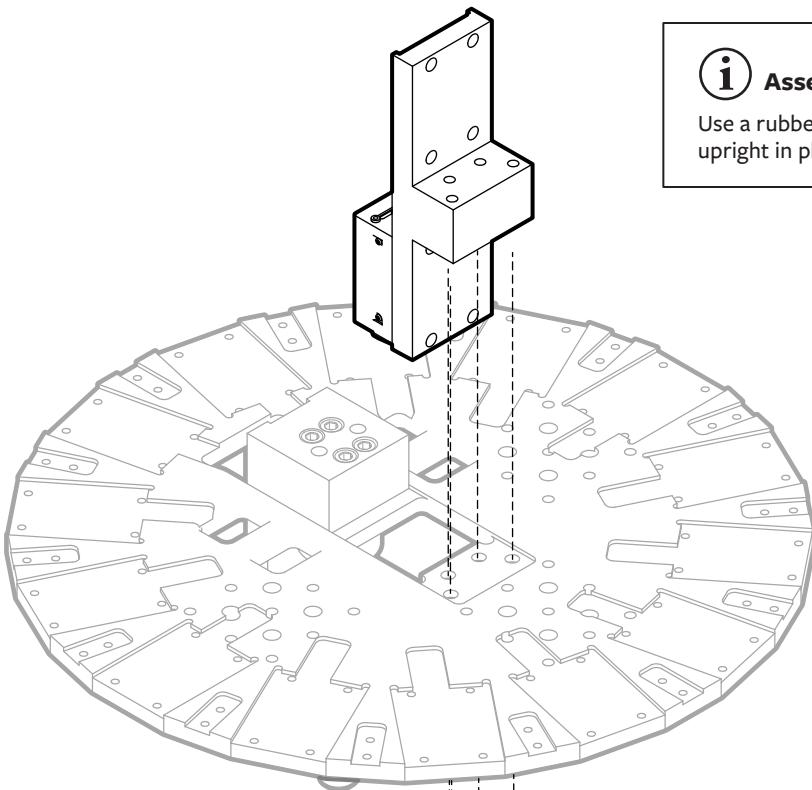
6. Upright



Assembly Note

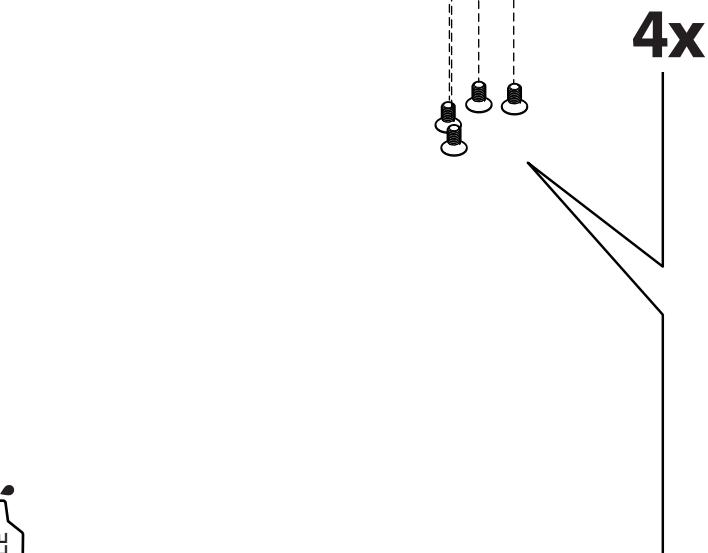
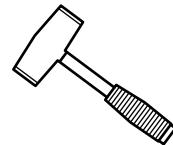


Flip 180° to tighten screws

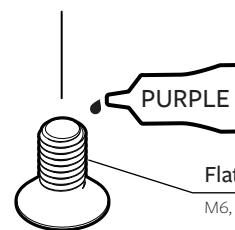


i Assembly Note

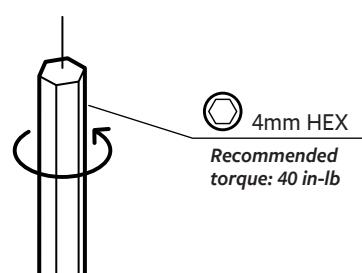
Use a rubber mallet to gently tap upright in place if fitting is too tight



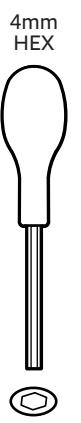
4X



PURPLE
Flat-Head Screw
M6, 12mm



4mm HEX
Recommended
torque: 40 in-lb



Wait for threadlocker to set

3

7.

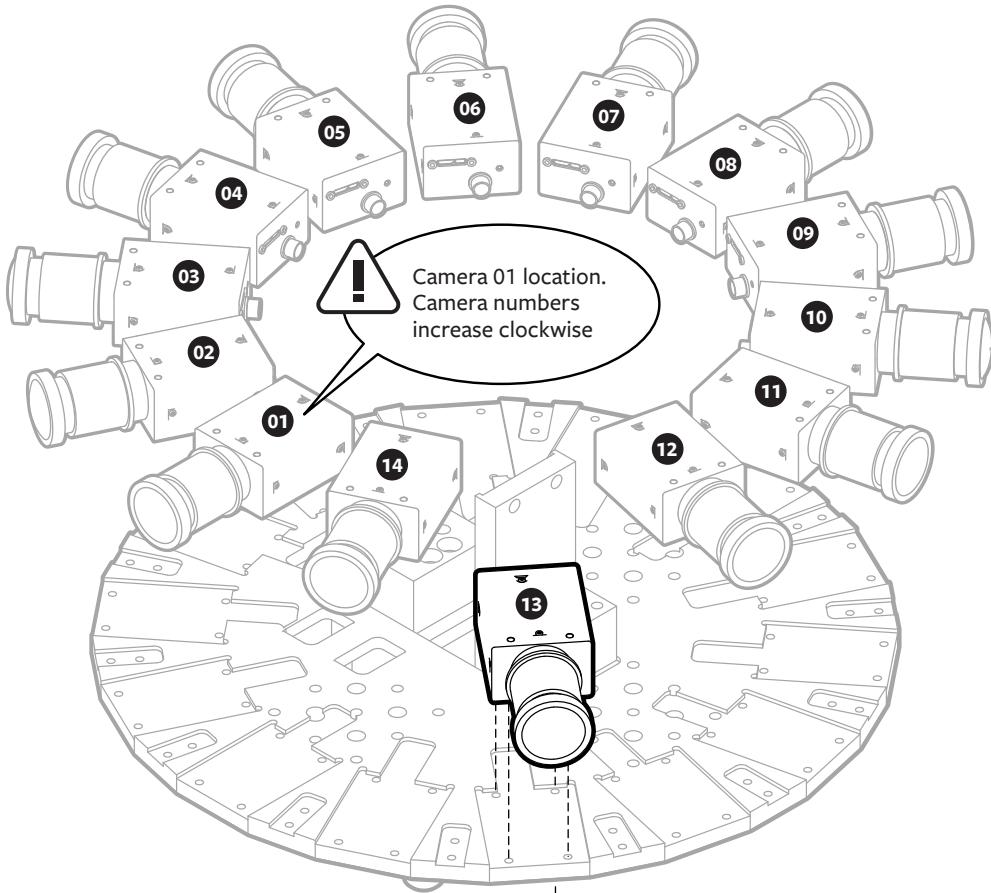
Side Cameras (Camera #01-14)



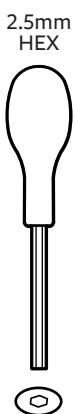
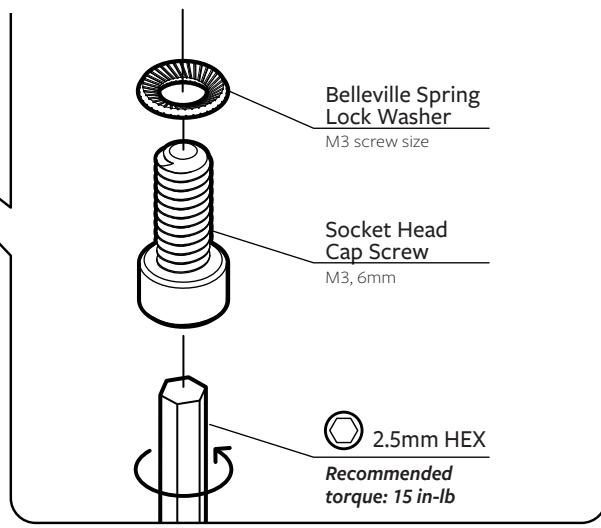
Assembly Note



Flip 180° to tighten screws



56x



3

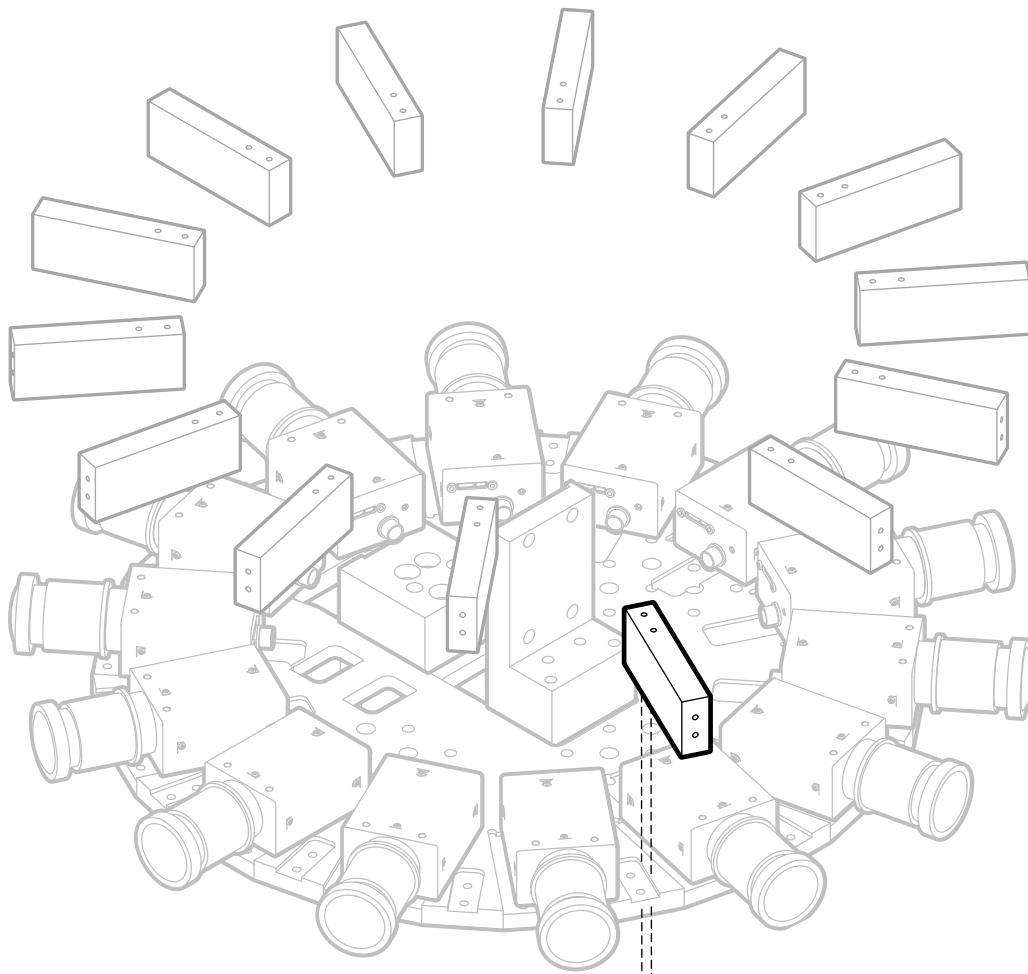
8. Blocks



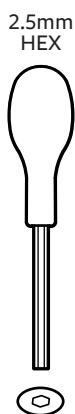
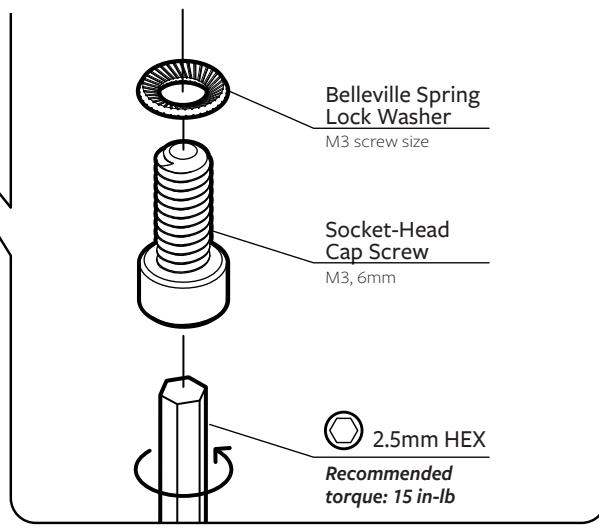
Assembly Note



Flip 180° to tighten screws



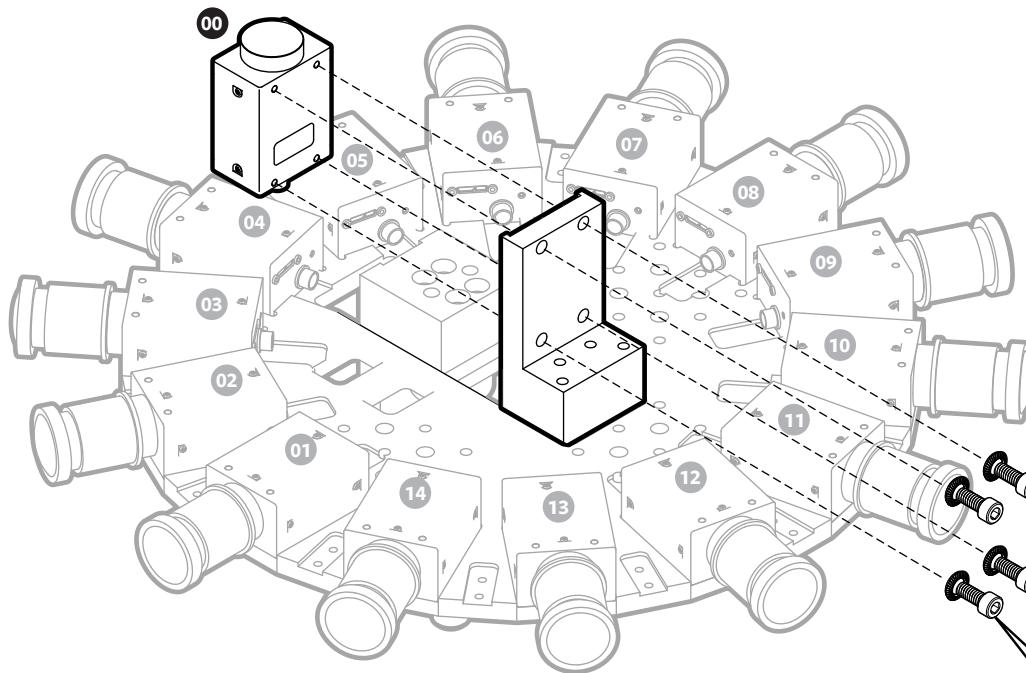
28x



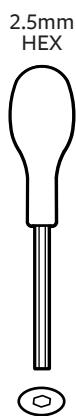
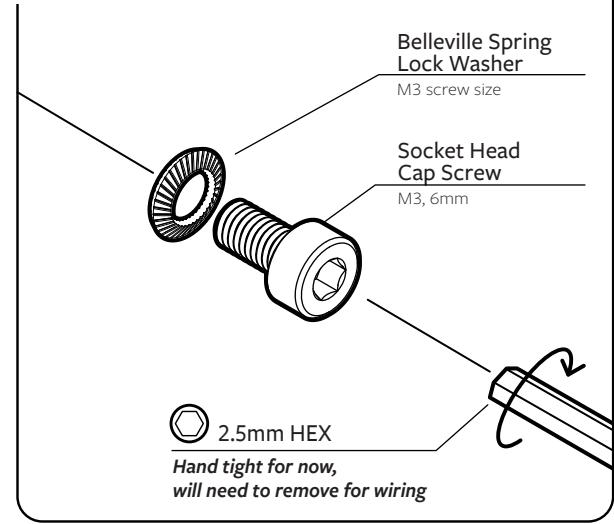
3

9.

Top Camera (Camera #00)



4x



3

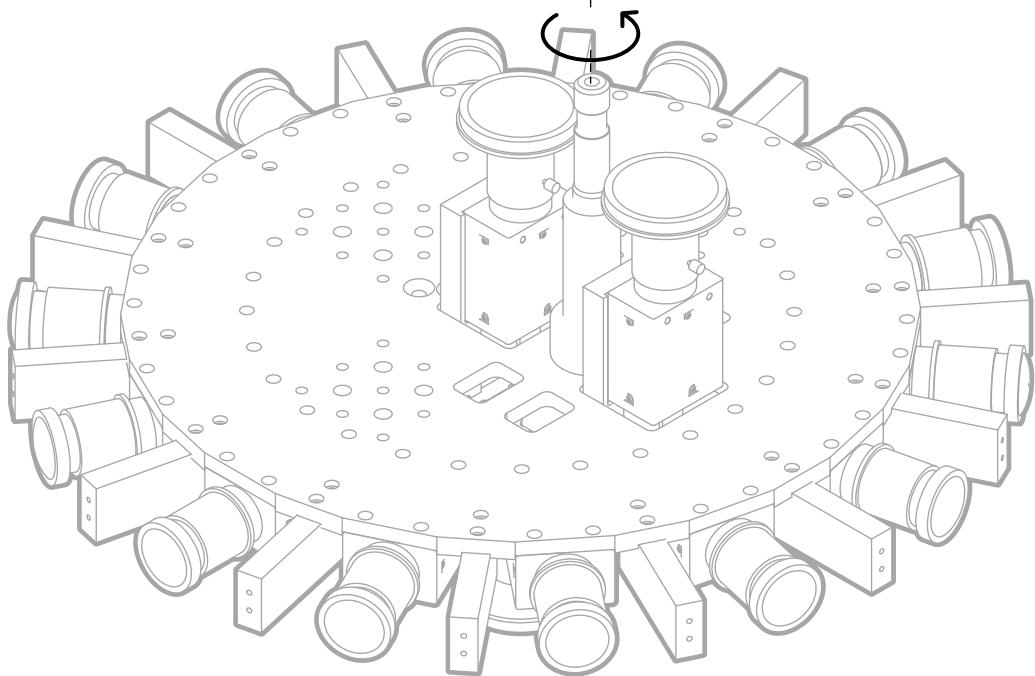
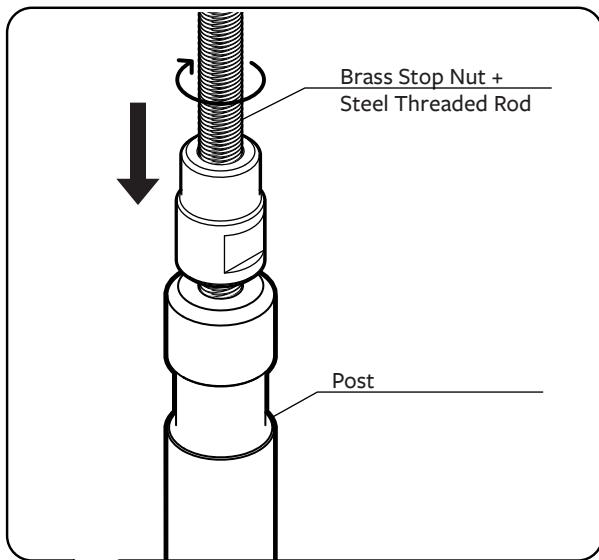
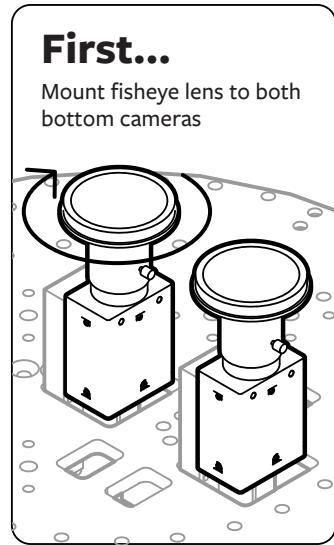
10.

