FINAL DRAWING PACKAGE

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MECH 490: Capstone Engineering Design Project

28/11/2017

Product Specifications

Overall dimensions of headset: 8.2 x 7.5 x 12.7 in

Overall weight: 100g (Screen) + 35g (Intel R200) + 60g (Odroid XU-4) + 428g (3d printed headset) +47g (Backpiece, Velcro) + ~330g (Fasteners, Cables) = ~1 kg

Processor

ODROID-XU4 chip

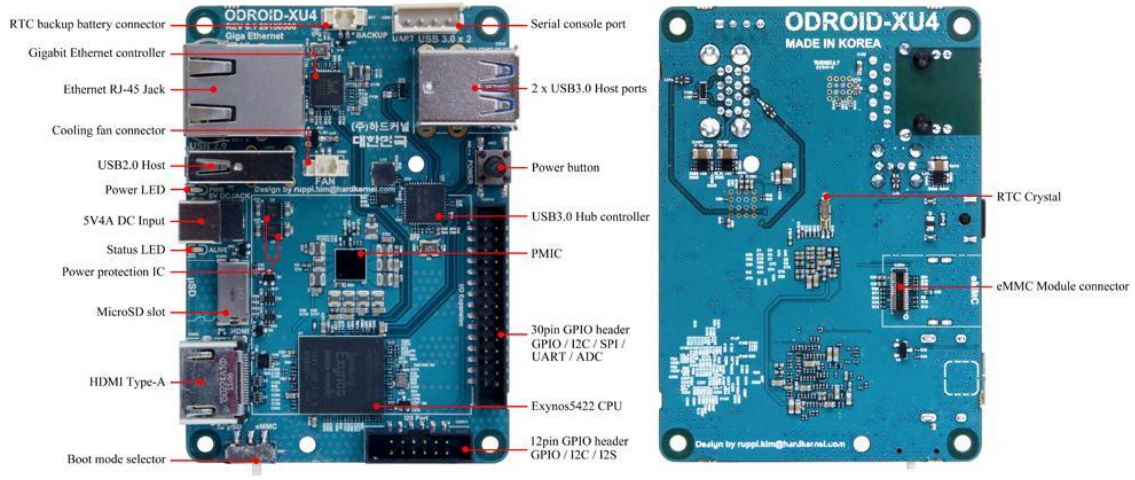

Figure 1: ODROID-XU4 board detail, adapted from [1]

2 x USB 3.0	read SSD (273 MB/sec) write SSD (258 MB/sec)
Power input	4.8-5.2 V (5V/4A Power supply recommended)
Processor	Samsung Exynos5422 ARM® Cortex™-A15 Quad 2.0GHz/Cortex™-A7 Quad 1.4GHz
Size/ weight	83x58x20 mm / 38 g
WiFi	USB IEEE 802.11 ac/b/g/n 1T1R WLAN (external adapter)
Display	HDMI 1.4a
Software	Linux Kernel 4.9 LTS
Memory	2Gbyte LPDDR3 RAM PoP (750Mhz, 12GB/s memory bandwidth, 2x32bit bus)
Ethernet port	Ethernet with RJ-45 Jack

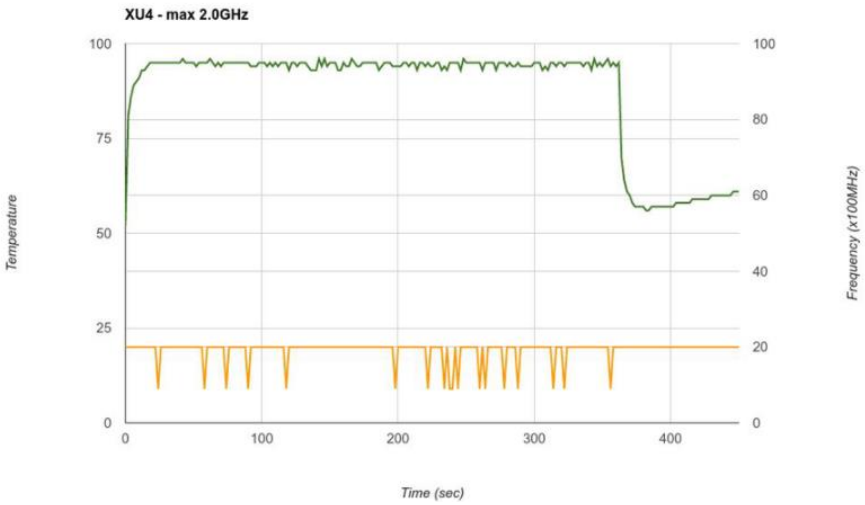

Figure 2: ODROID-XU4 operating temperature vs running time using active cooling, adapted from [1]

Sensors

Adafruit BNO055 9-DOF sensor

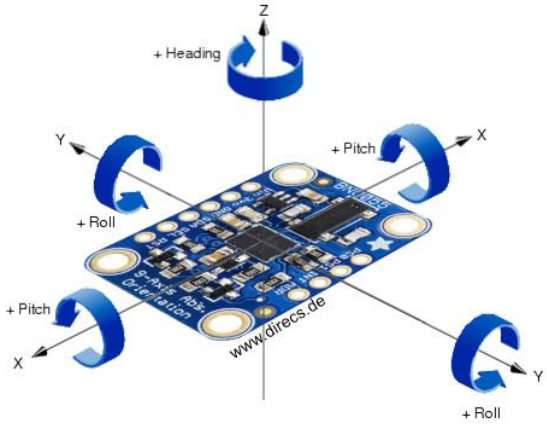

Figure 3: BNO055 axes of rotation, adapted from [2]

Data output [3]:

Absolute orientation on three axis based on a 360^{o} sphere
Angular velocity on three axis rotation speed
Acceleration vector on three axis (gravity + linear motion)
Linear acceleration vector on three axis (acceleration – gravity)
Ambient temperature in ^{o}C

Intel RealSense R200 camera

Feature	Color Camera	Infrared Cameras
Active Pixels	1920x1080 (2M)	640x480 (VGA)
Aspect Ratio	16:9	4:3
FOV (D x V x H)	77°x43°x70° (Cone)	70°x46°x59° (Cone)
Frame Rate	30FPS**	30/60FPS**
Filter Type	IR Cut Filter	IR Band Pass
Focus	Fixed	Fixed
Interface	MIPI* CSI-2, 2 Lanes	MIPI* CSI-2, 1 Lane/Camera

Figure 4: R200 camera specs, adapted from [4]

Capabilities: 3D Scanning, Speech recognition, person tracking, depth enabled photo and video, hand tracking, measurement, and scene perception.

Display

HDMI Display with Multitouch by ODROID

Figure 5: ODROID-VU5 5 inch HDMI Display with Multitouch [5]

Screen Resolution	800x480 pixels
Power Consumption	500mA / 5V
Screen Dimensions	121 x 83.31 x 15mm (Including switch & Connectors)
Viewable screen size	108 x 64 mm
View Angle (Deg)	Left 70, Right 70, Up 70, Down 50
Weight	100g
Other	TFT-LCD, 5 Finger Capacitive Touch Input, Backlight On/Off Switch

Also includes:

- 6 x 3.5mm screws
- 3 x Hex nuts
- Micro USB link board
- HDMI link board
- Micro-to-Type A USB Cable (approx. 35cm)
- Micro-to-Micro USB Cable (approx. 35cm)
- TypeA-to-TypeA HDMI cable (approx. 35cm)

Optics

Clear acrylic sheet, thickness approximatively ¼ inch.

Optional: Semi-reflective, 1-way mirror film. (Inserted over the acrylic sheet)

Significant OEM Purchases

1. ODROID-VU5 5 inch HDMI Display with Multitouch (decided after FFF): ~55$
2. Intel RealSense R200 Camera (purchased): ~153$
3. ODROID-XU4 processor (purchased): ~120$
4. Breakout Board 9-DOF Motion Sensor BNO005 (purchased): ~63$
5. Right Angle USB 3.0 to Micro B Male cable (purchased): ~9$
6. Right Angle HDMI to HDMI cable (purchased): ~9$
7. SanDisk 32GB microSD Class UHS-I (purchased): ~20$

Test and Safety Procedures

The following figures are used to better explain the reader of the tests that will be performed. Please note, these figures are for reference only. For more information please refer to the midterm report for the complete test.

Drop Test

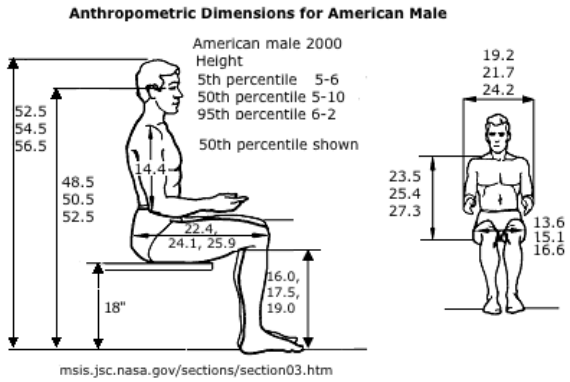

Figure 6: Heights of Males at Different Percentile [6]

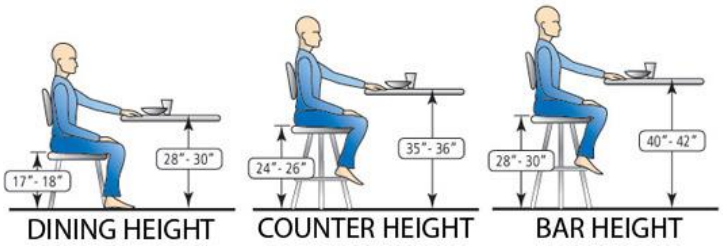

Figure 7: Average Height of Counters [7]

The objective of this test is to observe what occurs to the Augmented Reality (AR) headset after it is dropped from different heights. We will be dropping the AR headset from a counter height, when the average male is sitting down, and when the average male is standing. For this test, we will be replacing the hardware with test material to replicate the weight of the individual

components excluding the screen. The test will be performed in one of the MECH Labs located on the 10th floor of the H-building.

For this test, we will be following standard UL 60950-1 Standard on Information Technology Equipment Safety written by Underwriters Laboratories (UL). The drop test will show compliance to section 4.2.6 of standard UL 60950-1 (Drop Test) [8].

Thermal Test

Figure 8: Thermocouple

Figure 9: Small Wind tunnel

The objective of this test is to note the operating temperature of the Augmented Reality (AR) headset. Additionally, we want to observe the air speed required to adequately bring down the temperature of the AR headset to 30 °C.

Part A of this test requires us to find the baseline temperature of the AR headset when it is operating. This is done by using a thermocouple. The second part of this test requires us to place the AR headset (at the baseline temperature) in a wind tunnel and adjust the air speed and observe the time required to bring the temperature to 30 °C. This test will take place in the Heat transfer lab (H-10) for part A as well as the Mini-capstone room (H-10) for part B.