Threaded Rod & Stop Nut



Assembly Note
Flip 180° for this step

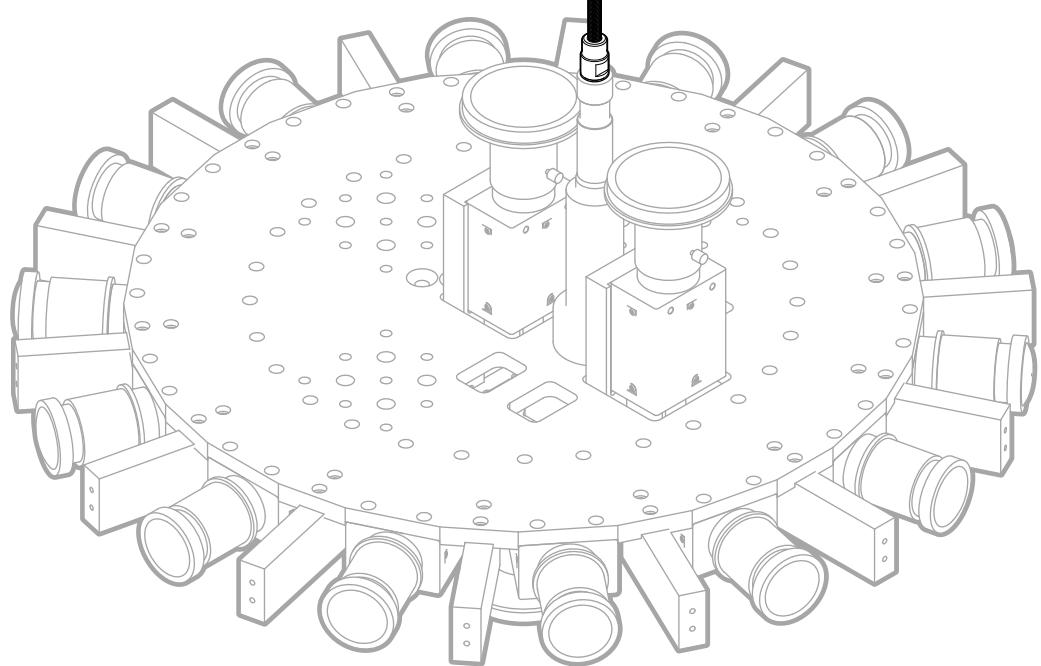
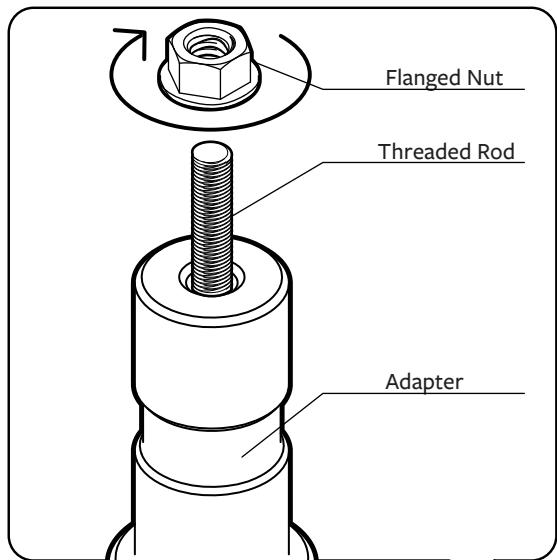
180°



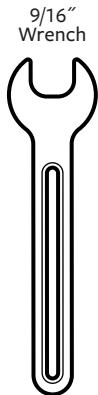
3

11. Tube & Adapter

Assembly Note  180°
Flip 180° for this step



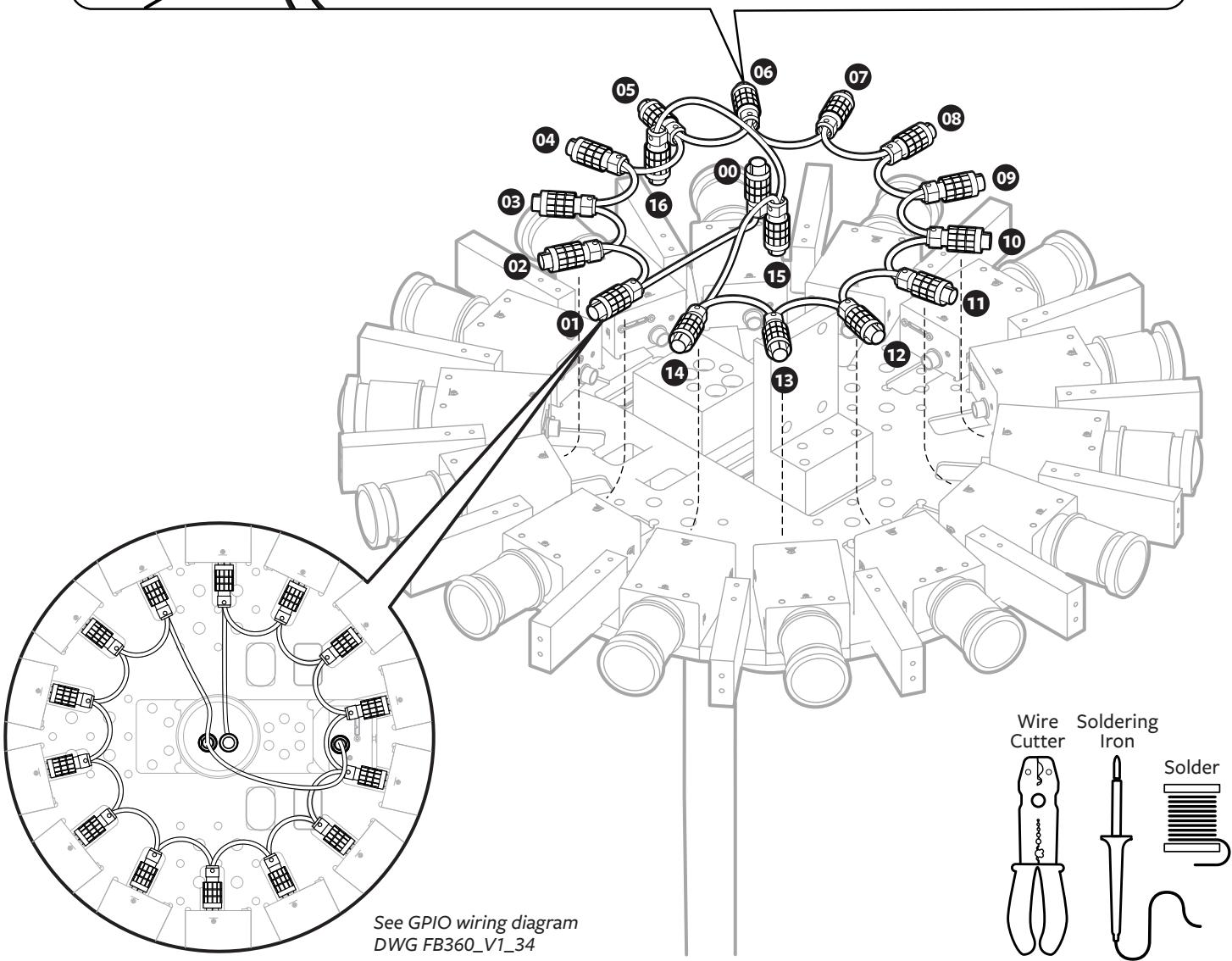
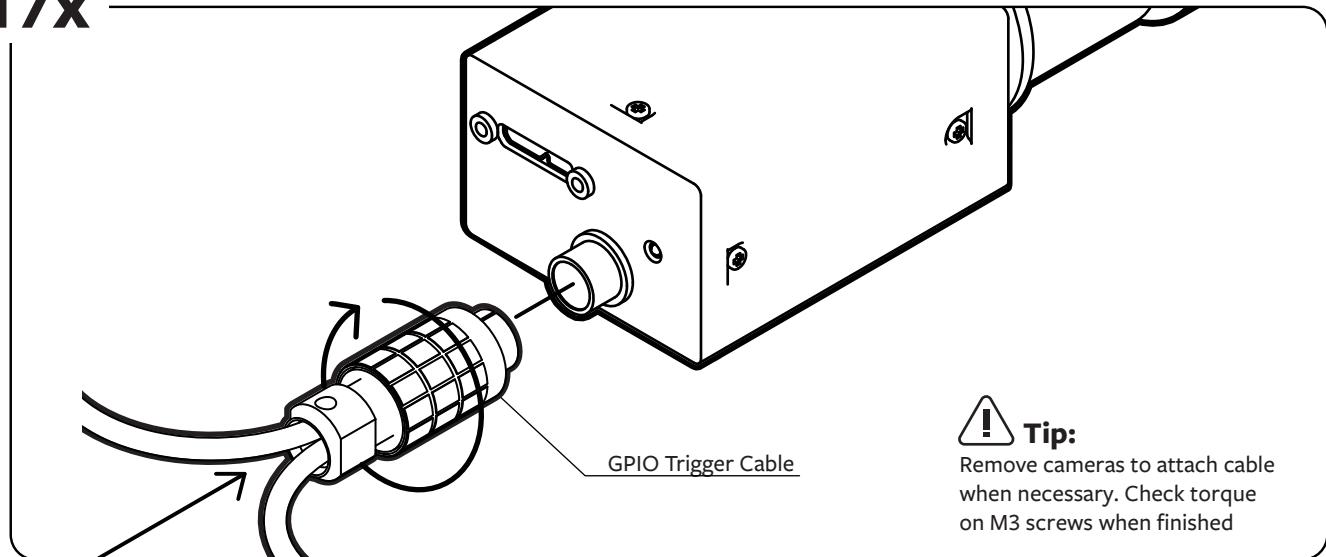
Tip:
Be careful not to overtighten flange nut



3

12. GPIO Trigger Cable

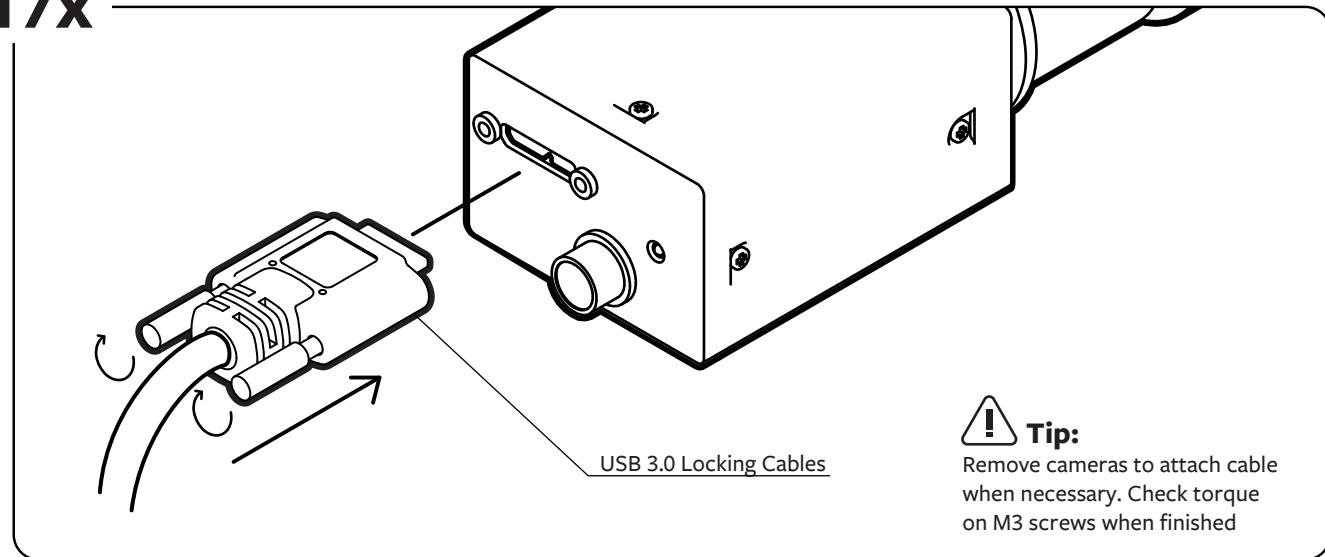
17x



3

13. USB 3.0 Cables

17x



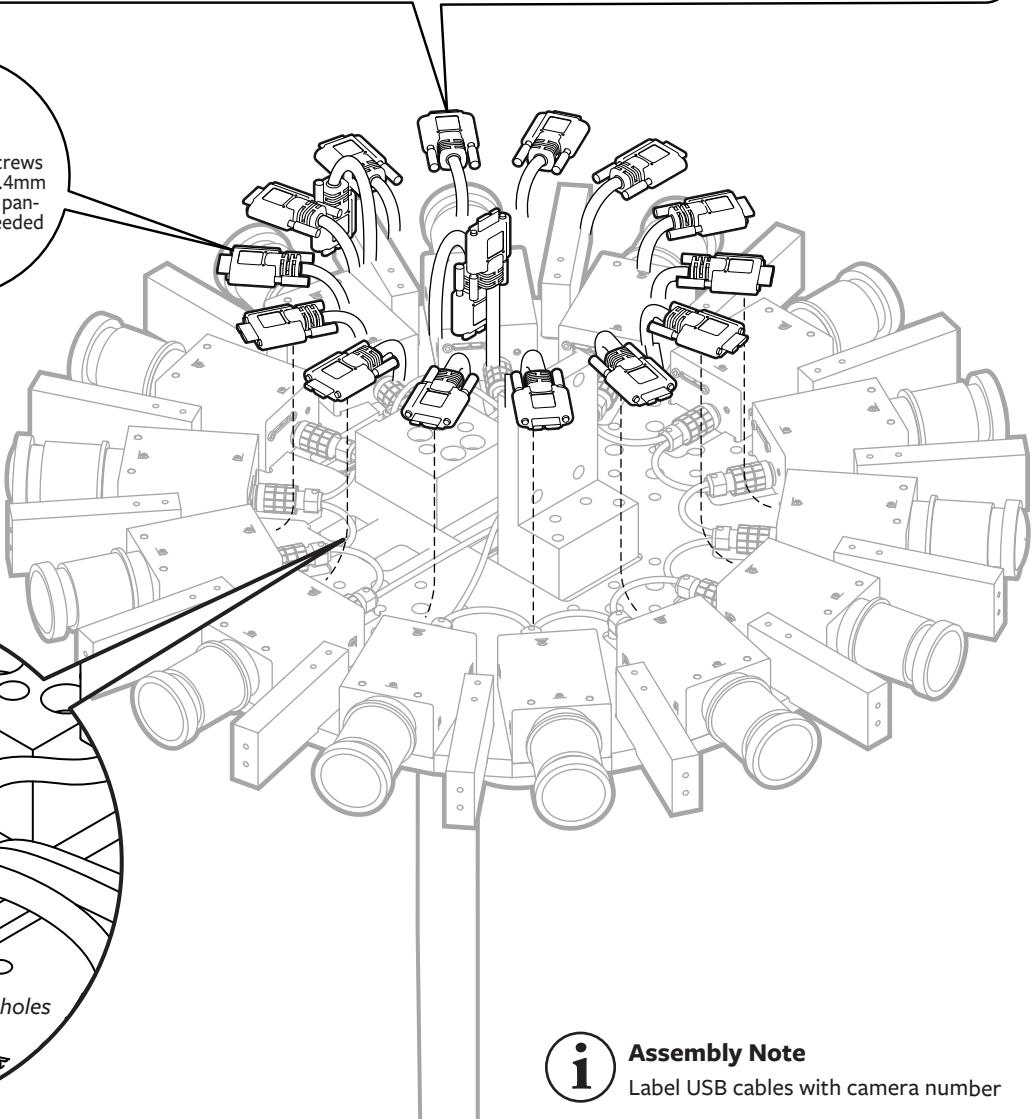
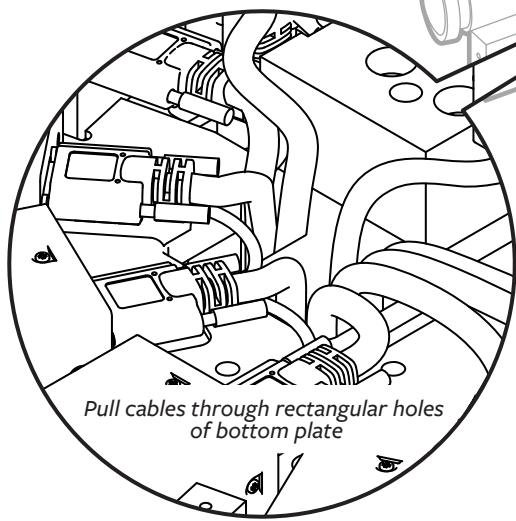
Tip:

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



Tip:

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



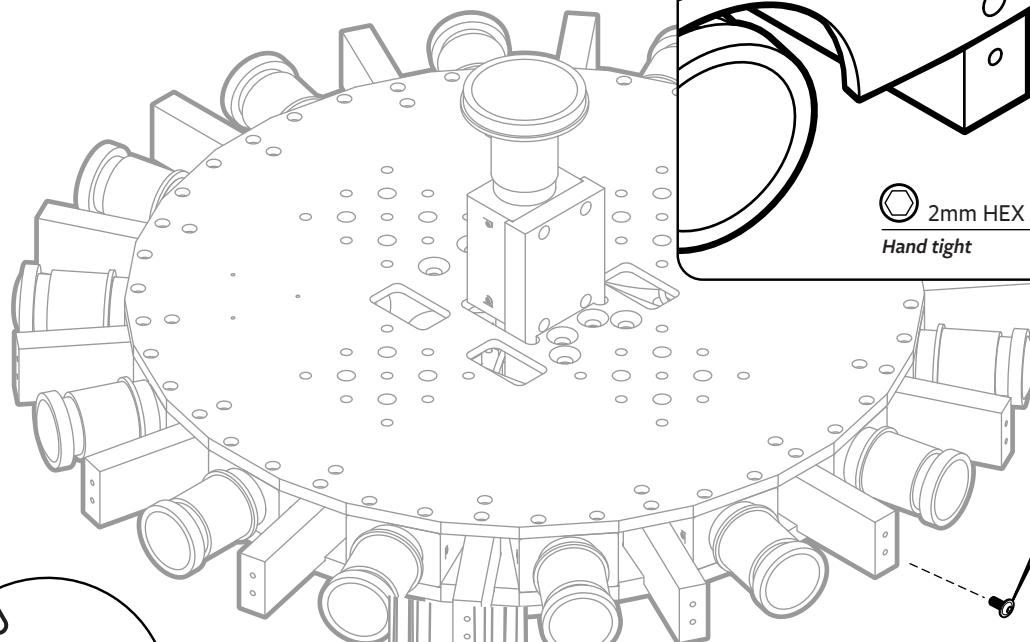
Assembly Note

Label USB cables with camera number

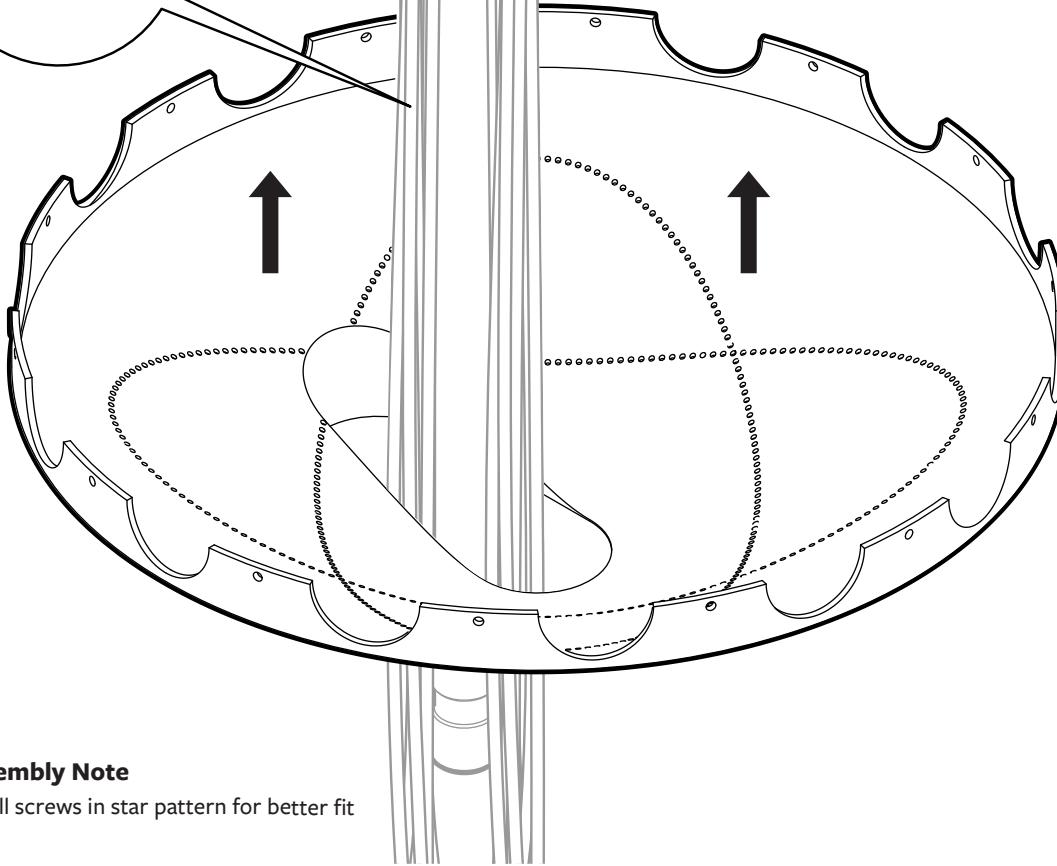
3

14.

Bottom Shell

**Tip:**

All USB cables should fit through opening of bottom shell

**Assembly Note**

Install screws in star pattern for better fit

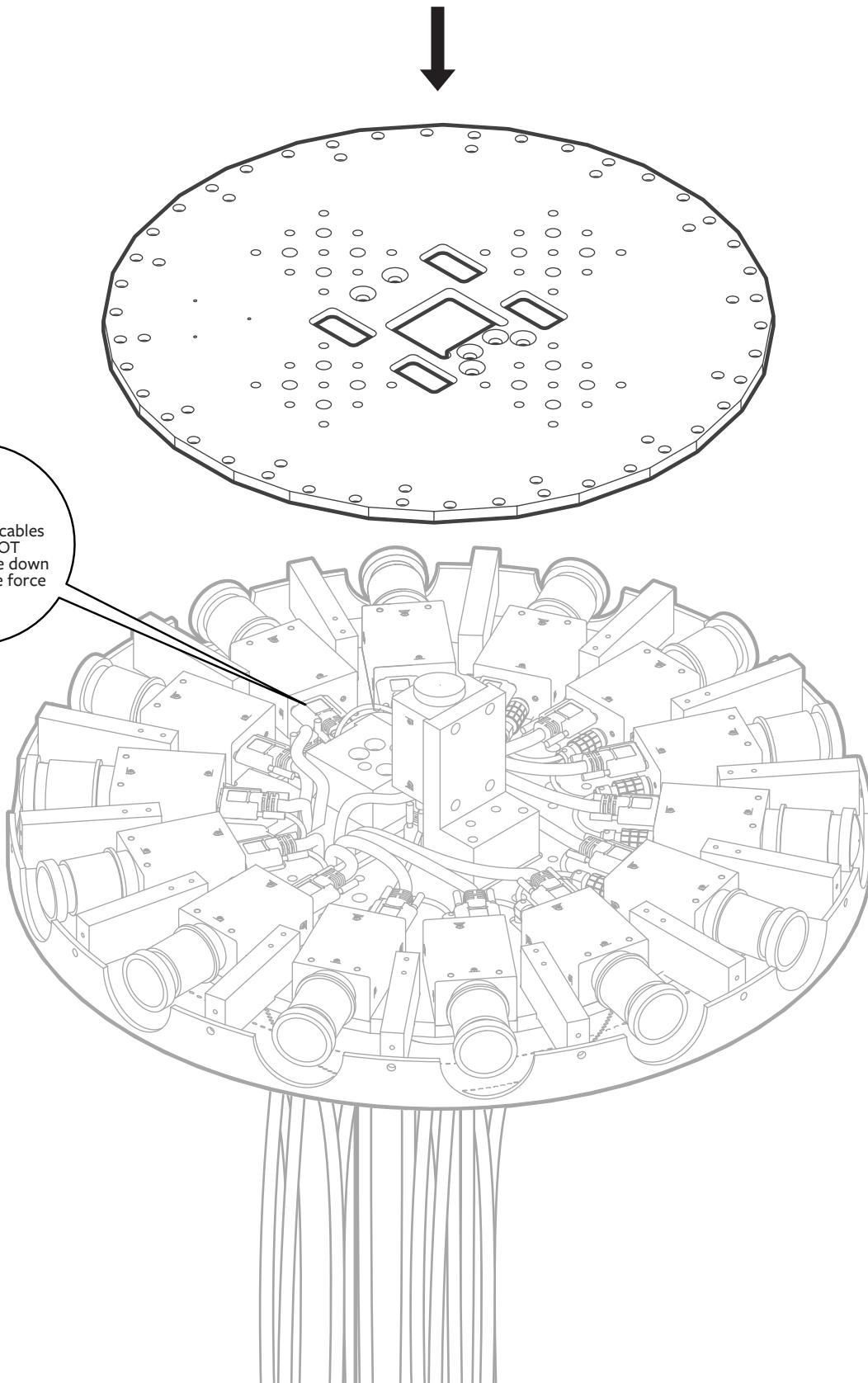
3

15. Top Plate



Assembly Note

Optional: Connect cameras to computer to test first



3

16.

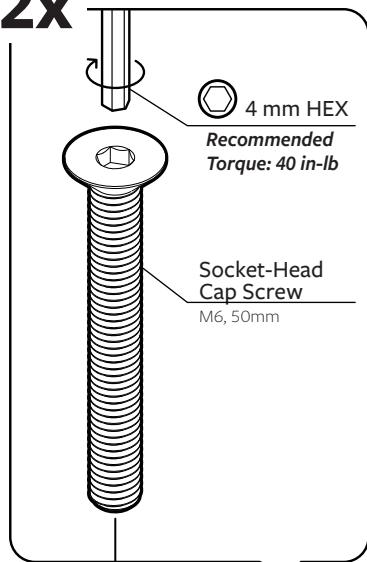
Top Plate Hardware



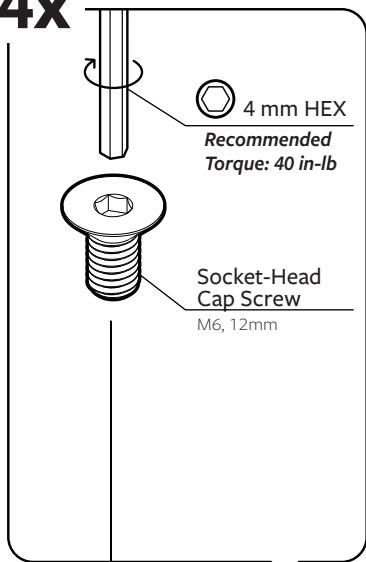
Assembly Note

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

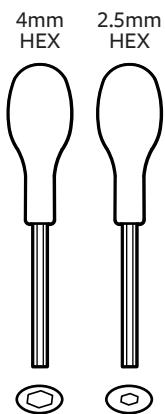
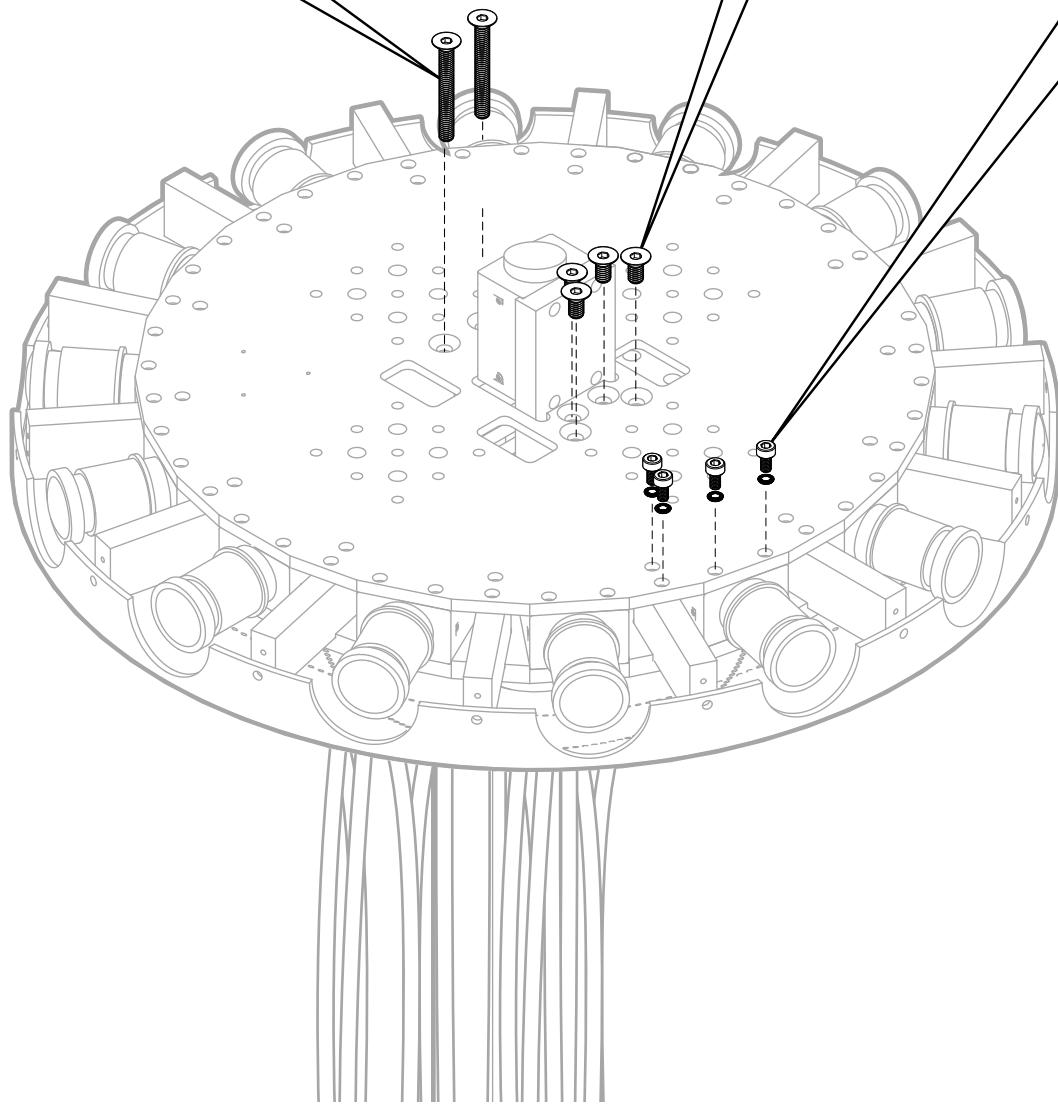
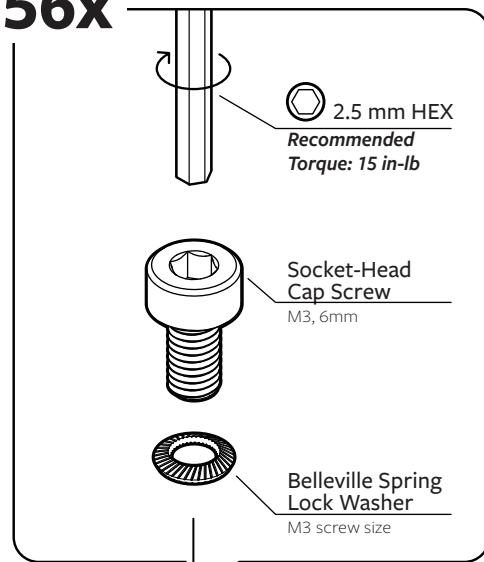
2x



4x



56x



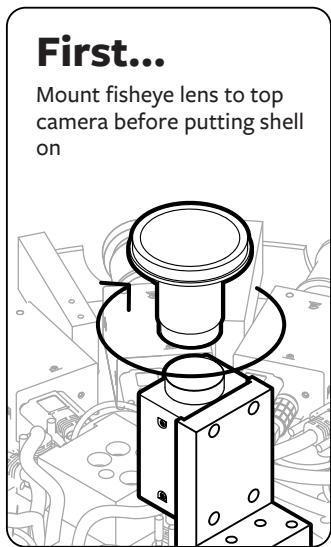
3

17. Top Shell

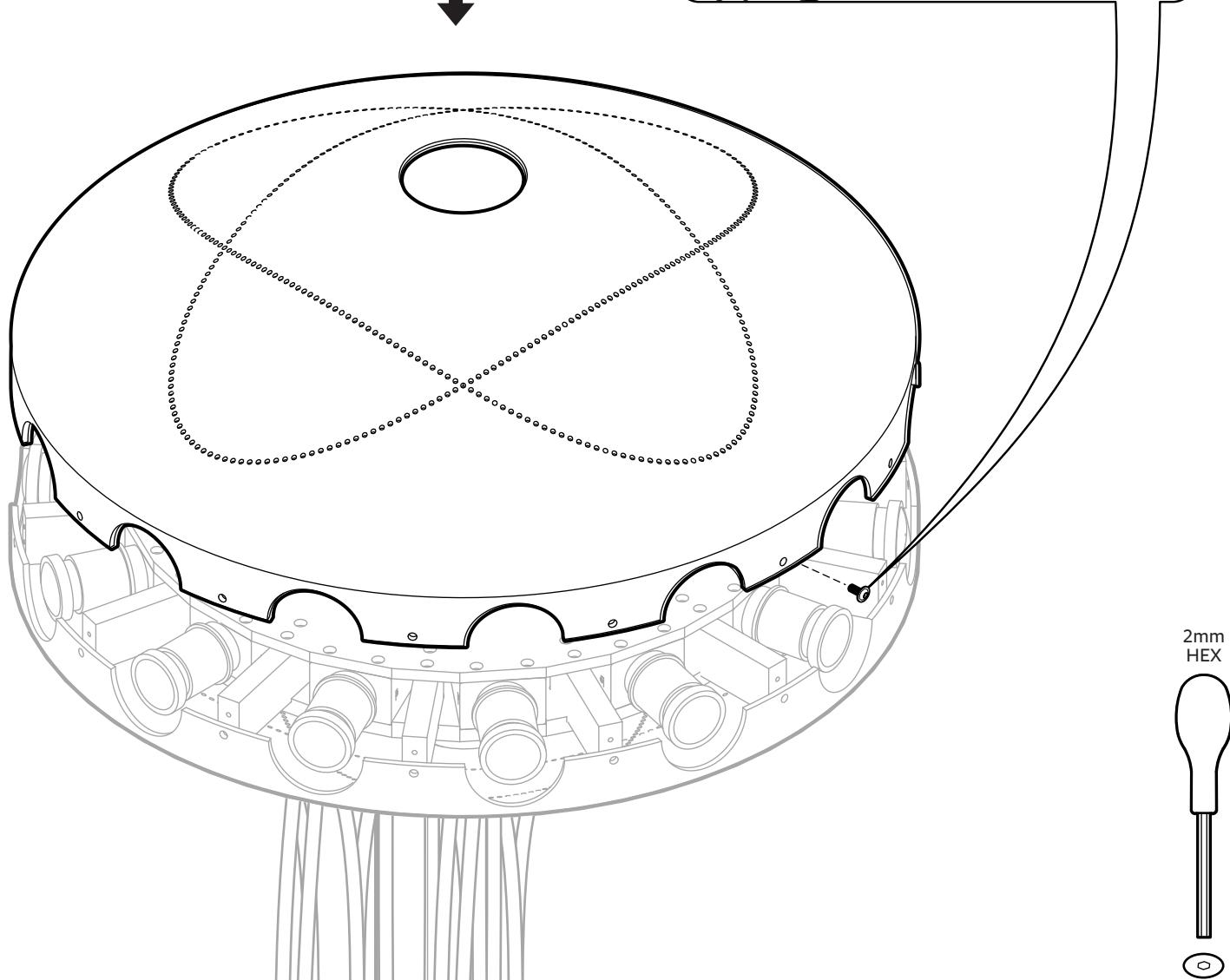
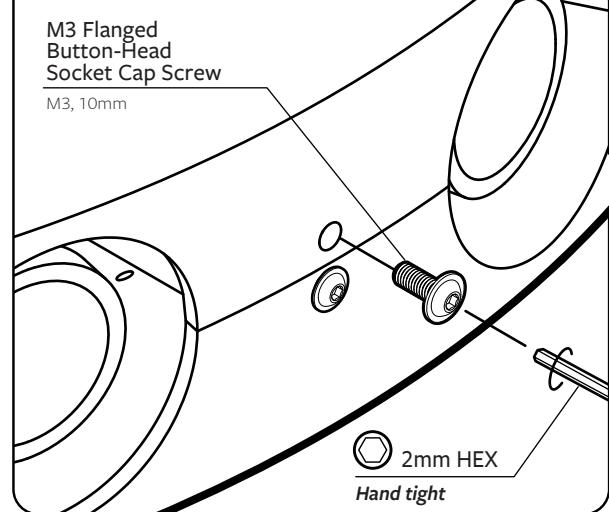