For this test, we will be using the GR-63-Core NEBSTM standard which states the temperature limits of touchable surfaces for metals and non-metals over certain periods of time.

Vibration Test

The objective of this test is to observe the effects of vibration on the Augmented Reality (AR) headset. The AR headset will be subjected to different frequencies for certain periods of time in a vibration machine to see whether any of the hardware comes loose. The location and machine is yet to be determined.

References

[1] Hardkernel co., Ltd. “Odriod platforms.” *ODROID | Hardkernel* [Online] Available at: http://www.hardkernel.com/main/products/prdt_info.php?g_code=G143452239825&tab_idx=2

[2] Knapp, Autor Markus. “The Adafruit BNO055 9-DOF Sensor IMU Breakout does not make it easy - or does it?” *DIRECS*, Available at: www.direcs.de/2017/07/der-adafruit-bno055-9-dof-sensor-imu-breakout-macht-es-einem-nicht-leicht-oder-doch/

[3] “Adafruit BNO055 Absolute Orientation Sensor.” *Overview | Adafruit BNO055 Absolute Orientation Sensor | Adafruit Learning System*, Available at: https://learn.adafruit.com/adafruit-bno055-absolute-orientation-sensor/overview

[4] “Specifications for the Intel® RealSense™ Camera R200.” *Intel*, Available at: www.intel.com/content/www/us/en/support/articles/000016214/emerging-technologies/intel-realsense-technology.html

[5] *5 inch HDMI Display with Multitouch for ODROID-VU5*, Available at: https://ameridroid.com/products/odroid-vu5-5-inch-hdmi-display-with-multitouch

[6] Msis.jsc.nasa.gov. (2017). ANTHROPOMETRY AND BIOMECHANICS. [online] Available at: https://msis.jsc.nasa.gov/sections/section03.htm [Accessed 13 Nov. 2017].

[7] Mydinette.com. (2017). Kitchen Set Buying Guide | Kitchen Sets | Bar Stools | Furniture Stores in South Jersey and Southeastern Pennsylvania. [online] Available at: https://www.mydinette.com/kitchen-set-buying-guide.html [Accessed 13 Nov. 2017].

[8] Information Technology Equipment – Safety – Part 1: General Requirements, 2nd ed. Northbrook, IL: Underwriters Laboratories, 2017, pp. 173-174.

Concordia University
ENCS
Engineering & Computer Science

Year	2017
Team	Group #9
Device	AR Headset

CODE	Item	Description	Drawing#/Part#	MNF/OEM/SPL	QTY	Volume [in3]	CASH Material [$]	CASH Labour [$]	TIME Time[hr]	CAPCOIN CODE	CAPCOIN Capcoin$	SPONSOR In Kind
		VERSION 3										
	1	HEADSET	11709001	EXTERNAL	1	17.16						
	2	TOP COVER	11709002	EXTERNAL	1	7.1						
	3	BACK COVER	11709003	EXTERNAL	1	3.94						
	4	BACK PIECE	11709004	STUDENT - Kostas - 3D print	1	1.39						
	5	HEAD STRAP	11709005	STUDENT - Kostas	2							
	6	HEADS UP DISPLAY	11709006	AMAZON	1							
	7	HEADS UP DISPLAY HINGE	11709007	EXTERNAL	1							
	8	SCREEN	11709011	AMERIDROID.COM	1							
	9	ADAFRUIT BNO 055 MOTION SENSOR	ADA2472	ADAFRUIT	1							
	10	INTEL REALSENSE CAMERA R200	MM#939143	INTEL REALSENSE	1		153.36					
	11	ODROID XU4	0007A	AMERIDROID.COM	1		120.57					
	12	PAN HEAD PHILLIPS, #6-32 THREAD	90272A152	MCMASTER	4							
	13	ROUND HEAD PHILLIPS, #4-40 THREAD	90279A108	MCMASTER	4							
	14	ROUND HEAD PHILLIPS, 1/4"-20 THREAD	90279A542	MCMASTER	2							
	15	ROUND HEAD PHILLIPS, #6-32 THREAD	91773A146	MCMASTER	4							
	16	HEX NUT, #4-40 THREAD	90480A005	MCMASTER	4							
	17	HEX NUT, #6-32 THREAD	90480A007	MCMASTER	8							
	18	NARROW HEX NUT, #6-32 THREAD	90760A007	MCMASTER	2							
	19	CAP NUT, 1/4"-20 THREAD, 1/4" THREAD DEPTH	91875A130	MCMASTER	2							
	20	THREADED STUD, 6-32 THREAD	95475A244	MCMASTER	1							
	21	MALE 90 DEGREE RIGHT ANGLE CABLE CORD		AMAZON	1		8.97					
	22	LARRITS 0.5M HIGH SPEED V2.0 HDMI CABLE		AMAZON	1		8.39					
	23	SanDisk ULTRA 32GB microSDHC		AMAZON	1		19.98					
	24	HEADS-UP DISPLAY - ACRYLIC SHEET										TECHNOLOGY SANDBOX
		VERSION 2										
	1	HEADSET V2	11709101	EXTERNAL - 3D HUB	1	20.97	44.9	-		-	-	
	2	TOP COVER V2	11709102	EXTERNAL - 3D HUB	1	8.17	24.07	-		-	-	
	3	BACK COVER V2	11709103	EXTERNAL - 3D HUB	1	3.85	8.32	-		-	-	
	4	BACK PIECE	11709104	STUDENT - Kostas - 3D print	1	1.39		-		-	-	
	5	HEAD STRAP	11709105		2			-		-	-	
	6	SCREEN V3	11709201		1			-		-	-	
	7	ADAFRUIT BNO 055 (motion sensor) V2	ADA2472		1			-		-	-	
	8	INTEL REALSENSE CAMERA R200	MM#939143	INTEL REALSENSE	1			-		-	-	
	9	ODROID XU4	0007A	AMERIDROID.COM	1			-		-	-	
	10	FASTENER, FLAT, M3.5 X 0.6mm	91420A173	MCMASTER	100			-		-	-	
	11	FASTENER, FLAT, M2.5 X 0.45mm	92010A016	MCMASTER	100			-		-	-	
	12	HEX NUT, M3.5	90592A010	MCMASTER	100			-		-	-	
	13	HEX NUT, M2.5	90592A006	MCMASTER	100			-		-	-	
		VERSION 1										
	1	HEADSET V1	HS-01	EXTERNAL - 3D HUB	1		22					
	2	TOP COVER V1	TC-01	TECHNOLOGY SANDBOX	2							
	3	BACK COVER V1	BC-01	STUDENT - Kostas	1							
	4	BACK PIECE	BP-02	STUDENT - Kostas	1							
	5	SCREEN V1	SC-01		1							Dr. Charles Kiyanda
	6	ADAFRUIT BNO 055 (motion sensor) V1	MS-01		1							Dr. Charles Kiyanda
	7	INTEL REALSENSE CAMERA R200	MM#939143	INTEL REALSENSE	1							
	8	ODRIOID XU4	0007A	AMERIDROID.COM	1							
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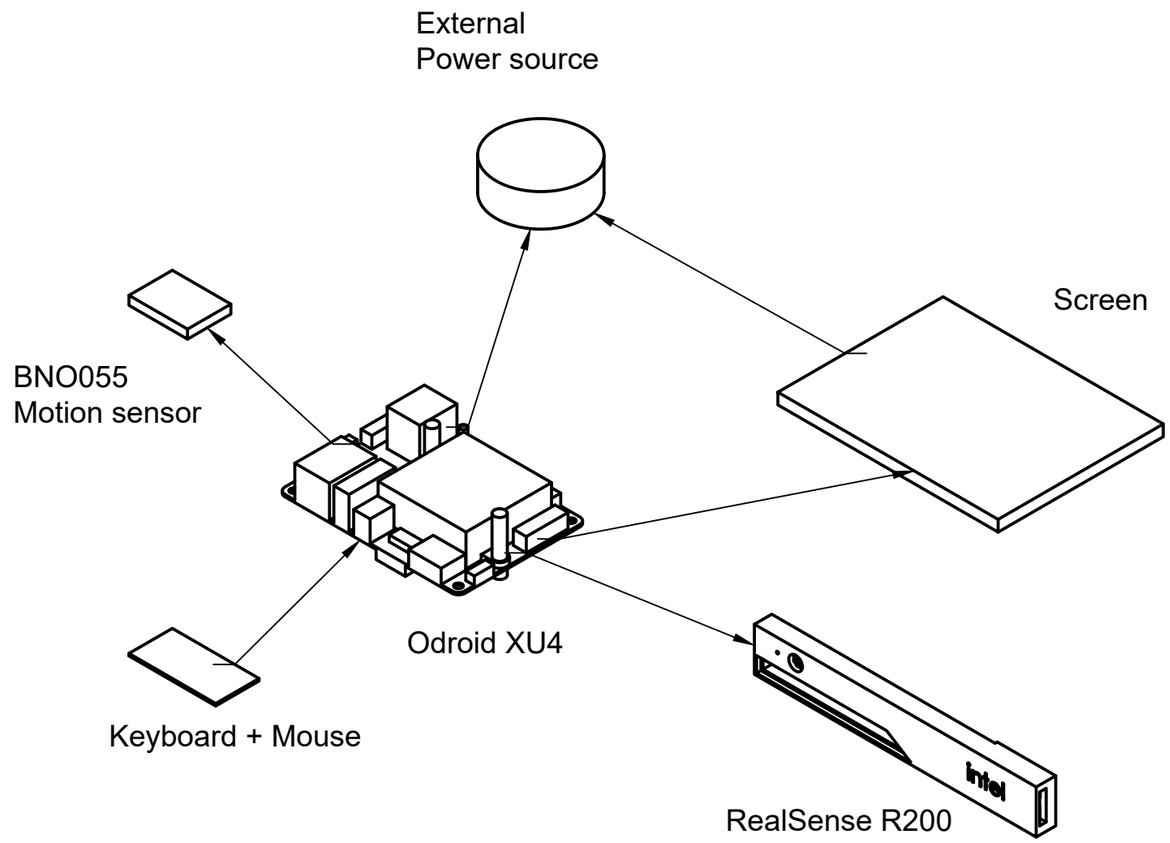