Assembly Note

Install screws in star pattern for better fit



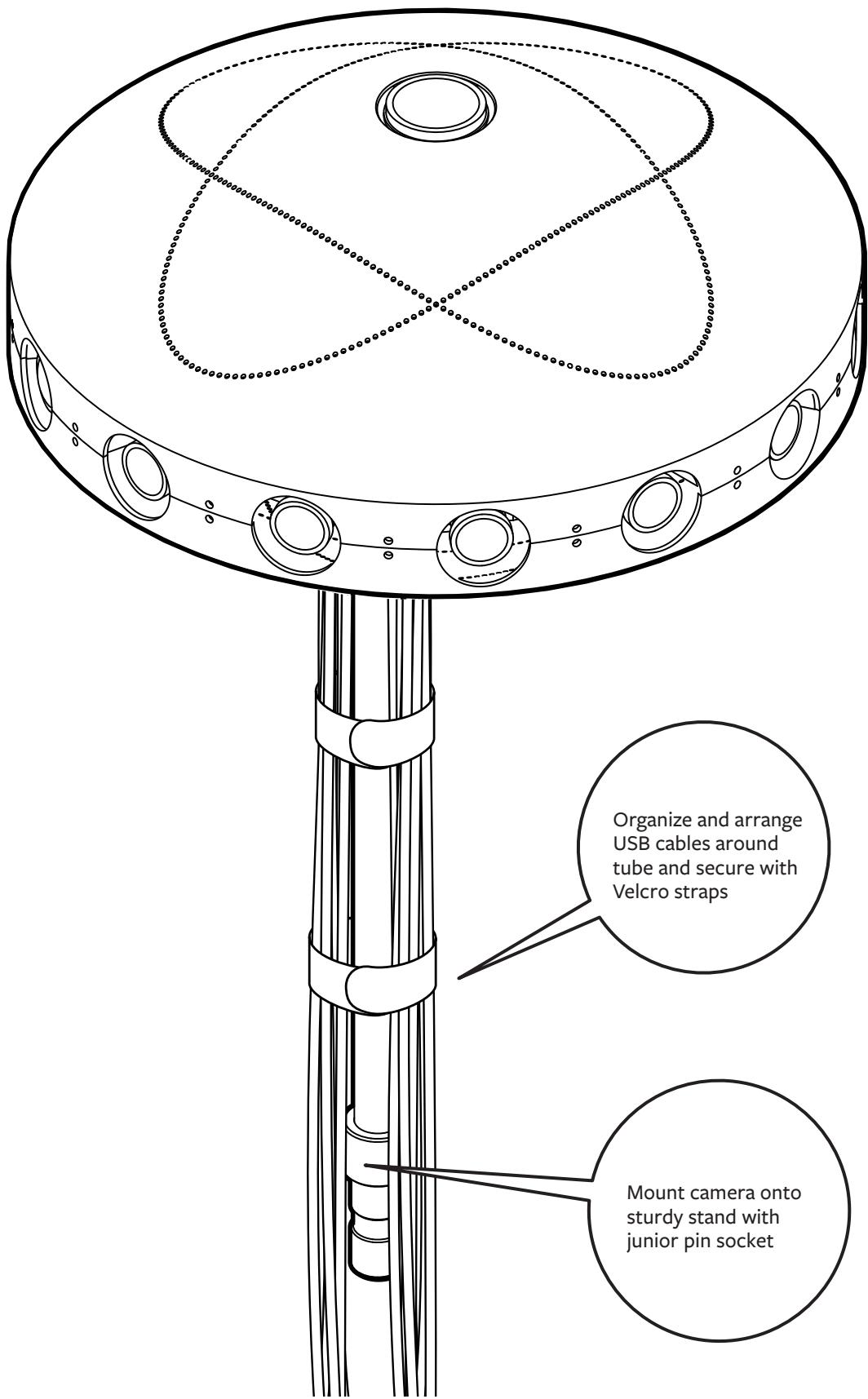
14x



3

18.

Cable Management & Stand



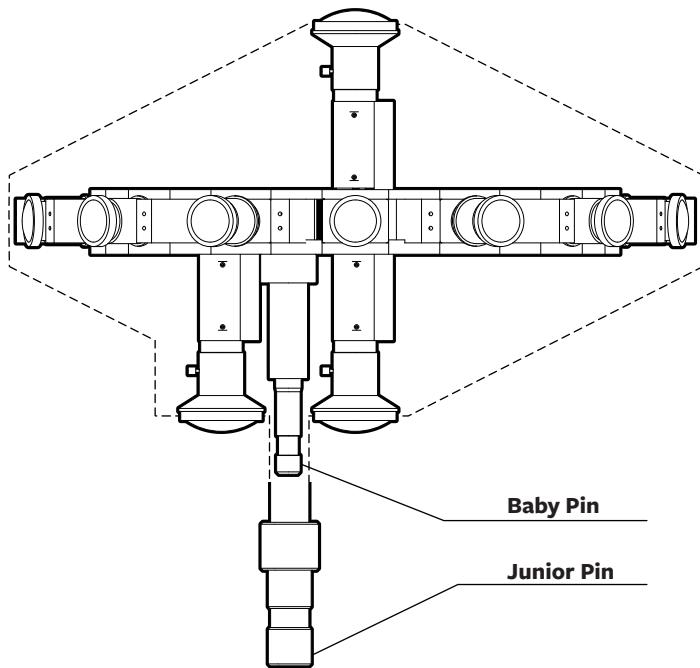
4

Camera Info

4

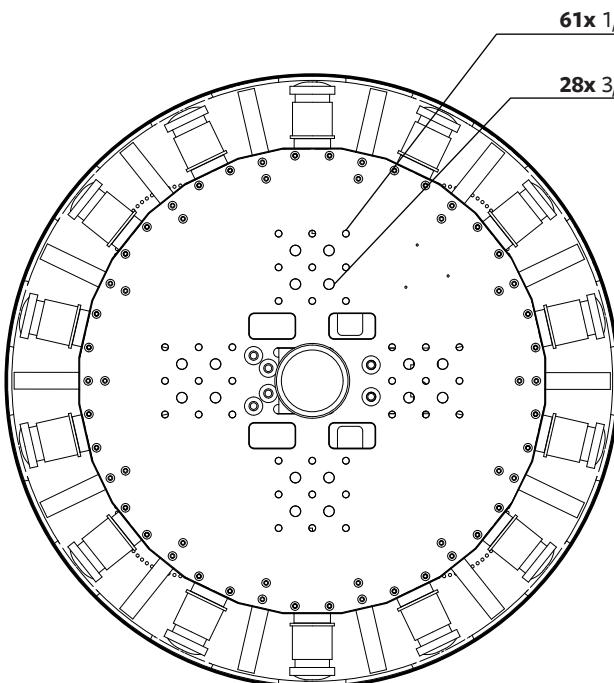
1a.

Mounting the Camera to Standard Grip Equipment

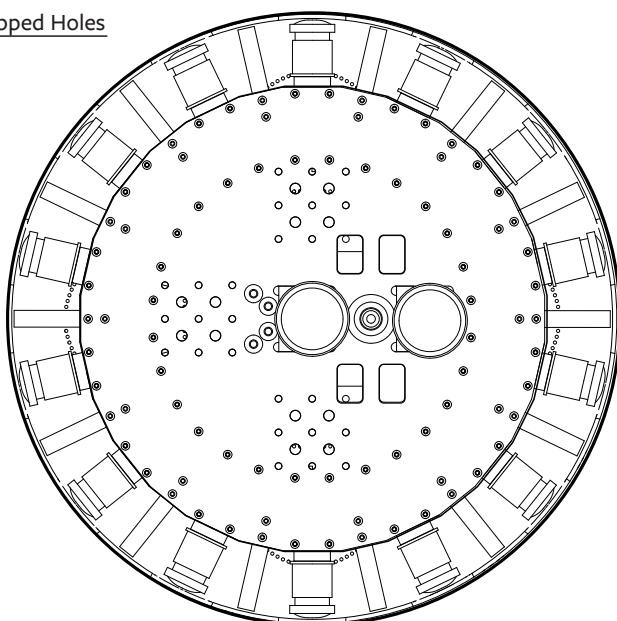


1b.

Attachment Options 89 MULTIPURPOSE MOUNTING HOLES



TOP PLATE

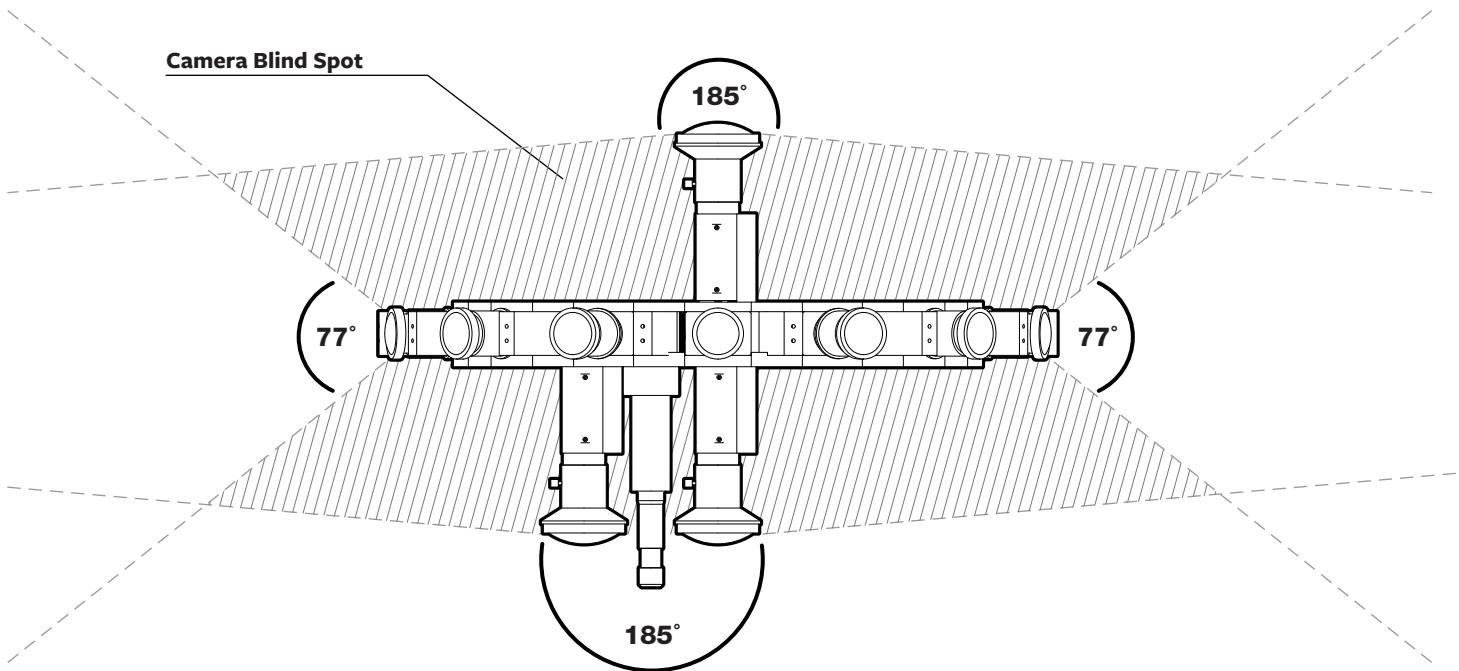


BOTTOM PLATE

4

2a.

Blind Spot for Mounting Accessories



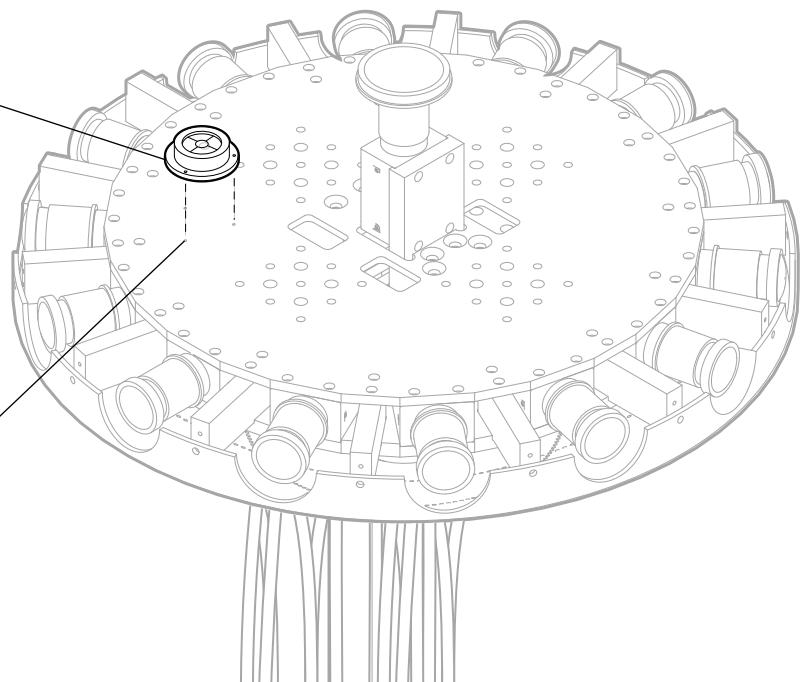
2b.

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



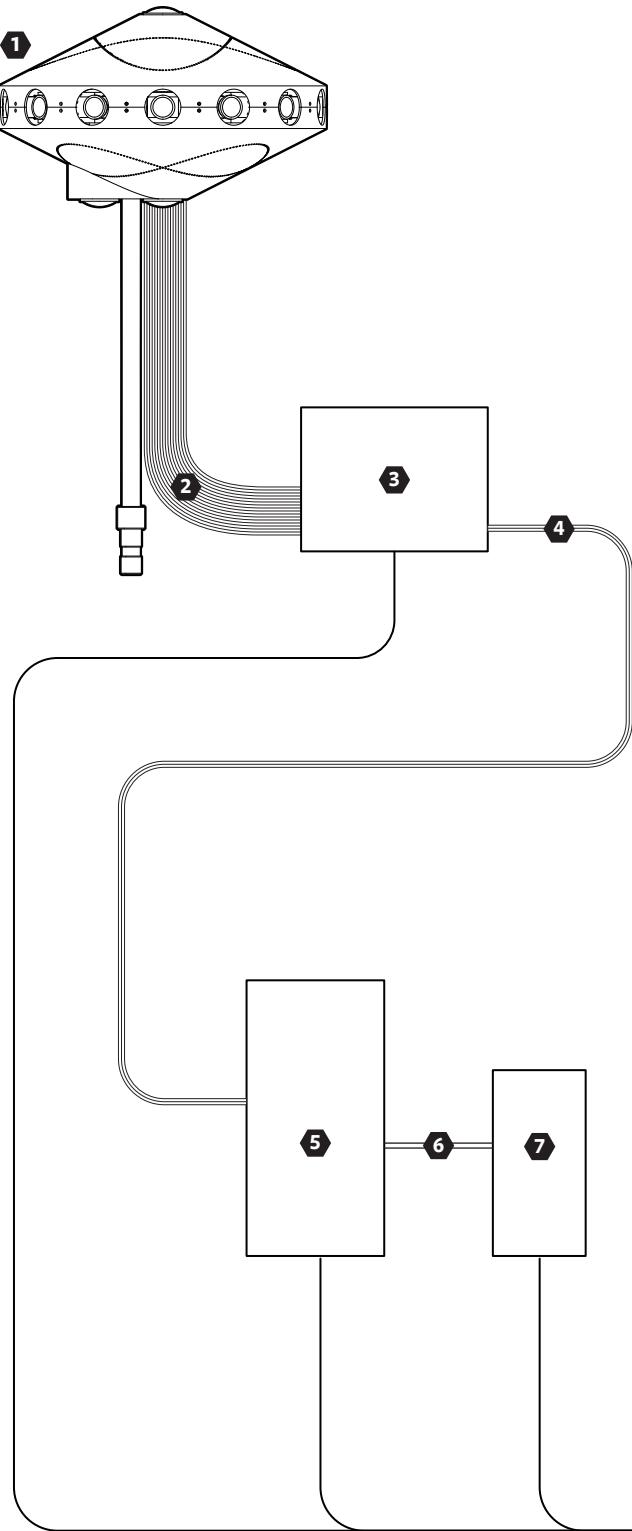
5

System Set Up Instructions

5

1.