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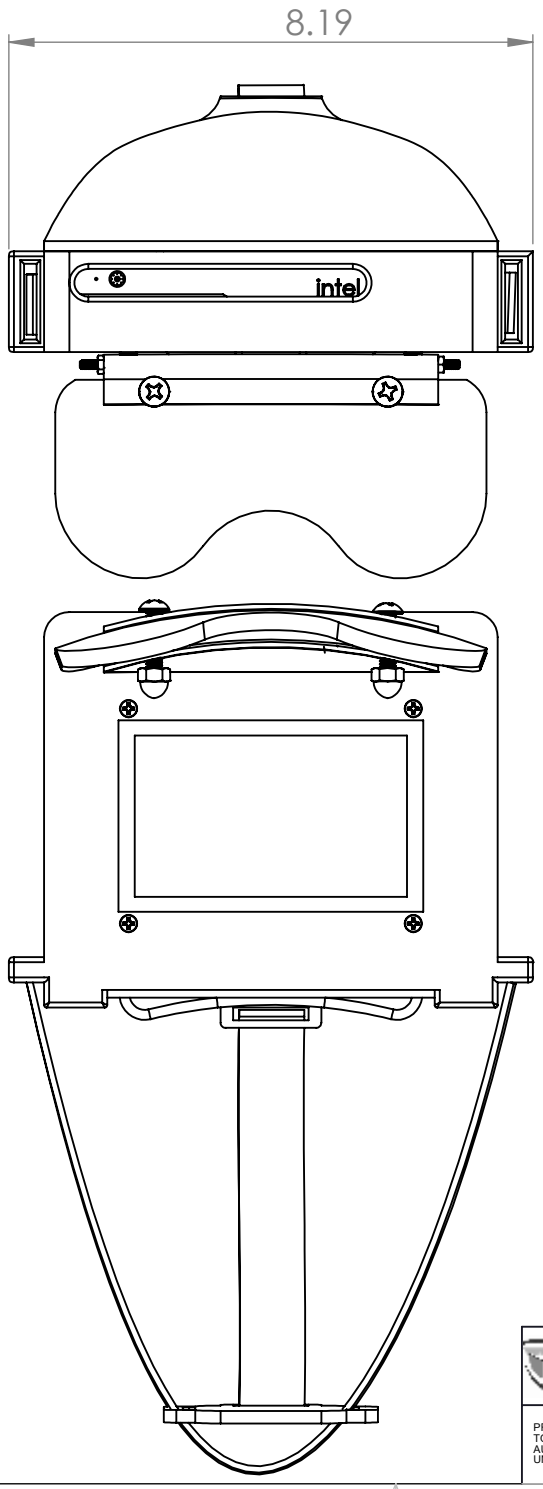

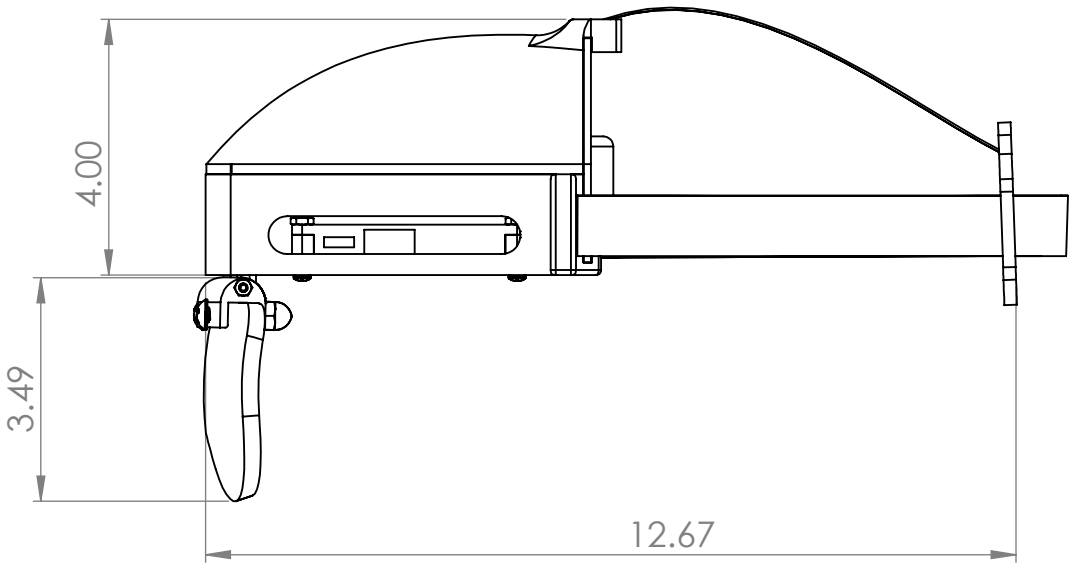

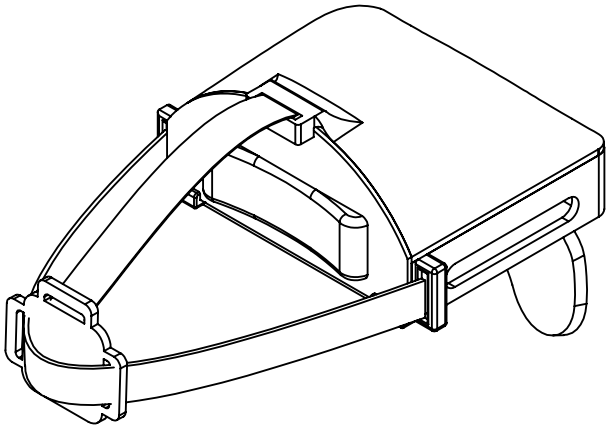

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FOR REFERENCE ONLY

Concordia	MATERIAL **VARIES**		SURFACE ROUGHNESS √	TITLE **ASSEMBLY**		
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PROPRIETARY INFORMATION NOT TO BE RELEASED WITHOUT WRITTEN AUTHORIZATION FROM CONCORDIA UNIVERSITY	DESIGNER **A.SHAWWA**	ALL DIMENSIONS IN **INCHES** UNLESS OTHERWISE SPECIFIED		A SIZE	DATE **11/25/2017**	USED ON **MECH 490**
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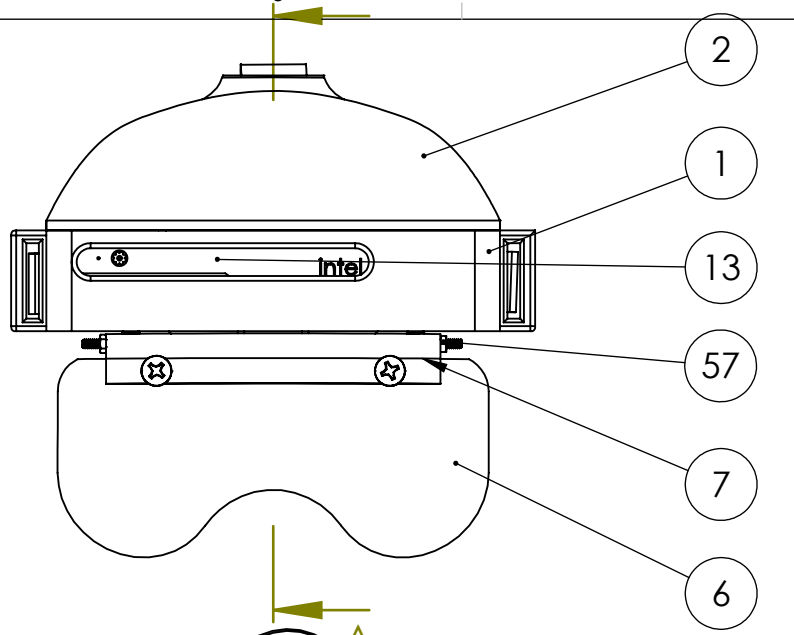

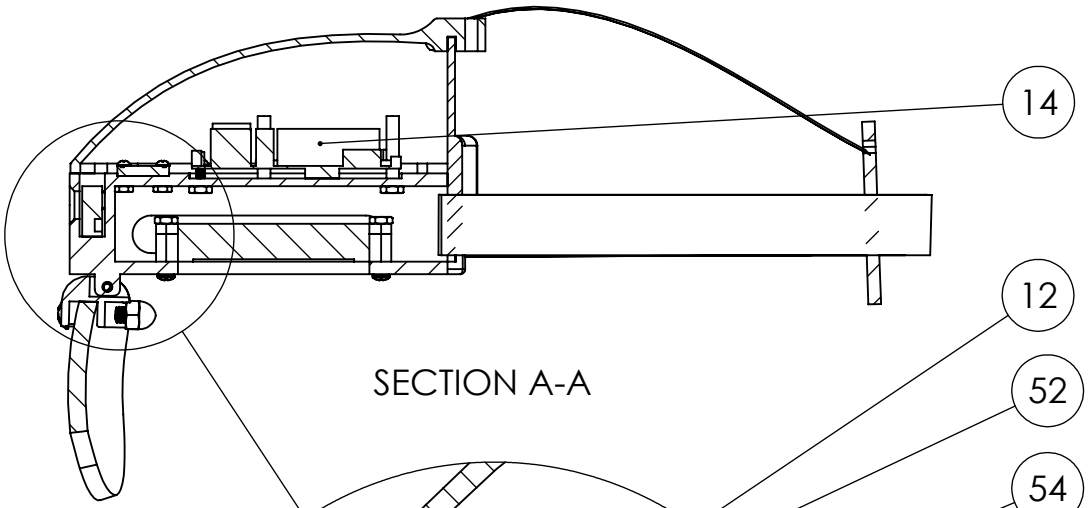

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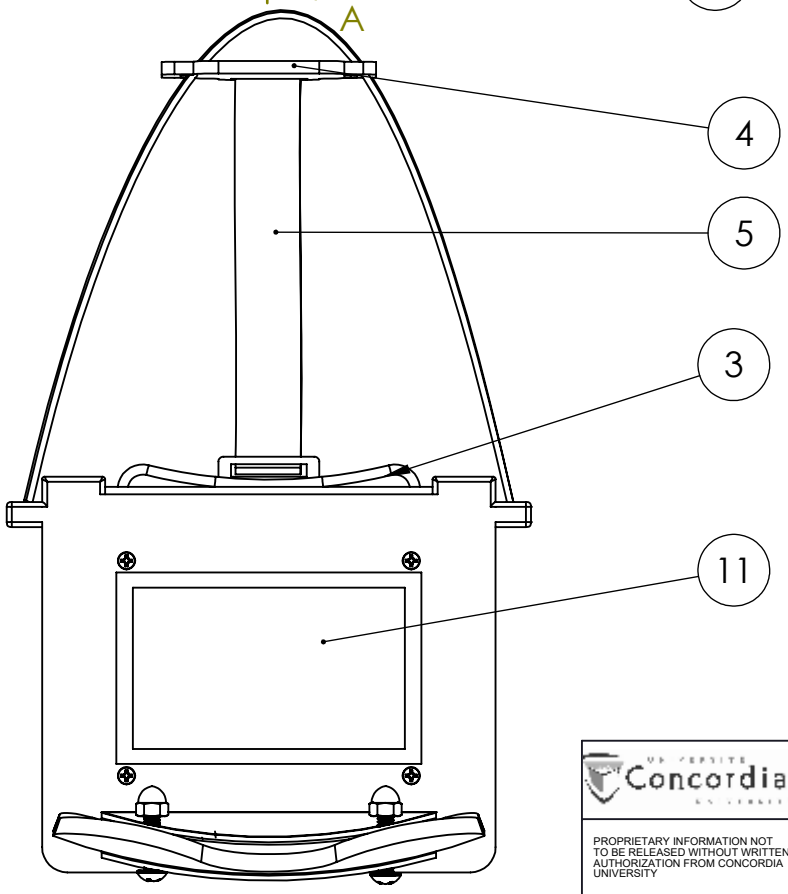