Surround 360 System Overview



SURROUND 360 SYSTEM with Fiber Optic Extension

- ❶ Surround 360 Camera
- ❷ USB 3.0 High Speed Type A to Micro-B Cables x17
- ❸ Fiber Optic Breakout Box
- ❹ PCIe x8 Active Optical Cable
- ❺ Lunchbox Computer (Computer)
- ❻ SFF-8644 to SFF-8644 MiniSAS Cable x2
- ❼ Raid Tower
- ❽ Power Supply

❶ SURROUND 360 Camera

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

❸ 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

❺ COMPUTER SPECIFICATIONS

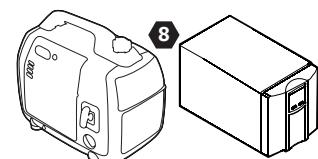
- Intel Core i7-5960X Haswell-E 8-Core 3.0 GHz LGA 2011-v3*
- GIGABYTE GA-X99P-SLI (rev. 1.0) LGA 2011-v3 Intel X99 Motherboard*
- 8GB DDR4 2400 288-PIN Memory ± (64GB of Memory Installed)*
- CPU COOLING FAN FOR LGA 2011-v3*
- 1GB NVIDIA PCIe x16 VIDEO CARD*
- 700 WATT POWER SUPPLY*
- 2.5" 128GB SSD*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

❼ RAID TOWER SPECIFICATIONS

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

❽ POWER SUPPLY

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



*Recommended
† Required

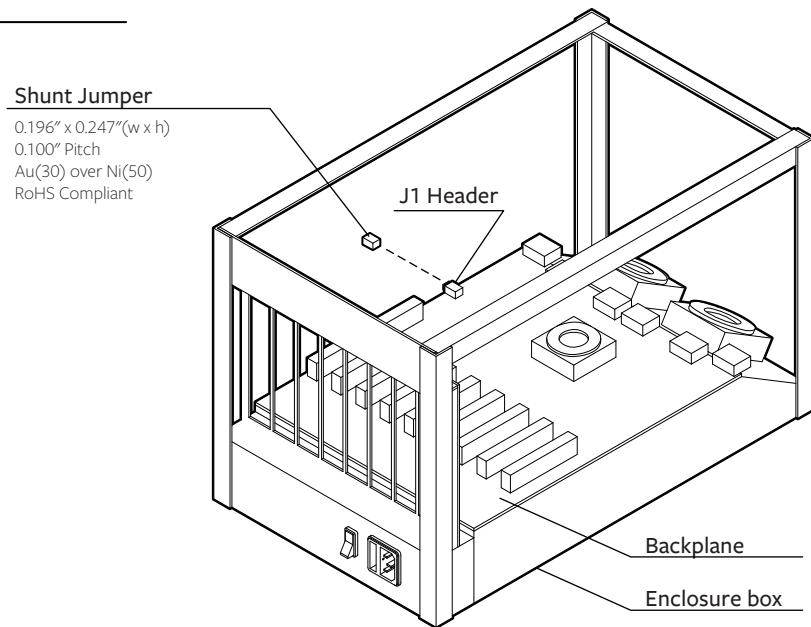
5

2a.

Fiber Optic Breakout Box

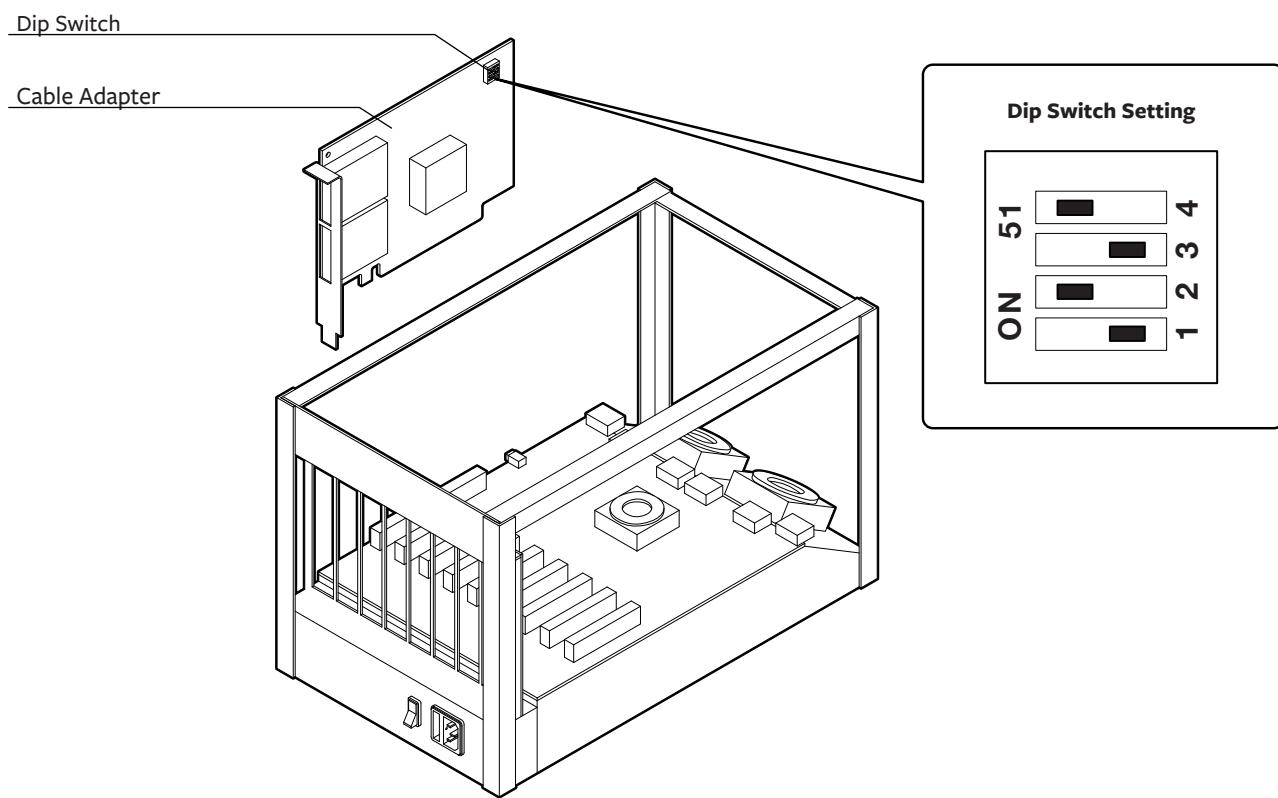
STEP 1

Insert jumper to a header on the backplane labeled J1



STEP 2

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



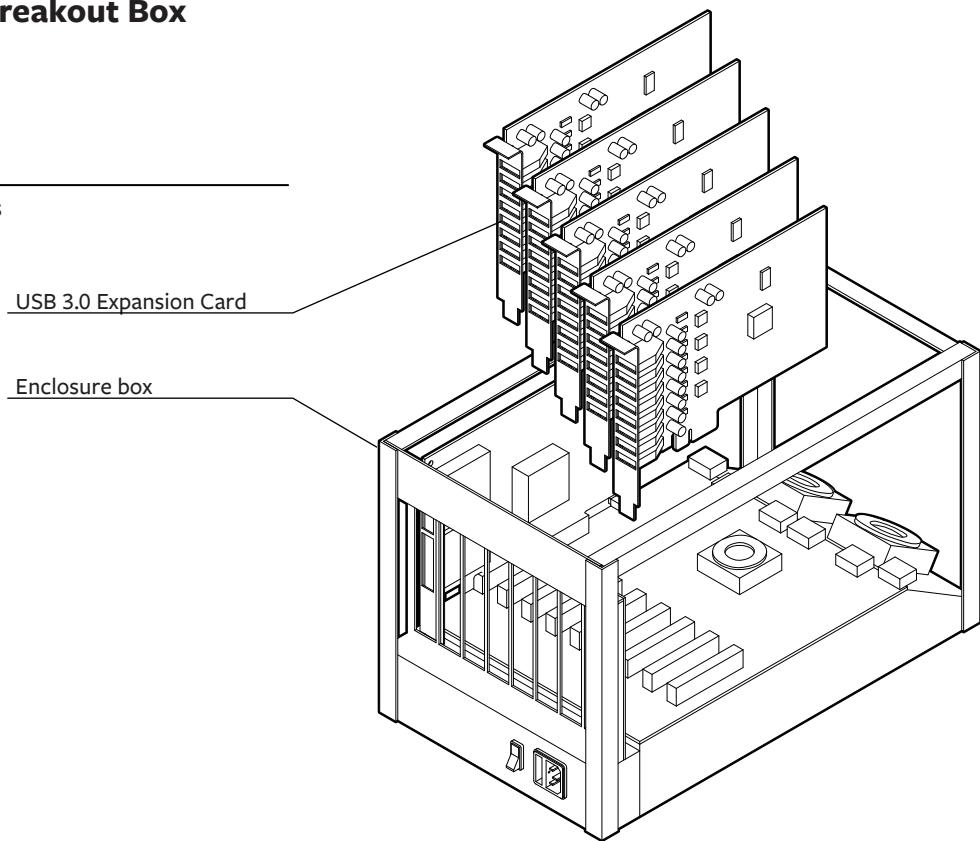
5

2b.

Fiber Optic Breakout Box

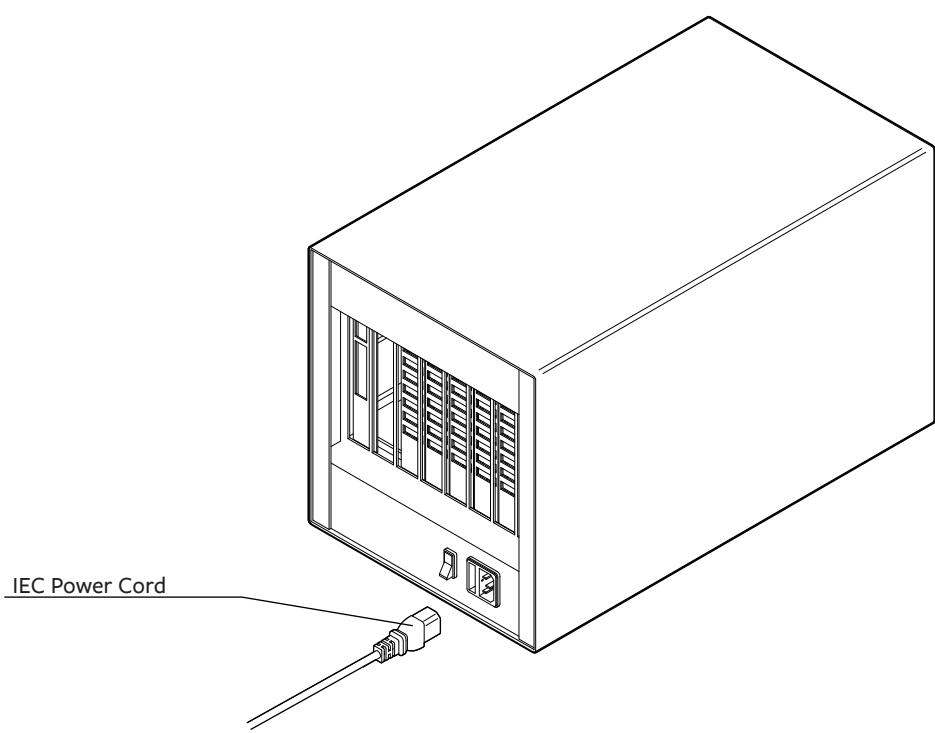
STEP 3

Insert 5 PCIe x4 USB 3.0 Expansion Cards



STEP 4

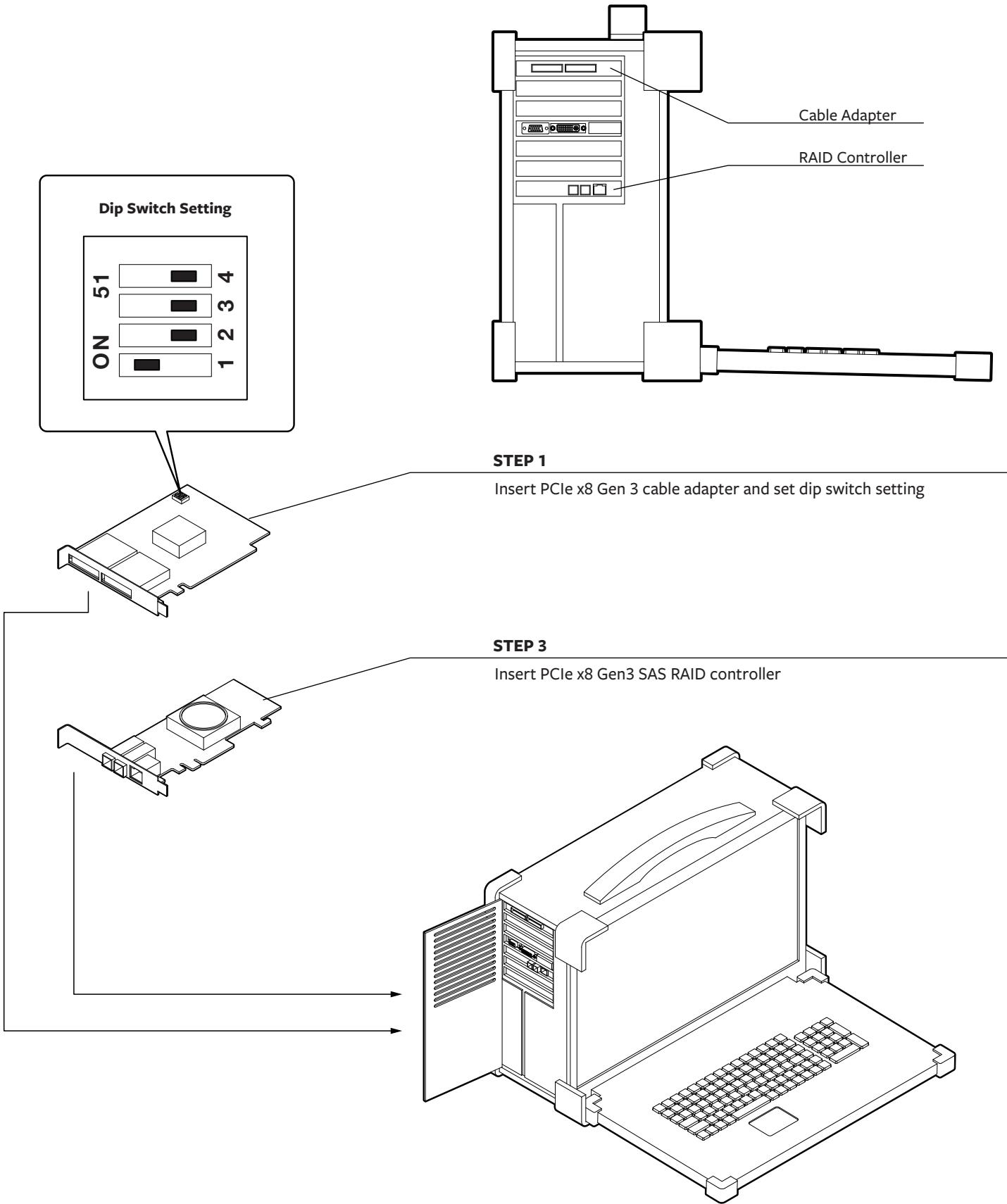
Close enclosure and connect power cable



5

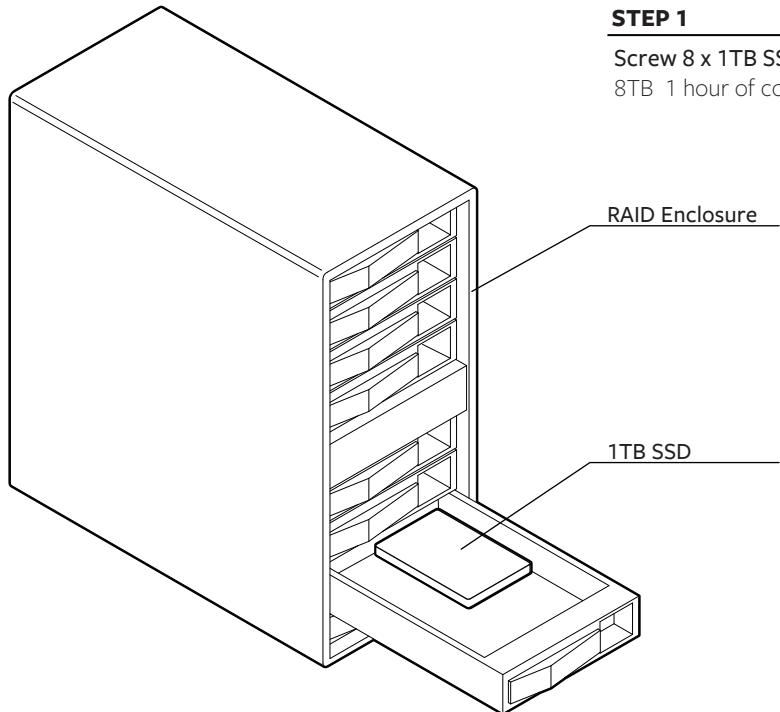
3.