DETAIL A
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PROPRIETARY INFORMATION NOT TO BE RELEASED WITHOUT WRITTEN AUTHORIZATION FROM CONCORDIA UNIVERSITY	DESIGNER **A.SHAWWA**	ALL DIMENSIONS IN **INCHES** UNLESS OTHERWISE SPECIFIED		A SIZE	DATE **11/25/2017**	USED ON **MECH 490**
	DRAFTER **M.A.YADAO**	APPROVED **R. PATEL**	SCALE **1:3**	SHEET **2 /14**	DWG NO. **11709302**	REV NO. **3**

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2	11709002	TOP COVER	EXTERNAL	1
3	11709003	BACK COVER	EXTERNAL	1
4	11709004	BACK PIECE	EXTERNAL	1
5	11709005	HEAD STRAP	STUDENT	1
6	11709006	HEADS UP DISPLAY	AMAZON	1
7	11709007	HEADS UP DISPLAY HINGE	EXTERNAL	1
11	11709011	SCREEN	AMERIDROID	1
12	ADA2472	ADAFRUIT BNO 055 MOTION SENSOR	ADAFRUIT	1
13	MM#939143	INTEL REALSENSE CAMERA R200	INTEL REALSENSE	1
14	0007A	ODRIOD XU4	AMERIDROID	1
51	90272A152	PAN HEAD PHILLIPS #6-32 THREAD	MCMASTER	4
52	90279A108	ROUND HEAD PHILLIPS #4-40 THREAD	MCMASTER	4
53	90279A542	ROUND HEAD PHILLIPS 1/4" -20 THREAD	MCMASTER	2
54	91773A146	ROUND HEAD PHILLIPS #6-32 THREAD	MCMASTER	4
55	90480A005	HEX NUT #4-40 THREAD	MCMASTER	4
56	90480A007	HEX NUT #6-32 THREAD	MCMASTER	8
57	90760A007	NARROW HEX NUT #6-32 THREAD	MCMASTER	2
58	91875A130	CAP NUT 1/4" -20 THREAD, 1/4" THREAD DEPTH	MCMASTER	2
59	95475A244	THREADED STUD 6-32 THREAD	MCMASTER	1

Concordia

MATERIAL

FINISH

DESIGNER **A.SHAWWA**

DRAFTER **M. A. YADAO**

ALL DIMENSIONS IN **INCHES** UNLESS OTHERWISE SPECIFIED

APPROVED **R.PATEL**

UNLESS OTHERWISE SPECIFIED

SURFACE ROUGHNESS √

TOLERANCES X ± .1
.X ± .05
.XX ± .005
.XXX ± .002
ANGLE ± .5°

SCALE **1:3**

TITLE **BOM**

A SIZE

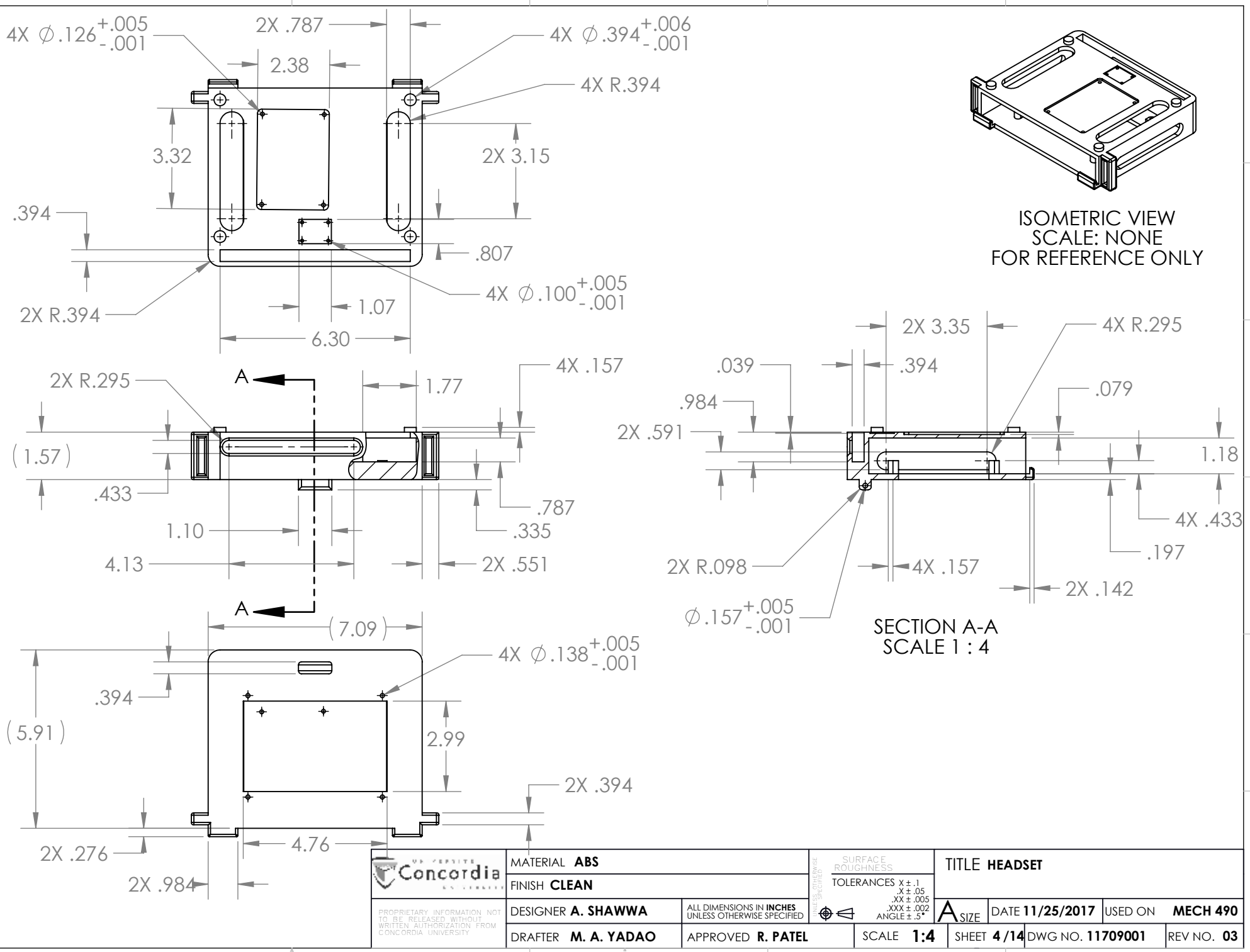
DATE **11/25/2017**

USED ON **MECH 490**

SHEET **3/14**

DWG NO. **11709303**

REV NO. **3**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DESIGNER A. SHAWWA
DRAFTER M. A. YADAO
APPROVED R. PATEL
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SURFACE ROUGHNESS
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.X ± .05
.XX ± .005
.XXX ± .002
ANGLE ± .5°
TITLE HEADSET
A SIZE
DATE 11/25/2017
USED ON MECH 490
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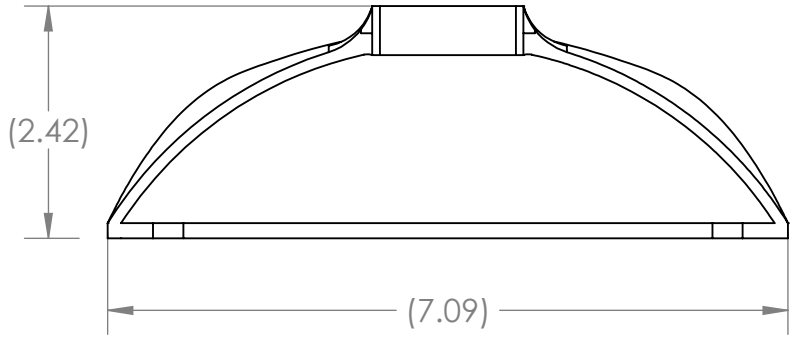

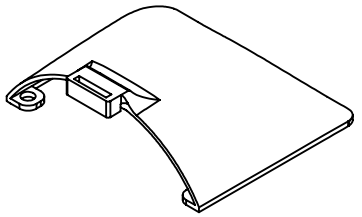

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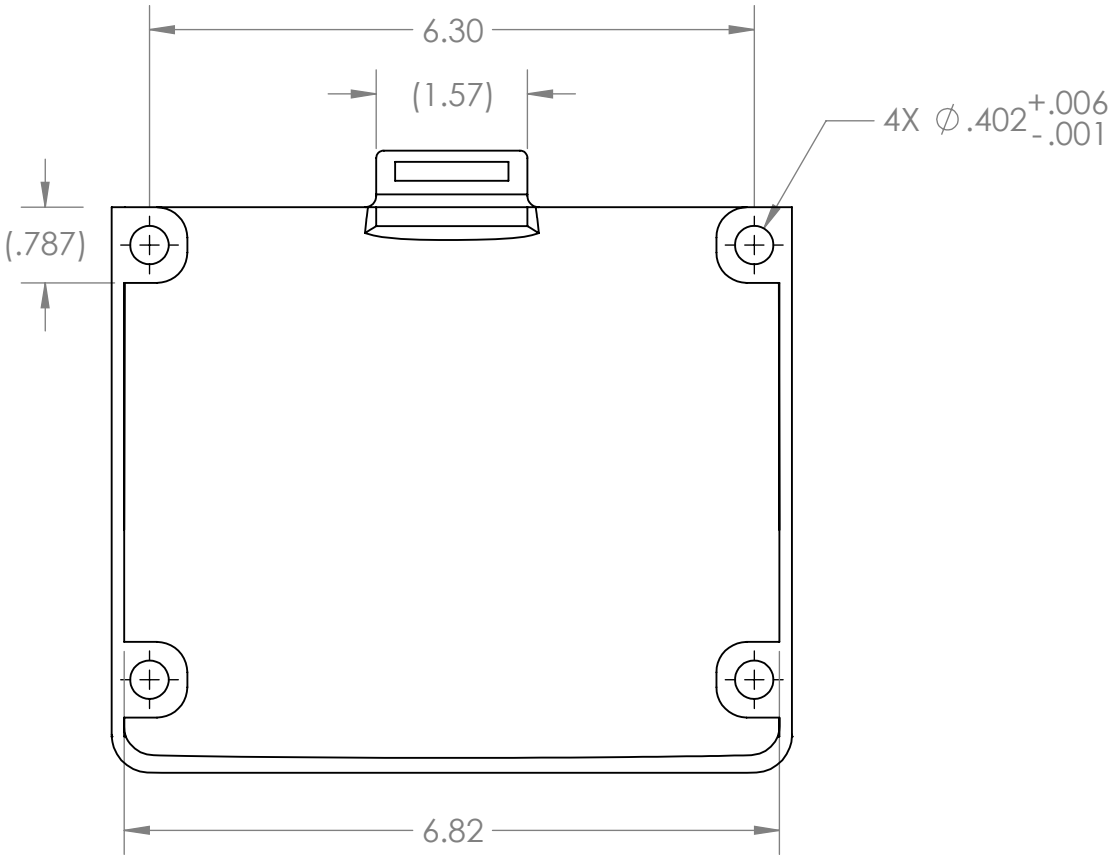
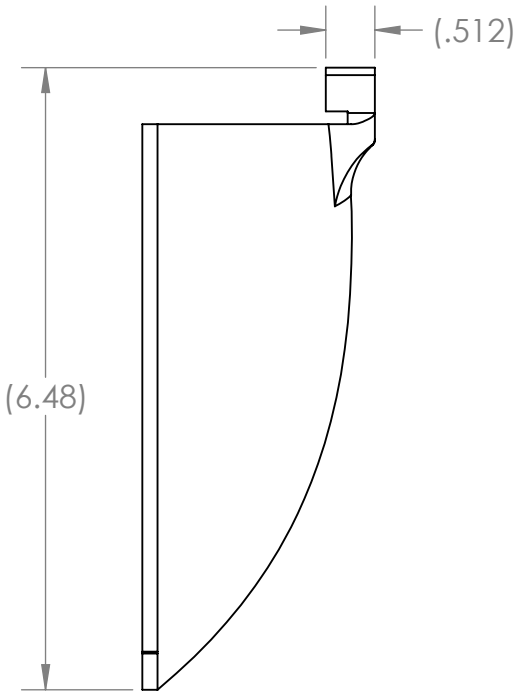
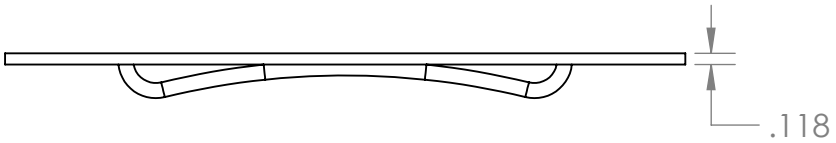
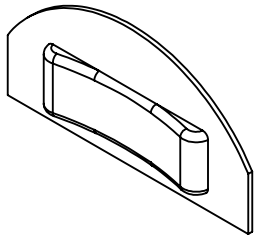