Computer - Lunchbox PC



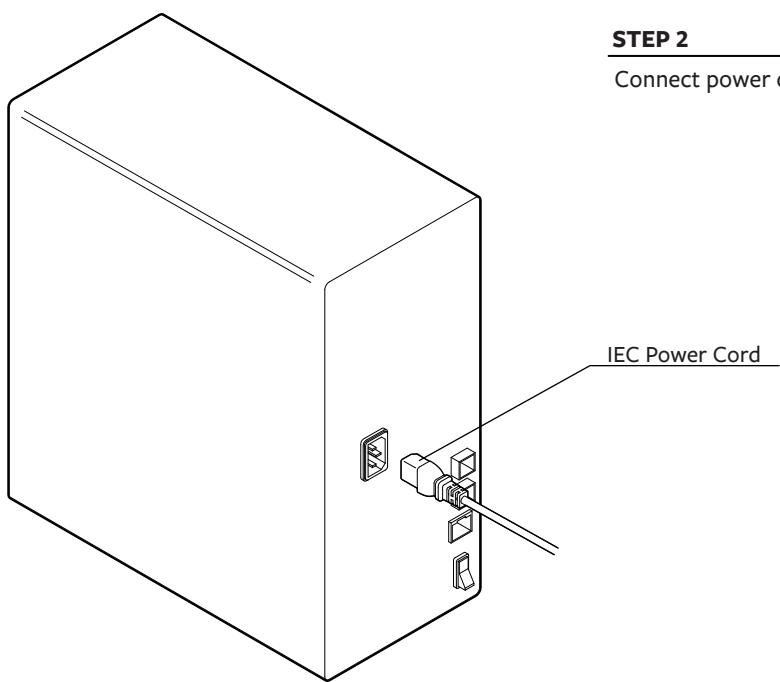
5

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

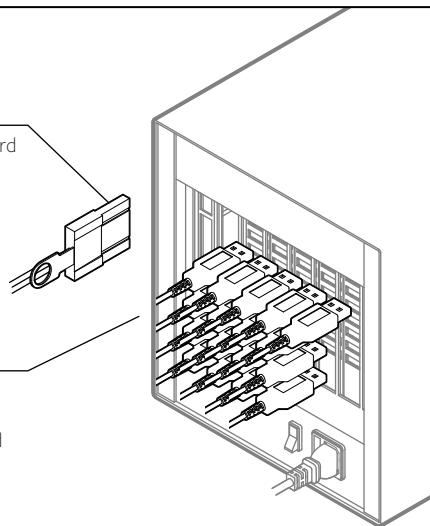
5

5. Cable Connections

Fiber Optic Breakout Box

PCIe x8 Active Optical Cable

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

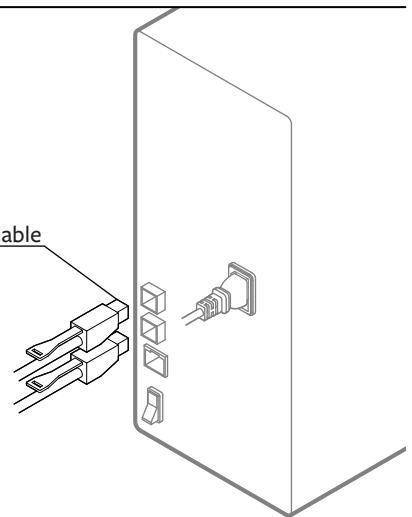


17 x USB 3.0 Cables

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

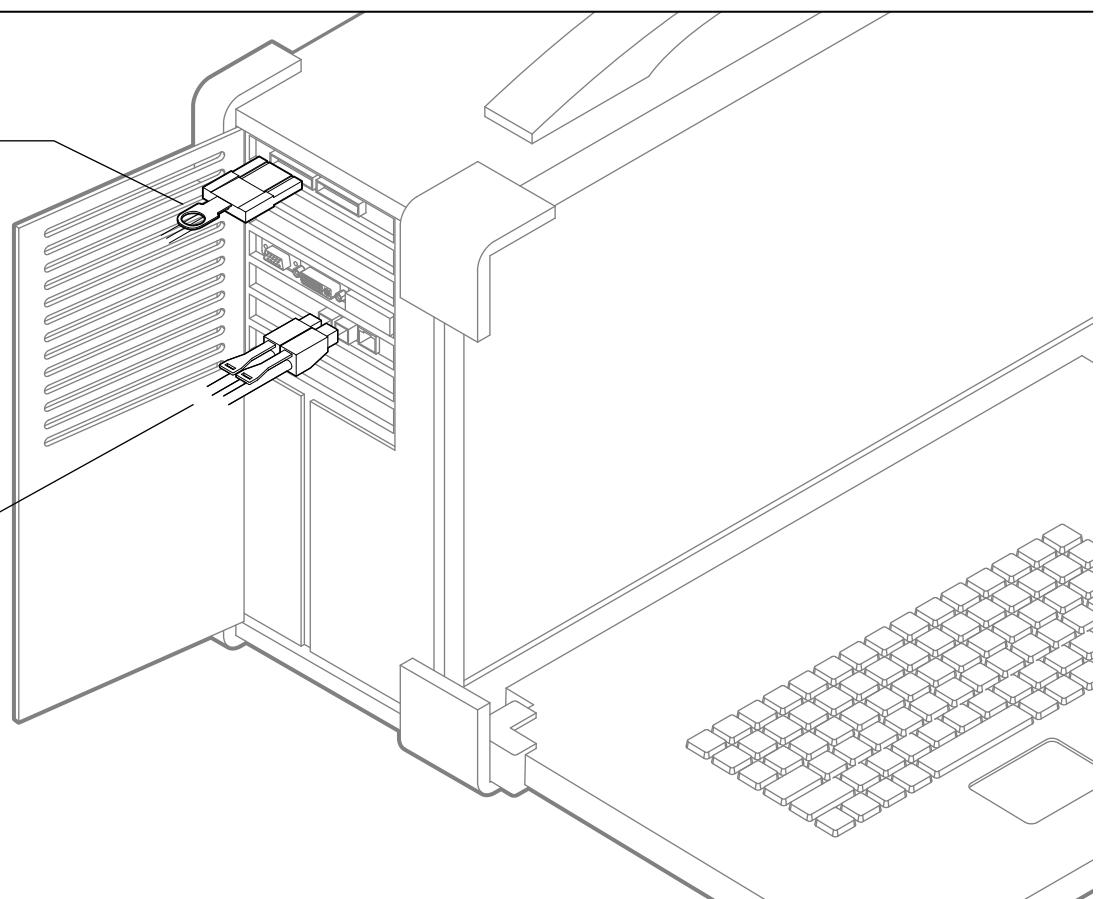


Computer

PCIe x8 Active Optical Cable

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

External 4x HD Mini-SAS Cable

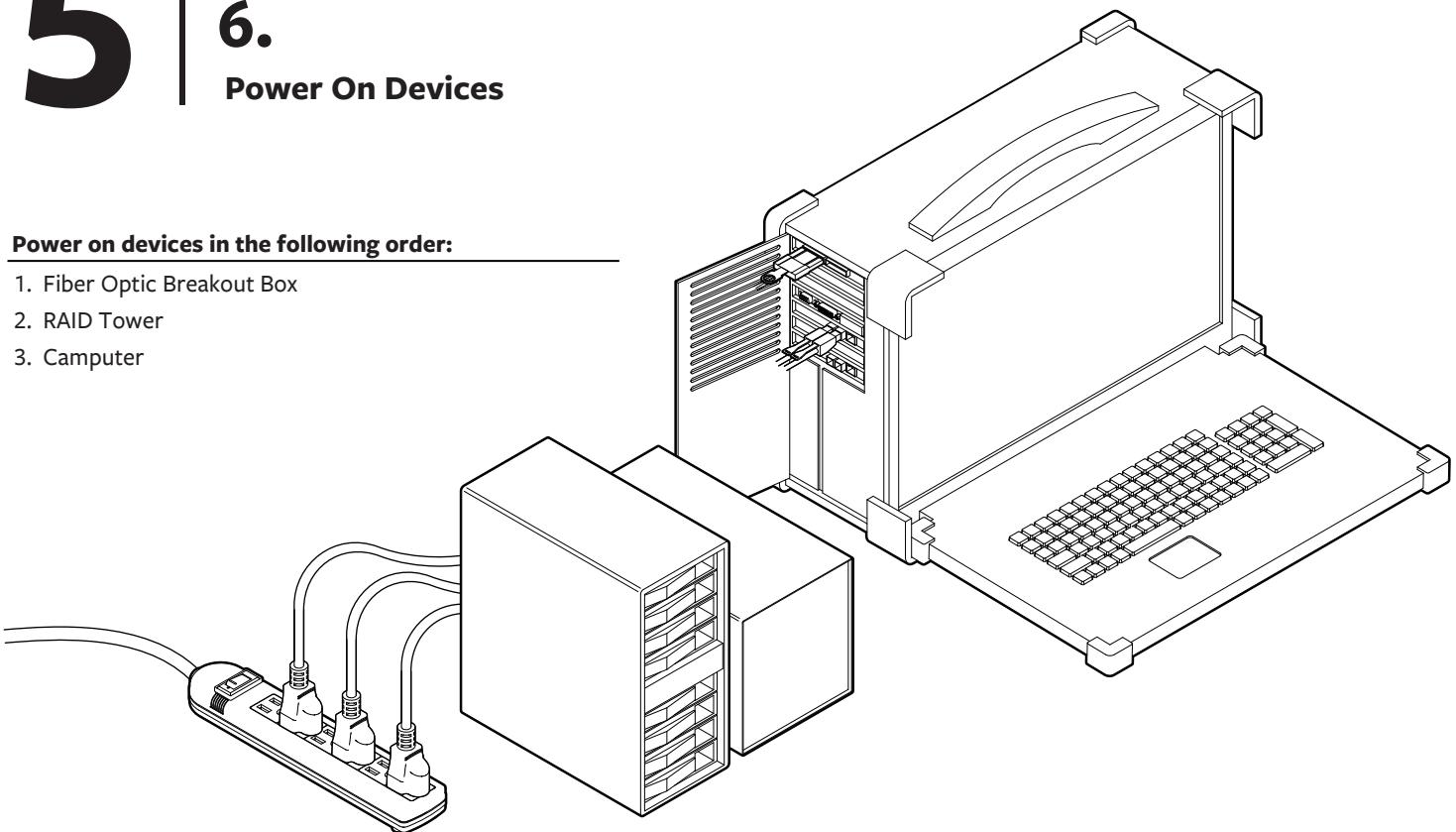


5

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

Follow README file to setup Computer:
<https://github.com/facebook/surround360>



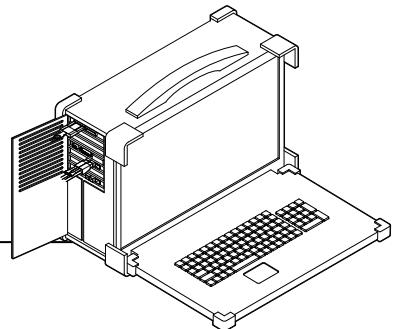
6

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

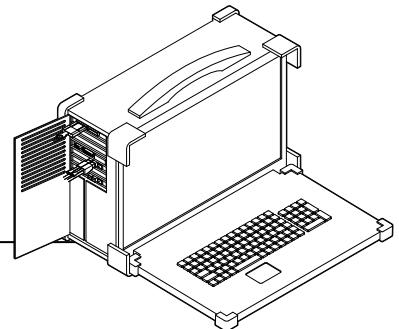
The screenshot shows the web-based control interface for the Surround 360 system. At the top, there's a header bar with a back button, a refresh button, and the URL <http://localhost>. Below the header, the main area is titled "Record Video". It includes the following controls:

- Actions :**
 - Start preview
 - Reset previously set parameters
- Label:** A text input field containing "1468888778".
- Duration of Capture:** A slider for "Shutter" ranging from 0 to 30 ms, with a value of 20.000 ms highlighted.
- Gain:** A slider ranging from 0.000 to 20.000 dB, with a value of 0.000 dB highlighted.
- Preview:** A section titled "Select Preview Cameras : Up to 4 cameras" with a list of checkboxes for cameras 0 through 17. The checkboxes for cameras 1, 2, 3, 4, and 17 are checked.
- Preview Panels:** A grid of four preview panels labeled:
 - PREVIEW IMAGE FROM CAMERA 1
 - PREVIEW IMAGE FROM CAMERA 2
 - PREVIEW IMAGE FROM CAMERA 3
 - PREVIEW IMAGE FROM CAMERA 4
- Latest Video Stats** and **Latest Previews** sections at the bottom.

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.

http://localhost

Record Video Stop Preview Start Recording Update Preview

Label

0 min 30 sec 20.000 ms

Shutter

Gain

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"/> 9	<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

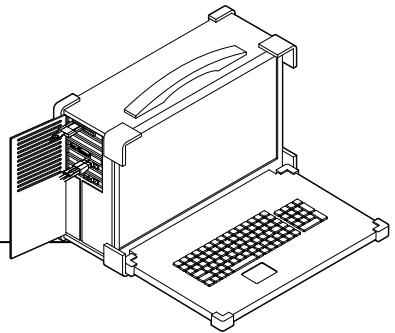
Latest Previews

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

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

|||

Shutter 20.000 ms

Gain 0.000 dB

Action:
- Stop recording

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

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"/> 9 | <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



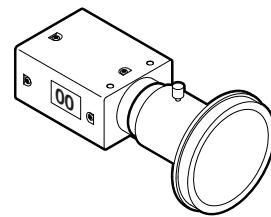
Tips

It is safe to stop capture midway

6

2.

How to Verify Camera Connections



Open FlyCapture (Point Grey capturing software)

| flycap

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

(x) (−) FlyCapture 2 Camera Selection 2.9.3.43

Camera List (17 cameras detected)				Camera Information	
Serial #	Model	Interface	IP Address	Serial Number:	16130496
15355848	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A	Model:	Grasshopper3 GS3-U3-41C6C
15636785	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A	Vendor:	Point Grey Research
15636826	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A	Sensor:	CMOSIS CMV4000 (1" Color CMOS)
15636828	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A	Resolution:	2048x2048
15636829	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A	Interface:	USB 3.0
15636830	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A	Bus Speed:	S5000
15636831	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A	IIDC Version:	1.32
15636832	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A	Firmware Version:	2.14.3.0
15636834	Grasshopper3 GS3-U3-41C6C	USB 3.0	N/A	Firmware Build Time:	Tue Apr 21 18:51:25 2015
				Driver	None

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.

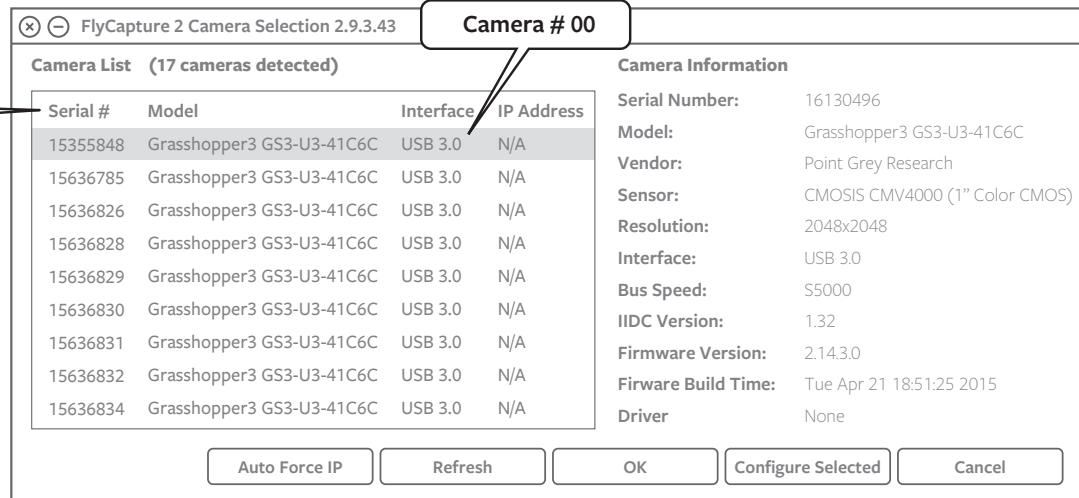
How to use Flycapture to Preview (Optional)

Step 1. Start FlyCapture

```
| flycap
```

Step 2. Select a camera to preview

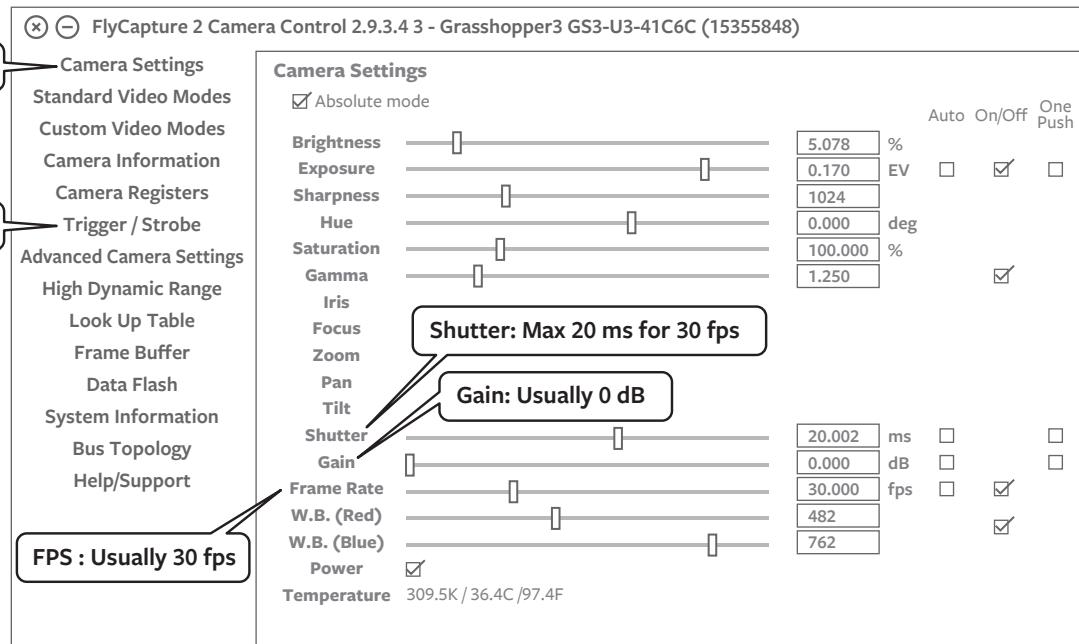
Cameras are arranged in ascending sequential order starting with top camera (# 00).