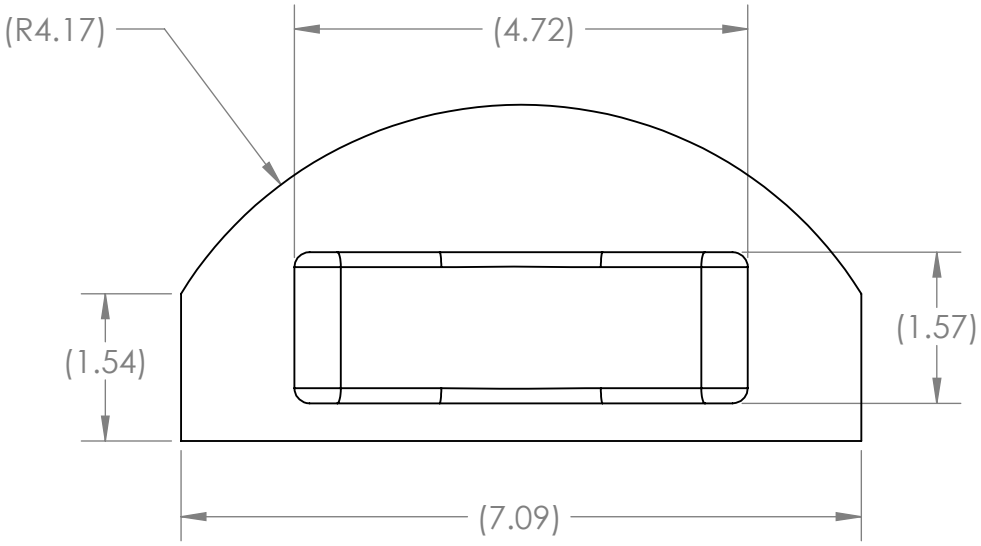


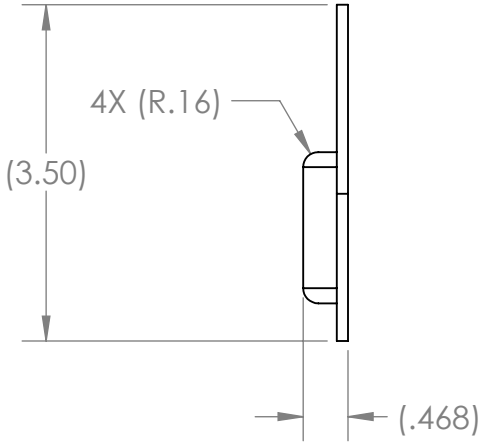
Concordia	MATERIAL **ABS**		SURFACE ROUGHNESS	TITLE **TOP COVER**		
	FINISH **CLEAN**		TOLERANCES X ± .1 .X ± .05 .XX ± .005 .XXX ± .002 ANGLE ± .5°			
PROPRIETARY INFORMATION NOT TO BE RELEASED WITHOUT WRITTEN AUTHORIZATION FROM CONCORDIA UNIVERSITY	DESIGNER **A. SHAWWA**	ALL DIMENSIONS IN **INCHES** UNLESS OTHERWISE SPECIFIED		A SIZE	DATE **11/25/2017**	USED ON **MECH 490**
	DRAFTER **M. A. YADAO**	APPROVED **R.PATEL**	SCALE **1:2**	SHEET **5 /14**	DWG NO. **11709002**	REV NO. **03**



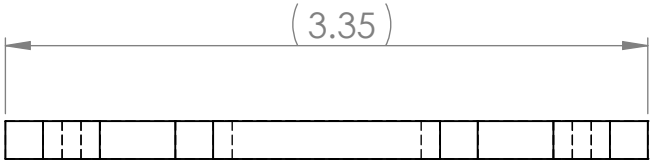


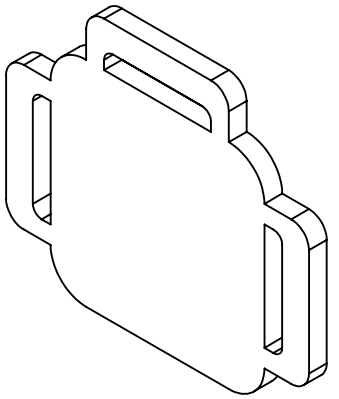
ISOMETRIC VIEW
SCALE: NONE
FOR REFERENCE ONLY





Concordia	MATERIAL **ABS**	SURFACE ROUGHNESS	TITLE **BACK COVER**			
	FINISH **CLEAN**	TOLERANCES X ± .1, .X ± .05, .XX ± .005, .XXX ± .002, ANGLE ± .5°				
PROPRIETARY INFORMATION. NOT TO BE RELEASED WITHOUT WRITTEN AUTHORIZATION FROM CONCORDIA UNIVERSITY	DESIGNER **A.SHAWWA**	ALL DIMENSIONS IN **INCHES** UNLESS OTHERWISE SPECIFIED	A SIZE	DATE **11/25/2017**	USED ON **MECH 490**	
	DRAFTER **M. A. YADAO**	APPROVED **R.PATEL**	SCALE **1:2**	SHEET **6 /14**	DWG NO. **11709003**	REV NO. **03**





ISOMETRIC VIEW
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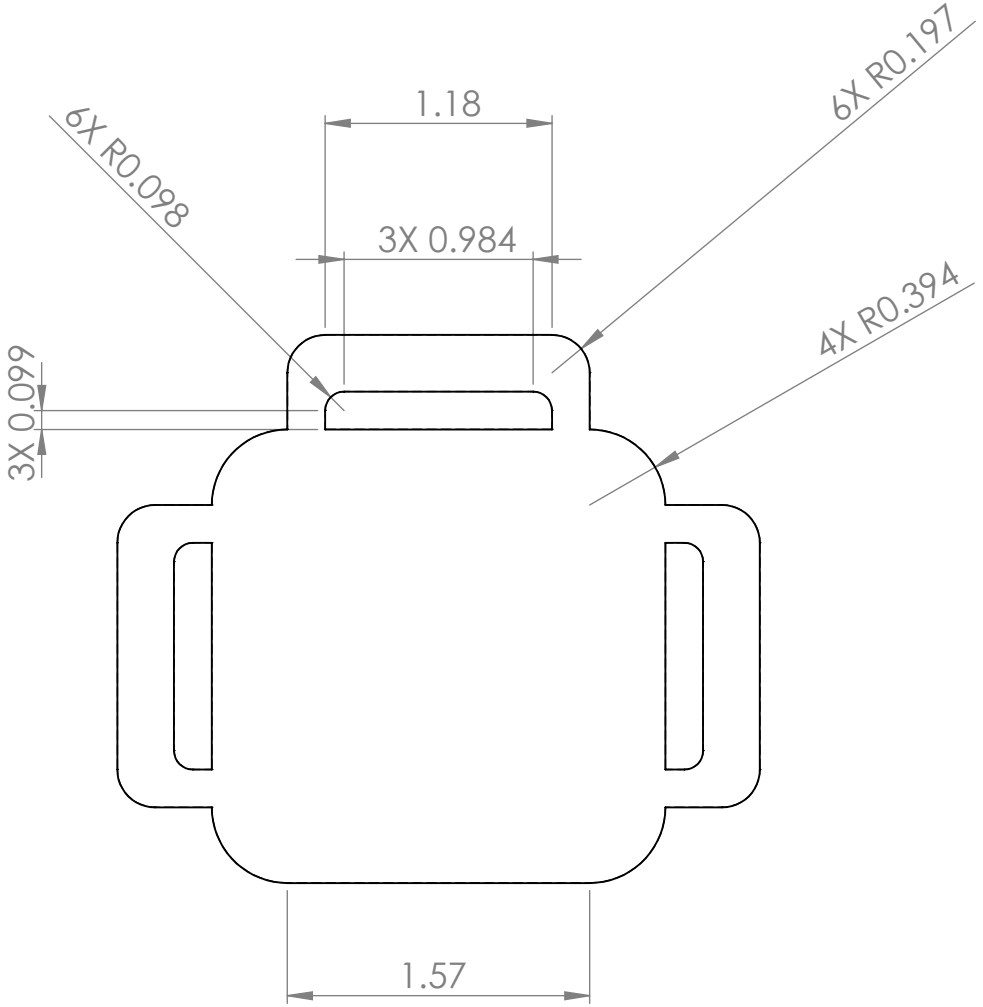
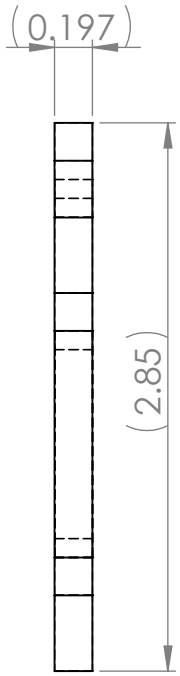
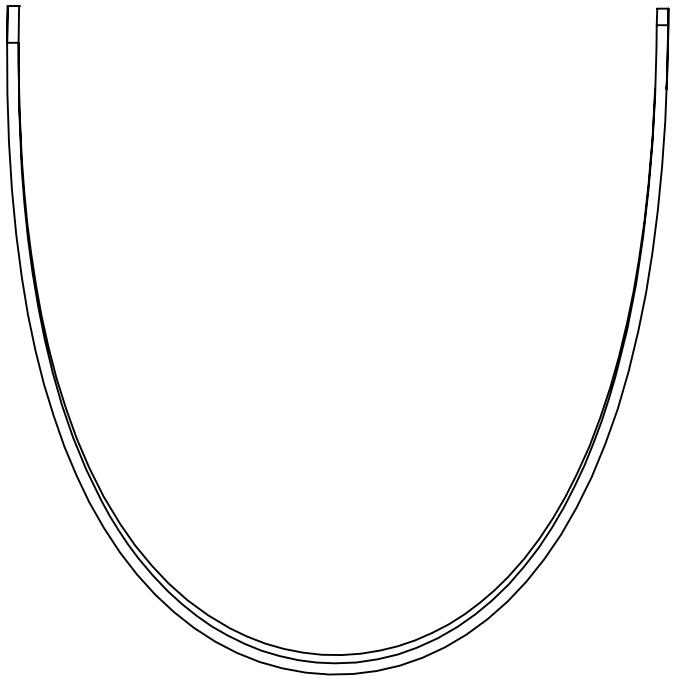
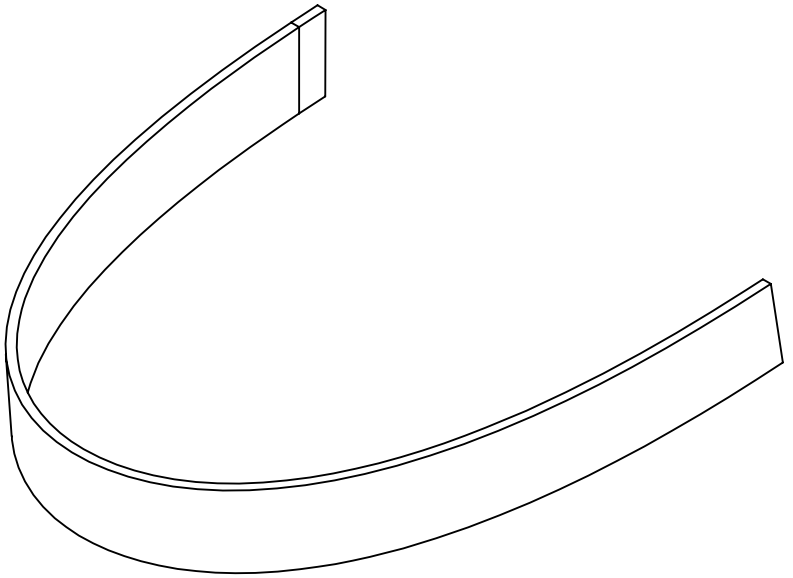
FOR REFERENCE ONLY





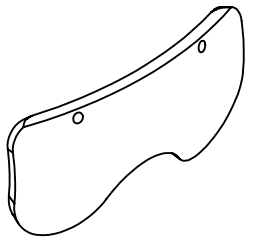
Concordia	MATERIAL **PLA**		SURFACE ROUGHNESS	TITLE **BACK PIECE**		
	FINISH **CLEAN**		TOLERANCES X ± .1 .X ± .05 .XX ± .005 .XXX ± .002 ANGLE ± .5°			
PROPRIETARY INFORMATION NOT TO BE RELEASED WITHOUT WRITTEN AUTHORIZATION FROM CONCORDIA UNIVERSITY	DESIGNER **N. CIERSON**	ALL DIMENSIONS IN **INCHES** UNLESS OTHERWISE SPECIFIED		A SIZE	DATE **11/25/2017**	USED ON **MECH 490**
	DRAFTER **M. A. YADAO**	APPROVED **R. PATEL**	SCALE **1:1**	SHEET **7 /14**	DWG NO. **11709004**	REV NO. **03**





ISOMETRIC VIEW
SCALE: NONE
FOR REFERENCE ONLY

Concordia UNIVERSITY	MATERIAL **VELCRO**		SURFACE ROUGHNESS	TITLE **HEAD STRAP**		
	FINISH **-**		TOLERANCES X ± .1 .X ± .05 .XX ± .005 .XXX ± .002 ANGLE ± .5°			
PROPRIETARY INFORMATION NOT TO BE RELEASED WITHOUT WRITTEN AUTHORIZATION FROM CONCORDIA UNIVERSITY	DESIGNER **A. SHAWWA**	ALL DIMENSIONS IN **INCHES** UNLESS OTHERWISE SPECIFIED		A SIZE	DATE **11/25/2017**	USED ON **MECH 490**
	DRAFTER **A.SHAWWA**	APPROVED **R. PATEL**	SCALE **1:2**	SHEET **8 /14**	DWG NO. **11709005**	REV NO. **03**



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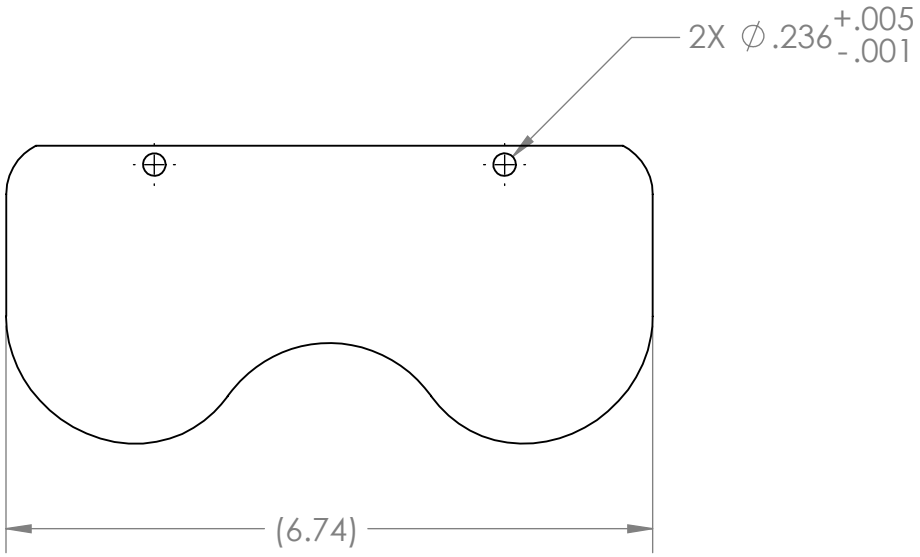
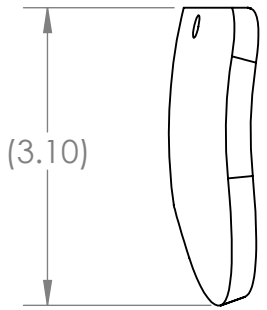
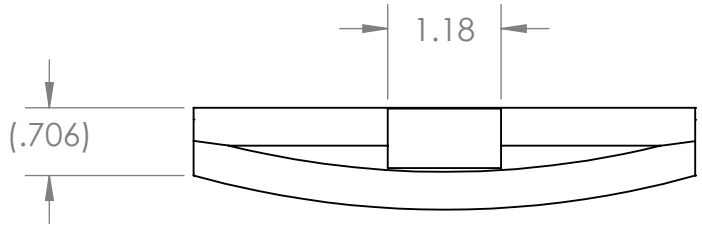
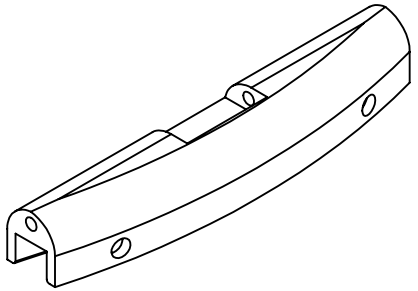
FOR REFERENCE ONLY





Concordia	MATERIAL **ACRYLIC**		SURFACE ROUGHNESS	TITLE **HEADS UP DISPLAY**		
	FINISH **CLEAN**		TOLERANCES X ± .1 .X ± .05 .XX ± .005 .XXX ± .002 ANGLE ± .5°			
PROPRIETARY INFORMATION. NOT TO BE RELEASED WITHOUT WRITTEN AUTHORIZATION FROM CONCORDIA UNIVERSITY	DESIGNER **A. SHAWWA**	ALL DIMENSIONS IN **INCHES** UNLESS OTHERWISE SPECIFIED		A SIZE	DATE **11/25/2017**	USED ON **MECH 490**
	DRAFTER **M. A. YADAO**	APPROVED **R.PATEL**	SCALE **1:2**	SHEET **9 /14**	DWG NO. **11709006**	REV NO. **03**