Step 2. Go to setting panel from preview panel

Set the following values:

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



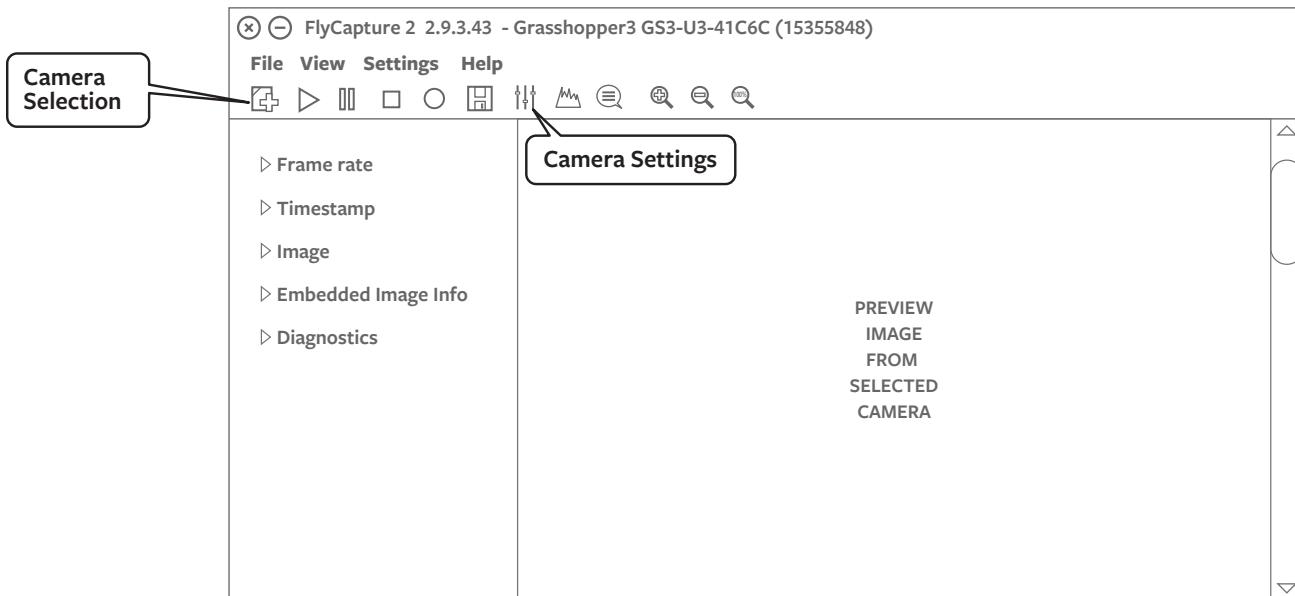
6

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

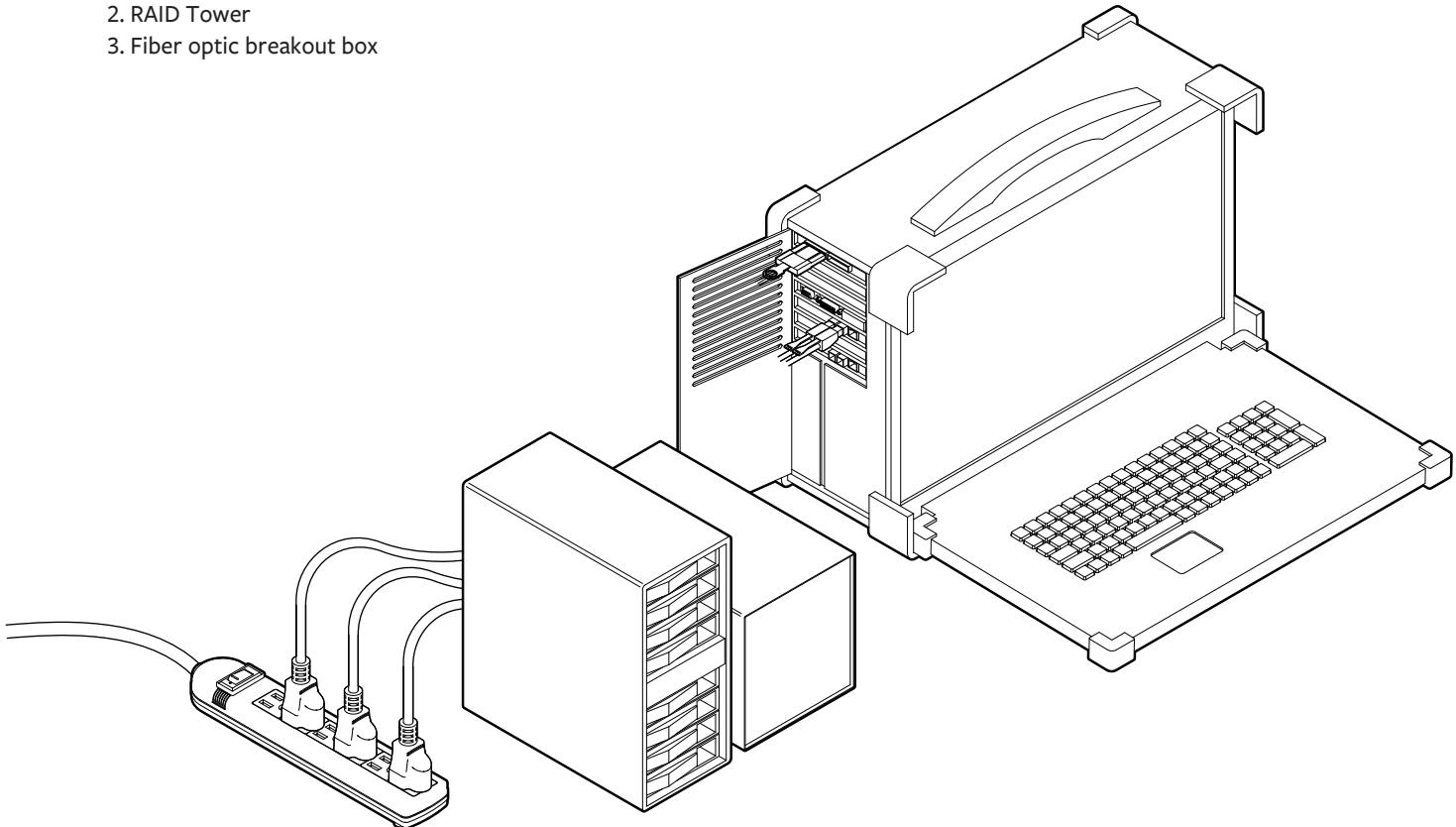
Each time you capture using the Surround 360, all camera settings are set to capture settings, and preview is disabled. When you load flycap (e.g., to change settings), you'll see the Point Grey logo instead of a preview. To re-enable preview, find the "Trigger/Strobe" settings and uncheck "Trigger Control."

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

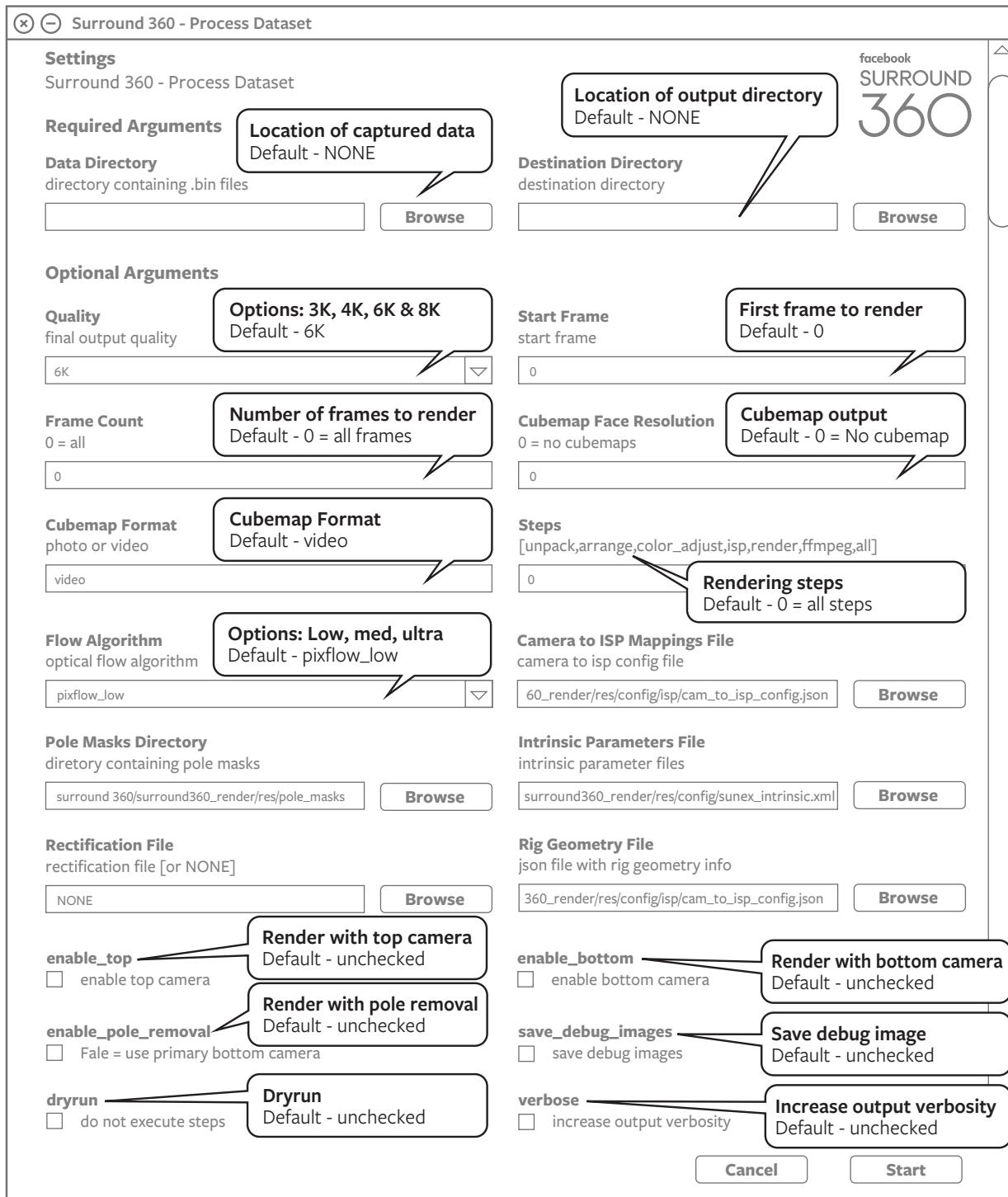
5.

How to Render

To start the rendering process

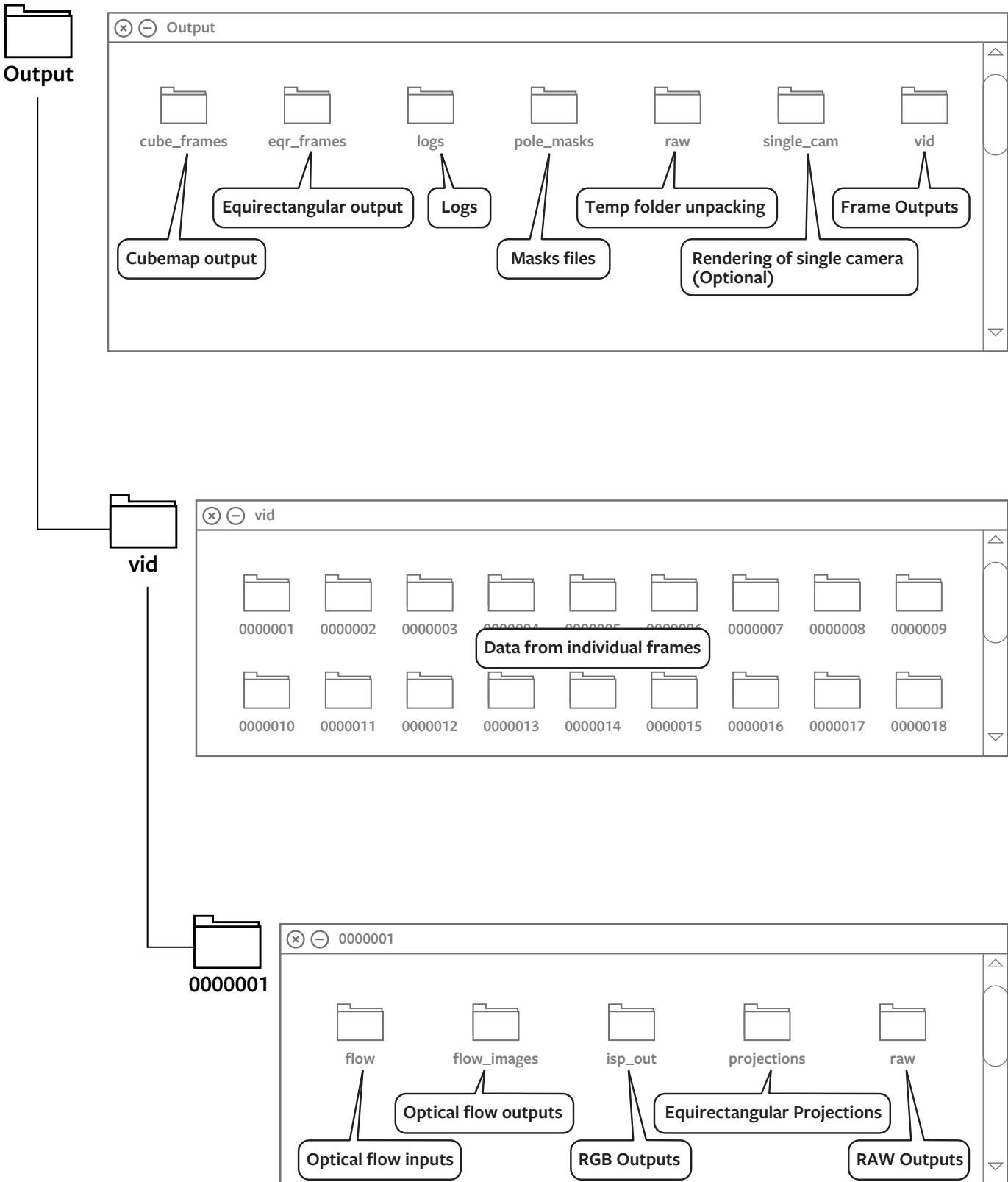
Run the following script

```
| cd <path_to_surround360>/surround360_render && python scripts/run-all.py
```



6

6. Output Directory



7

Pro Tips

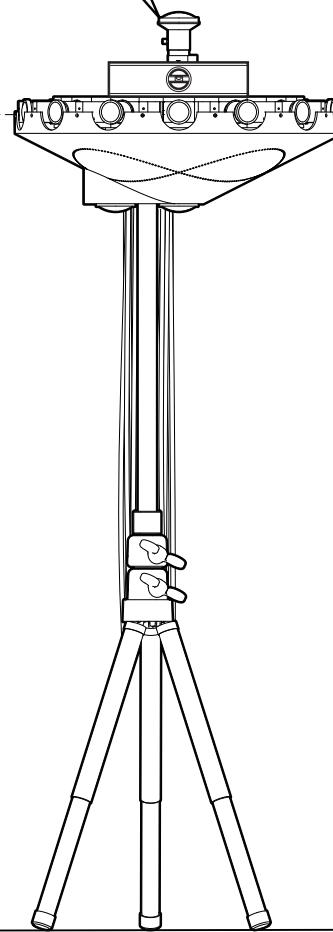
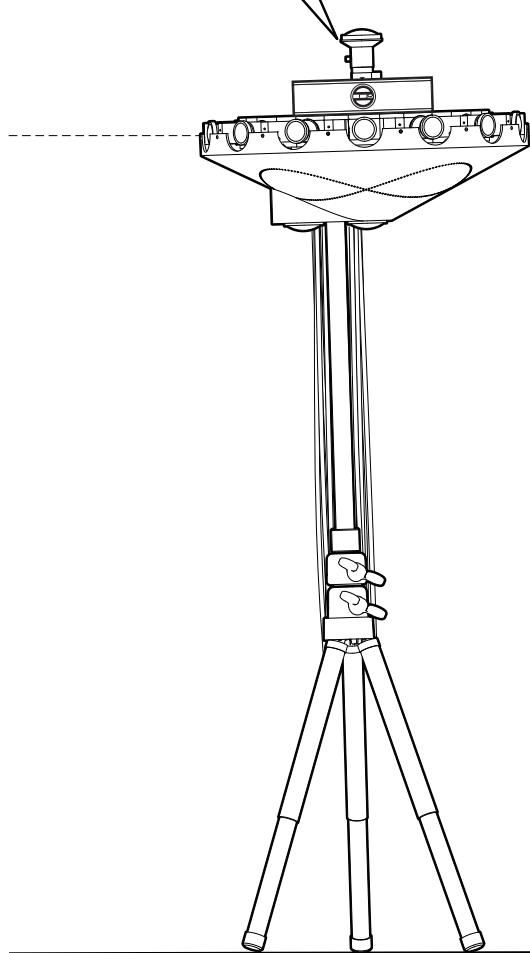
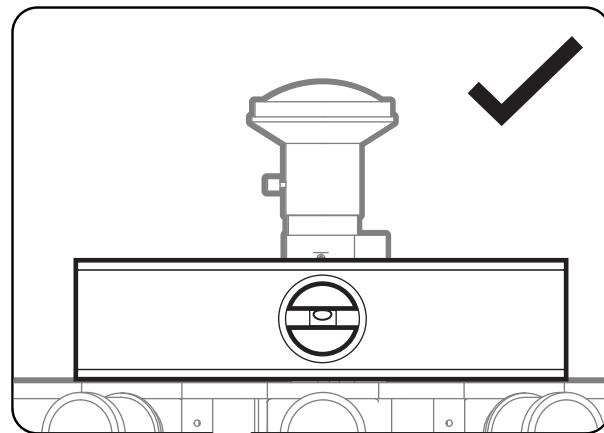
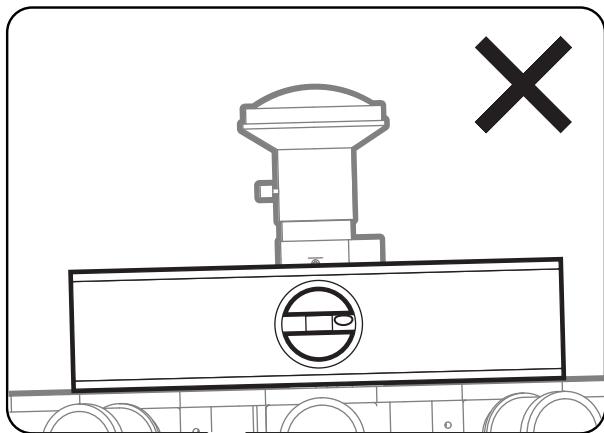
7

1.

Level Camera for Level Horizon Line



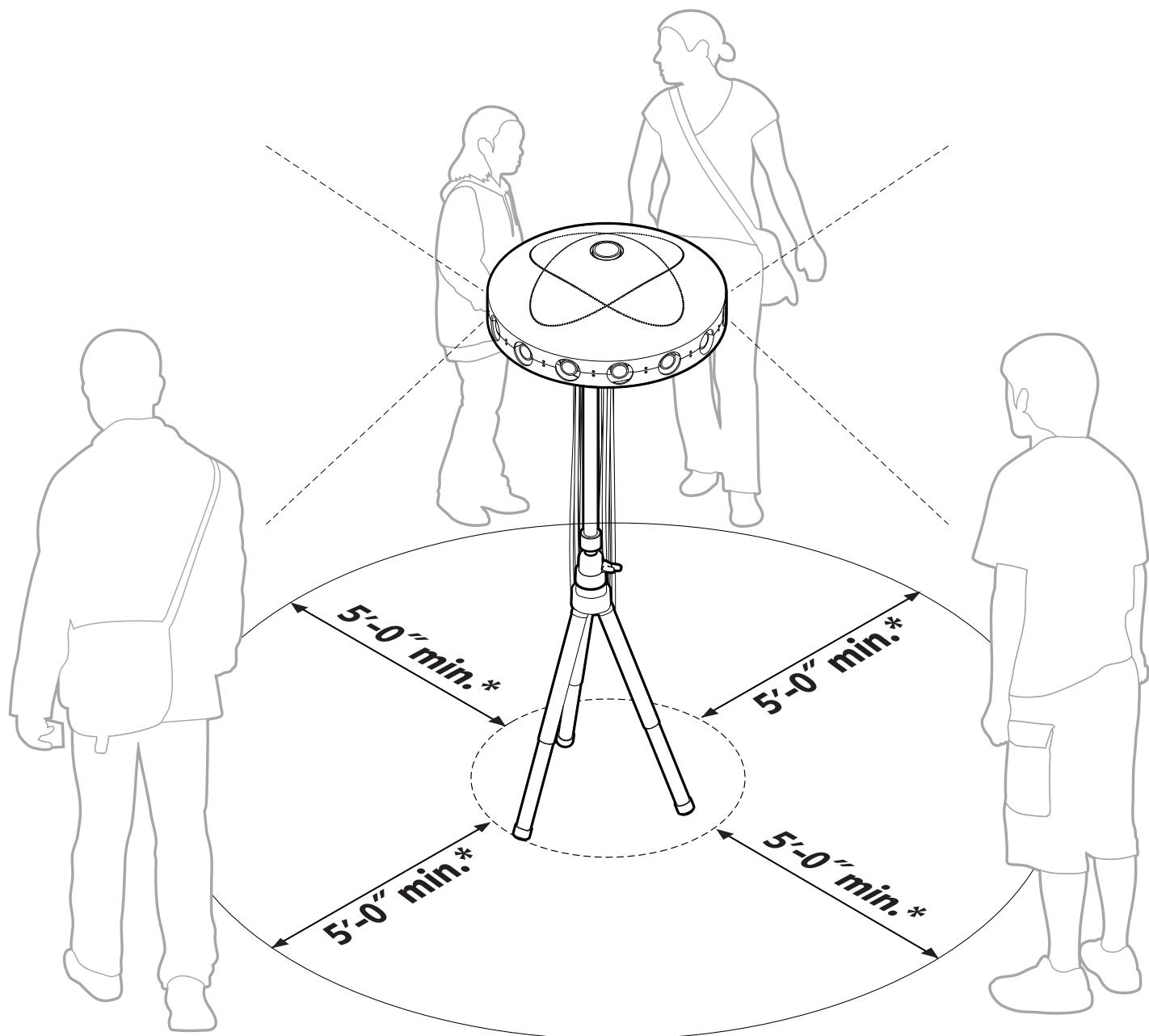
Remove top shell first!



7

2.

Avoid Close Objects

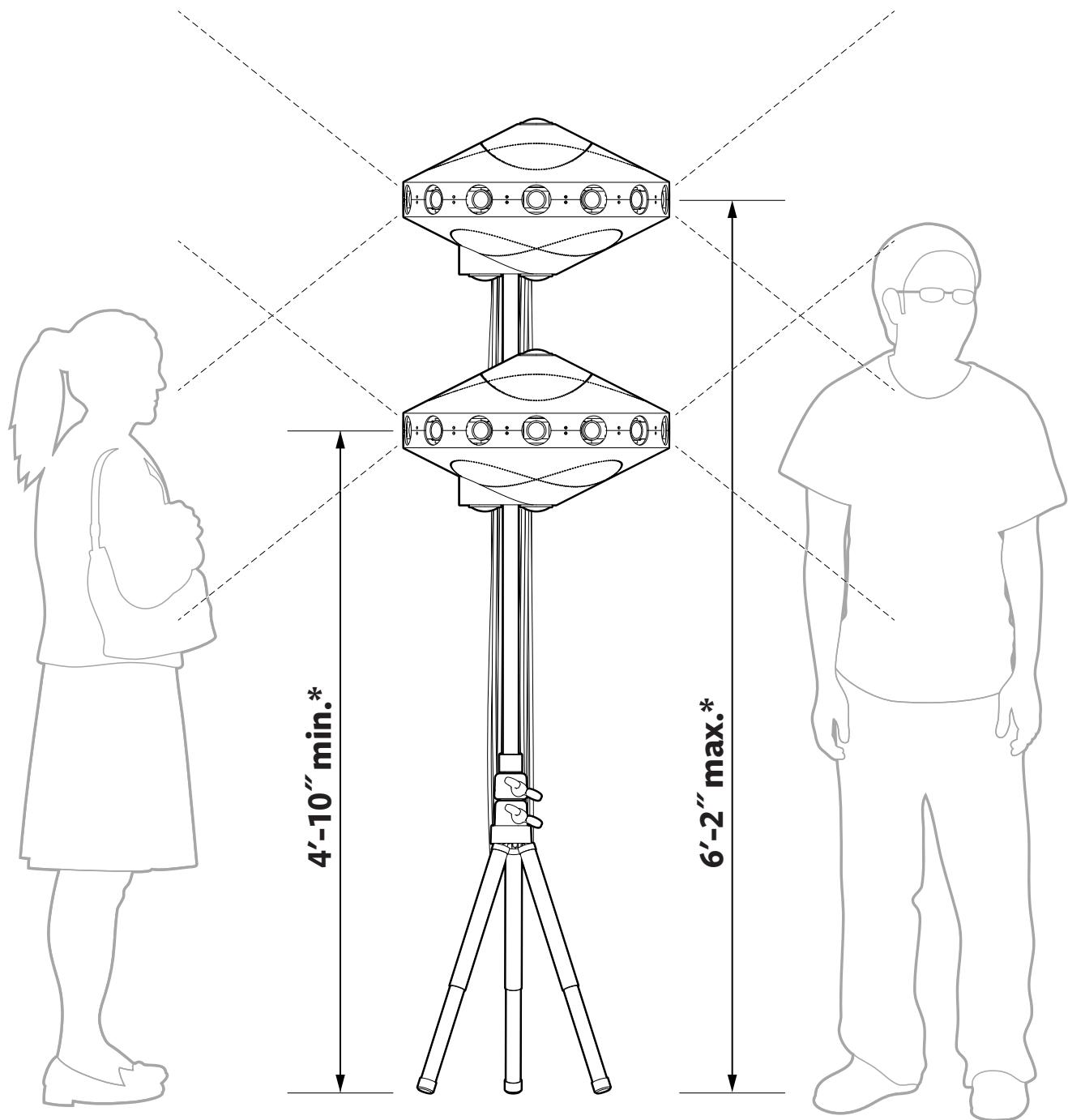


* recommendation only

7

3.

Be Aware of Camera Height for Better VR Experience

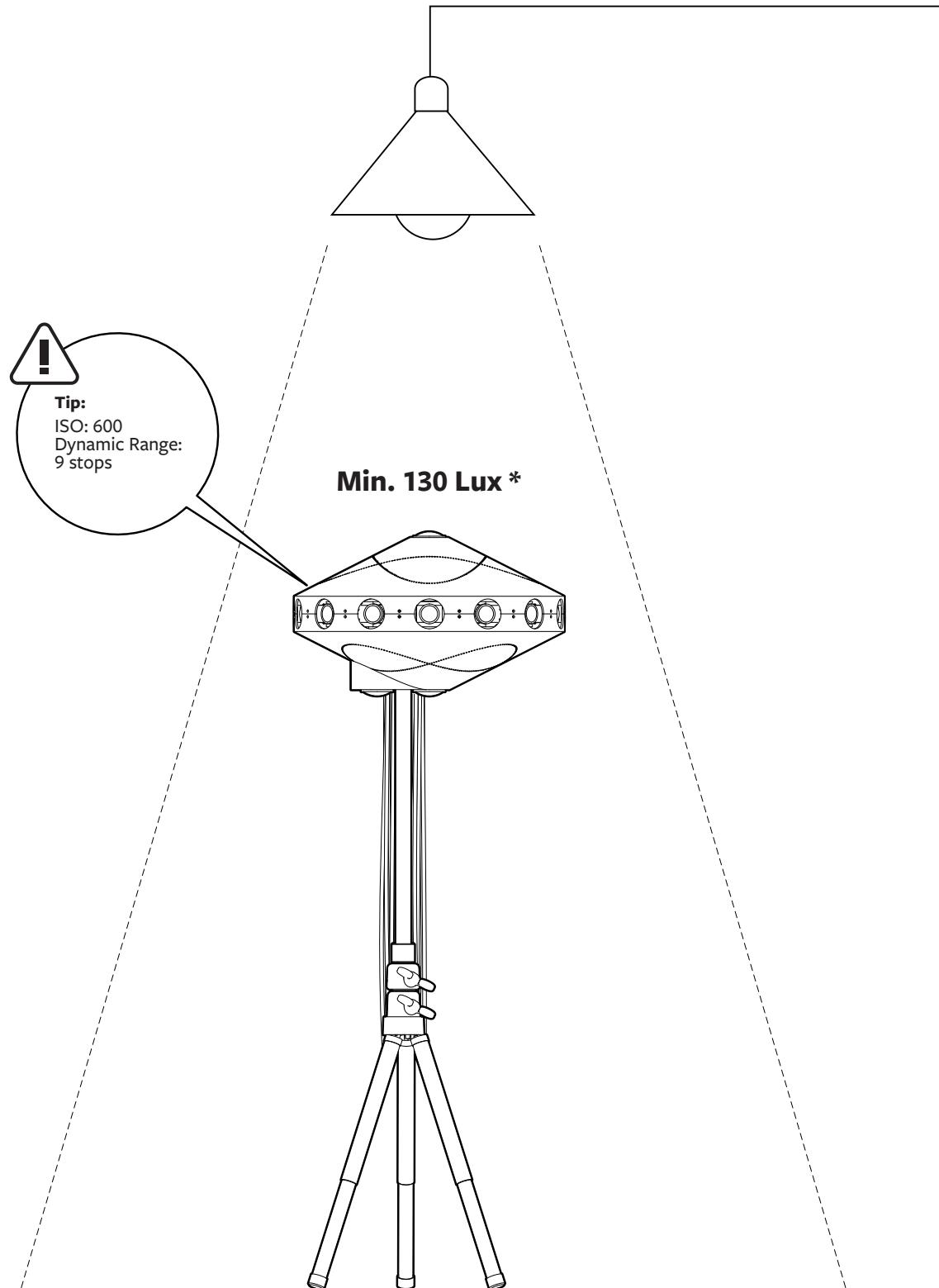


* recommendation only

7

4.

Avoid Low Light Condition to Minimize Noise in Footage

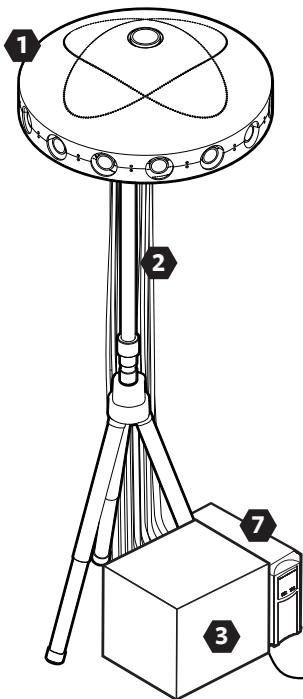


* recommendation only

7

5a.

Placement of Surround 360

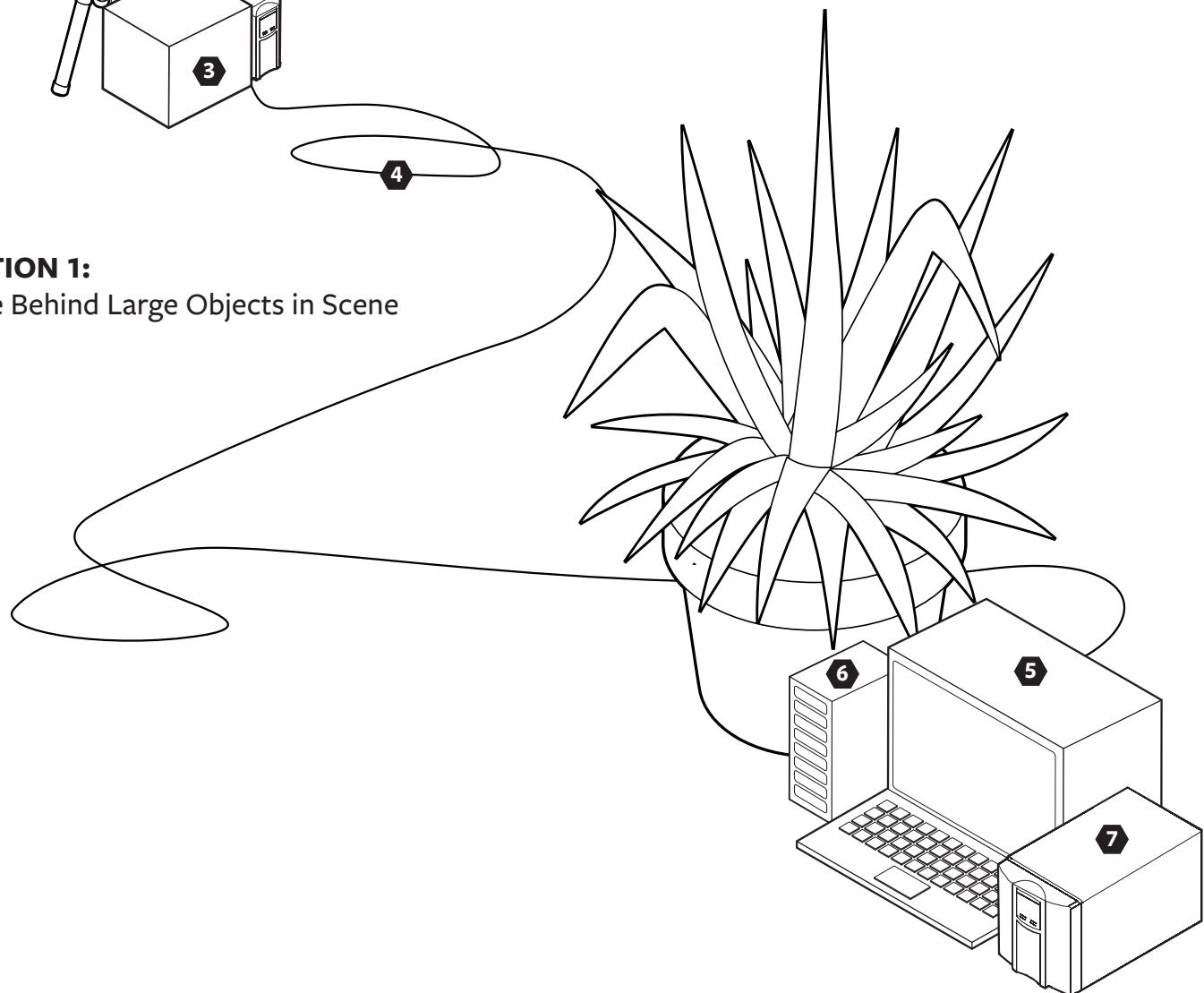


LEGEND

- 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:

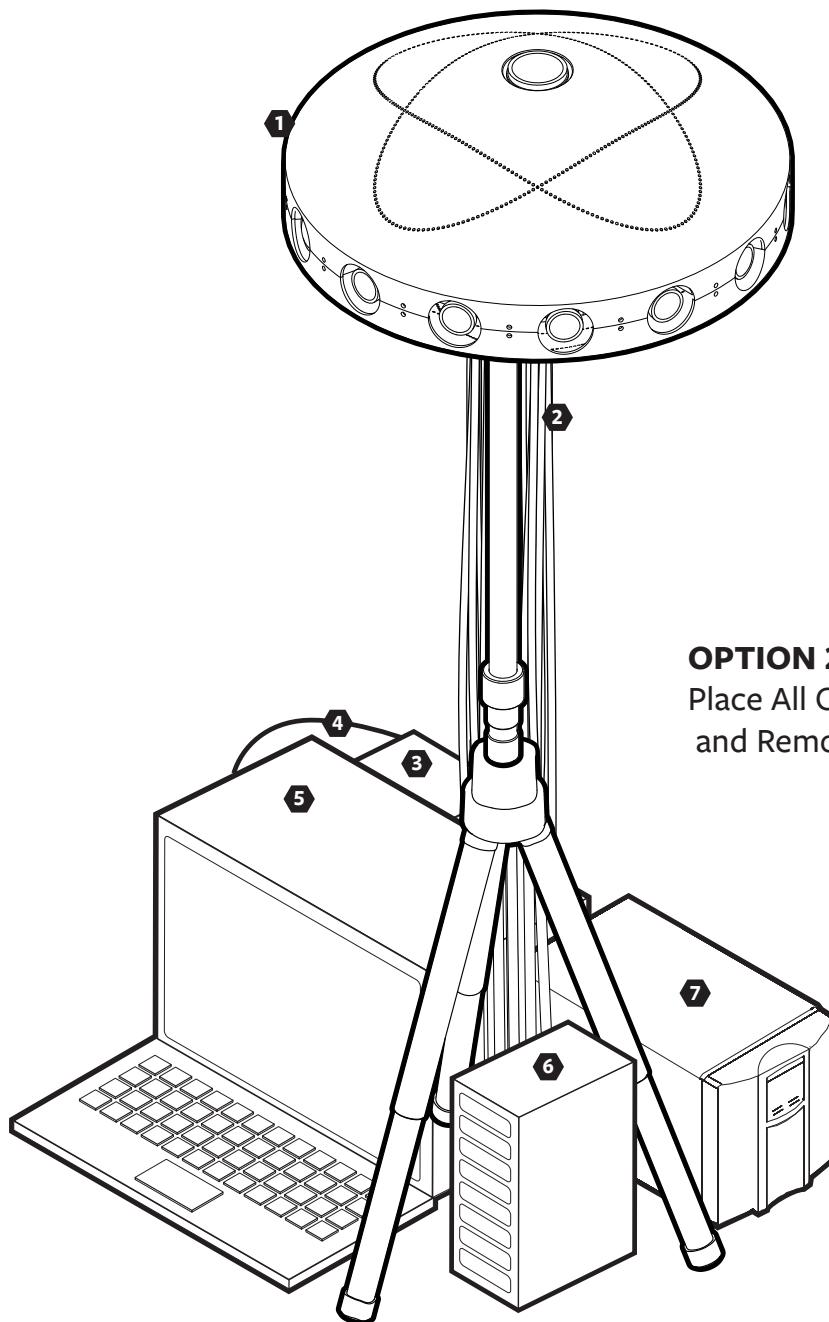
Hide Behind Large Objects in Scene



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 µm
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 12 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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