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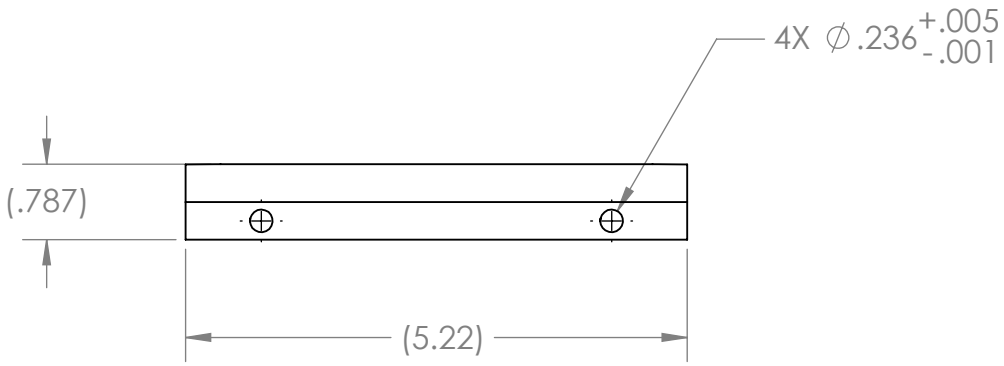
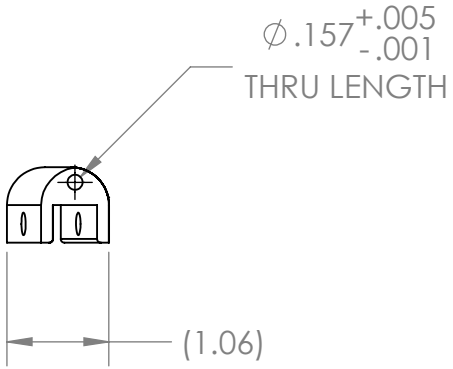
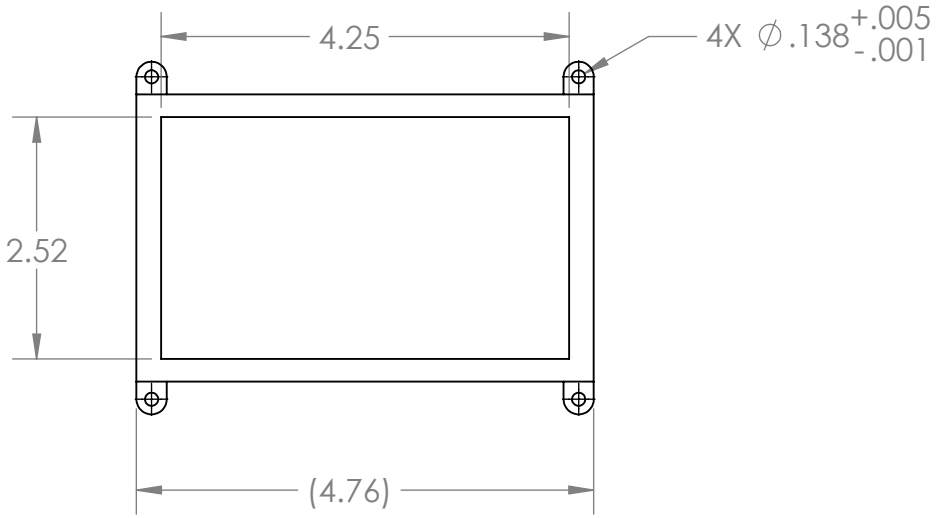
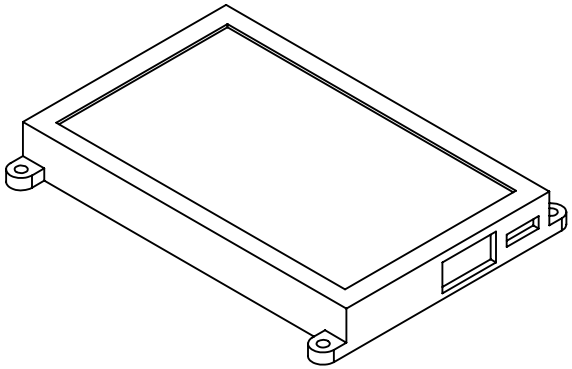
FOR REFERENCE ONLY





Concordia	MATERIAL **ABS**		SURFACE ROUGHNESS	TITLE **HEADS UP DISPLAY HINGE**			
	FINISH **CLEAN**		TOLERANCES X ± .1 .X ± .05 .XX ± .005 .XXX ± .002 ANGLE ± .5°				
PROPRIETARY INFORMATION NOT TO BE RELEASED WITHOUT WRITTEN AUTHORIZATION FROM CONCORDIA UNIVERSITY	DESIGNER **A. SHAWWA**	ALL DIMENSIONS IN **INCHES** UNLESS OTHERWISE SPECIFIED		A SIZE	DATE **11/25/2017**	USED ON **MECH 490**	
	DRAFTER **M. A. YADAO**	APPROVED **R.PATEL**	SCALE **1:2**	SHEET **10/14**	DWG NO. **11709007**	REV NO. **01**	





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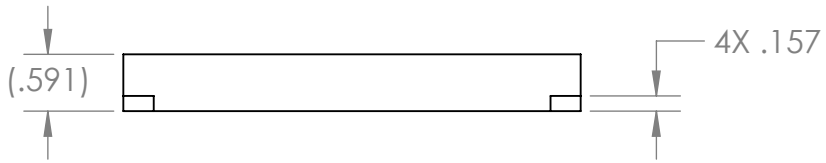
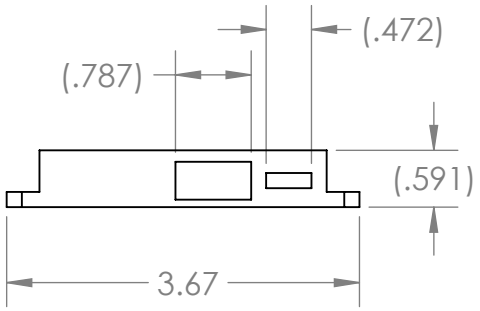
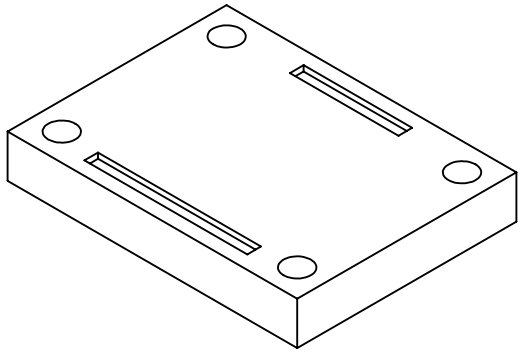




Concordia	MATERIAL **VARIES**		SURFACE ROUGHNESS	TITLE **SCREEN**		
	FINISH **VARIES**		TOLERANCES X ± .1, .X ± .05, .XX ± .005, .XXX ± .002, ANGLE ± .5°			
PROPRIETARY INFORMATION. NOT TO BE RELEASED WITHOUT WRITTEN AUTHORIZATION FROM CONCORDIA UNIVERSITY	DESIGNER **A. SHAWWA**	ALL DIMENSIONS IN **INCHES** UNLESS OTHERWISE SPECIFIED		A SIZE	DATE **11/25/2017**	USED ON **MECH 490**
	DRAFTER **M. A. YADAO**	APPROVED **R.PATEL**	SCALE **1:2**	SHEET **11/14**	DWG NO. **11709011**	REV NO. **03**



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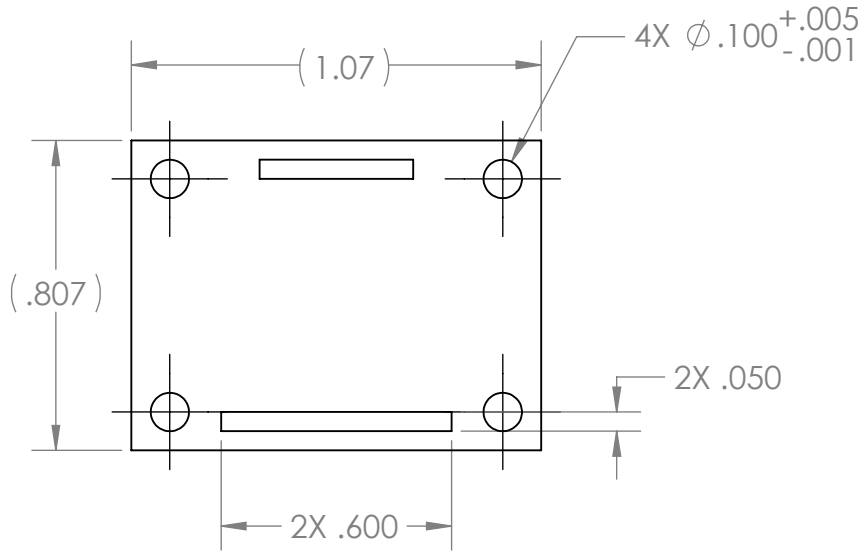
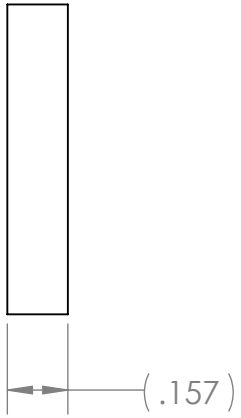
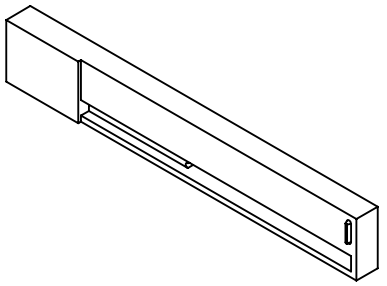
FOR REFERENCE ONLY





Concordia	MATERIAL **VARIES**		SURFACE ROUGHNESS	TITLE **ADAFRUIT BNO 055 MOTION SENSOR**		
	FINISH **VARIES**		TOLERANCES X ± .1, .X ± .05, .XX ± .005, .XXX ± .002, ANGLE ± .5°			
PROPRIETARY INFORMATION. NOT TO BE RELEASED WITHOUT WRITTEN AUTHORIZATION FROM CONCORDIA UNIVERSITY	DESIGNER **ONLINE**	ALL DIMENSIONS IN **INCHES** UNLESS OTHERWISE SPECIFIED		A SIZE	DATE **11/25/2017**	USED ON **MECH 490**
	DRAFTER **ONLINE**	APPROVED **ONLINE**	SCALE **2:1**	SHEET **12/14**	DWG NO. **ADA2472**	REV NO. **03**



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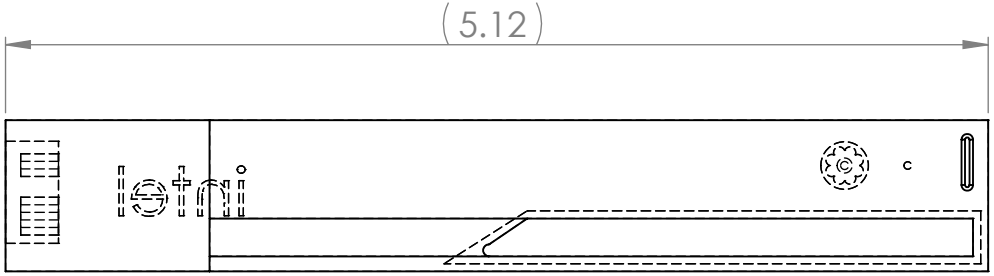
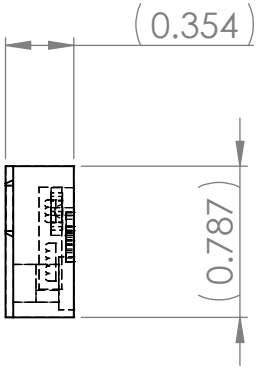
FOR REFERENCE ONLY





Concordia	MATERIAL **VARIES**		SURFACE ROUGHNESS	TITLE **INTEL REALSENSE CAMERA R200**		
	FINISH **VARIES**		TOLERANCES X ± .1 .X ± .05 .XX ± .005 .XXX ± .002 ANGLE ± .5°			
PROPRIETARY INFORMATION NOT TO BE RELEASED WITHOUT WRITTEN AUTHORIZATION FROM CONCORDIA UNIVERSITY	DESIGNER **ONLINE**	ALL DIMENSIONS IN **INCHES** UNLESS OTHERWISE SPECIFIED		A SIZE	DATE **11/25/2017**	USED ON **MECH 490**
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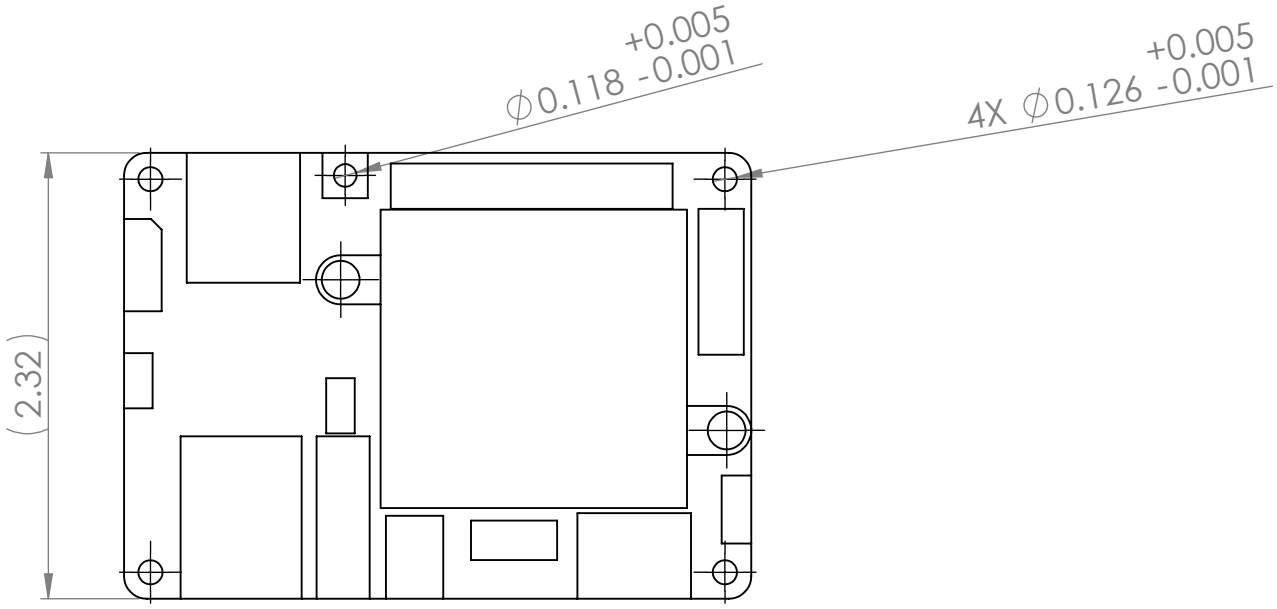

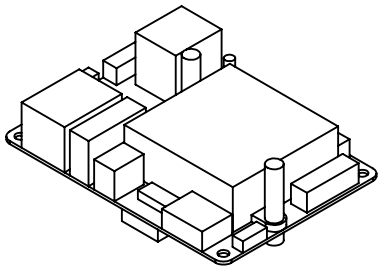

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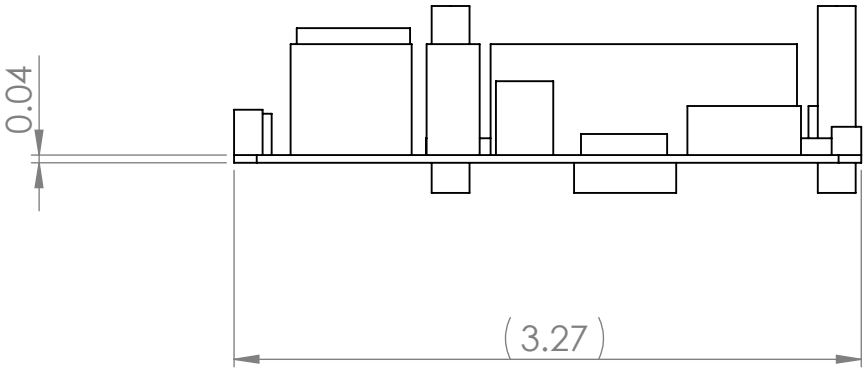
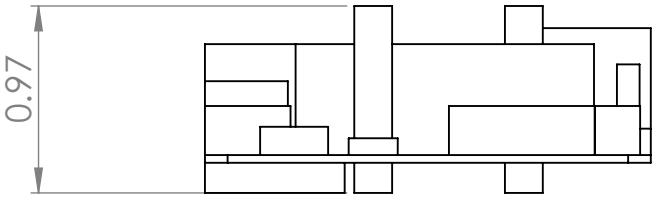
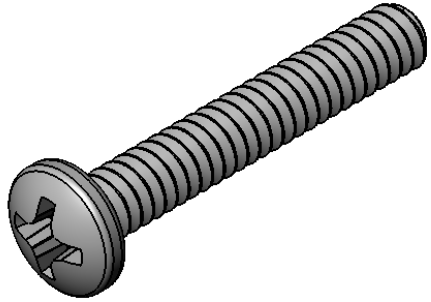
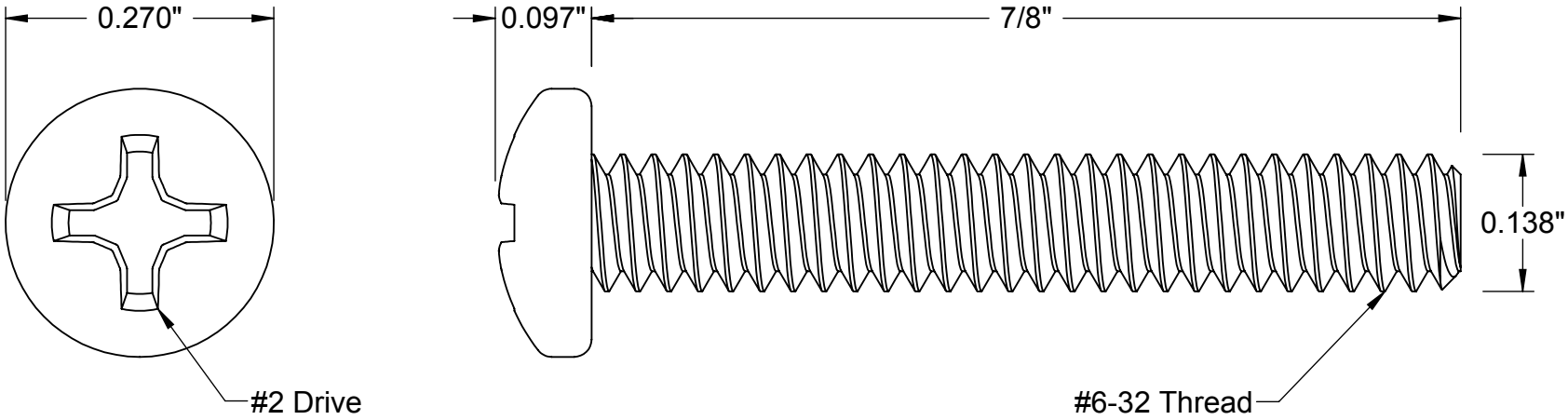
SCALE: NONE
FOR REFERNCE ONLY





Concordia UNIVERSITY	MATERIAL **VARIES**		SURFACE ROUGHNESS	TITLE **ODROID XU4**		
	FINISH **VARIES**		TOLERANCES X ± .1, .X ± .05, .XX ± .005, .XXX ± .002, ANGLE ± .5°			
PROPRIETARY INFORMATION NOT TO BE RELEASED WITHOUT WRITTEN AUTHORIZATION FROM CONCORDIA UNIVERSITY	DESIGNER **ONLINE**	ALL DIMENSIONS IN **INCHES** UNLESS OTHERWISE SPECIFIED		A SIZE	DATE **11/25/2017**	USED ON **MECH 490**
	DRAFTER **ONLINE**	APPROVED **ONLINE**	SCALE **1:1**	SHEET **14/14**	DWG NO. **0007A**	REV NO. **03**





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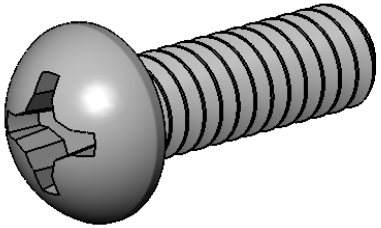
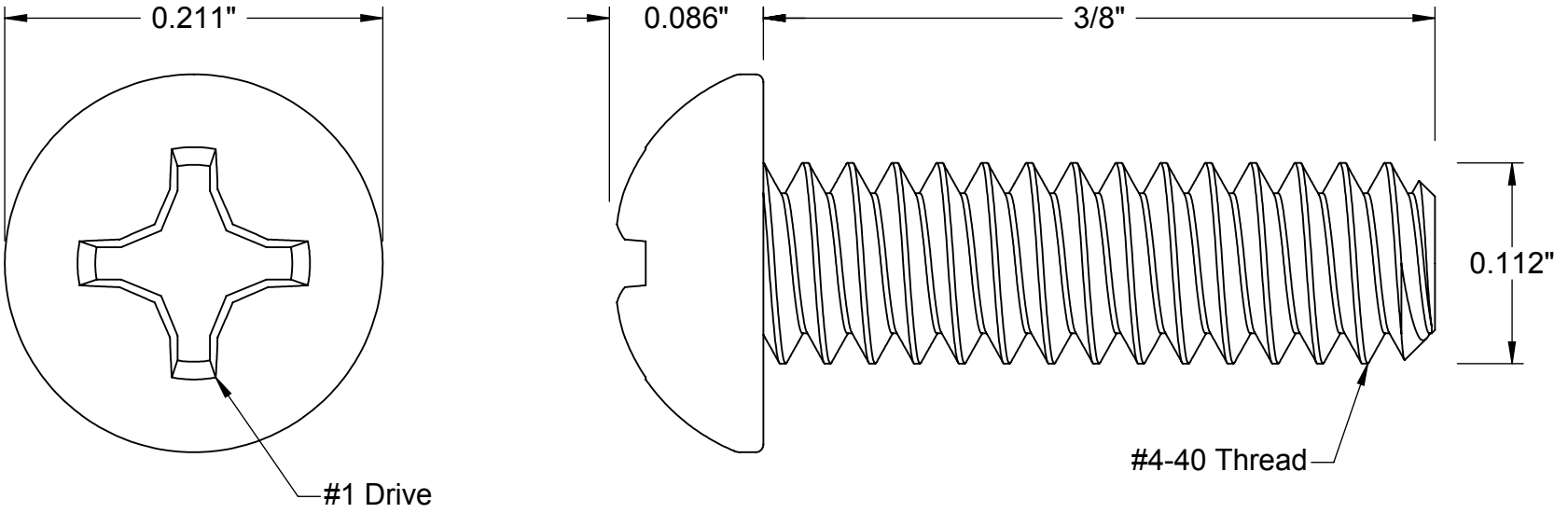
Information in this drawing is provided for reference only.

PART NUMBER **90272A152**

Pan Head Phillips Machine Screw



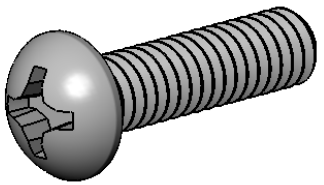


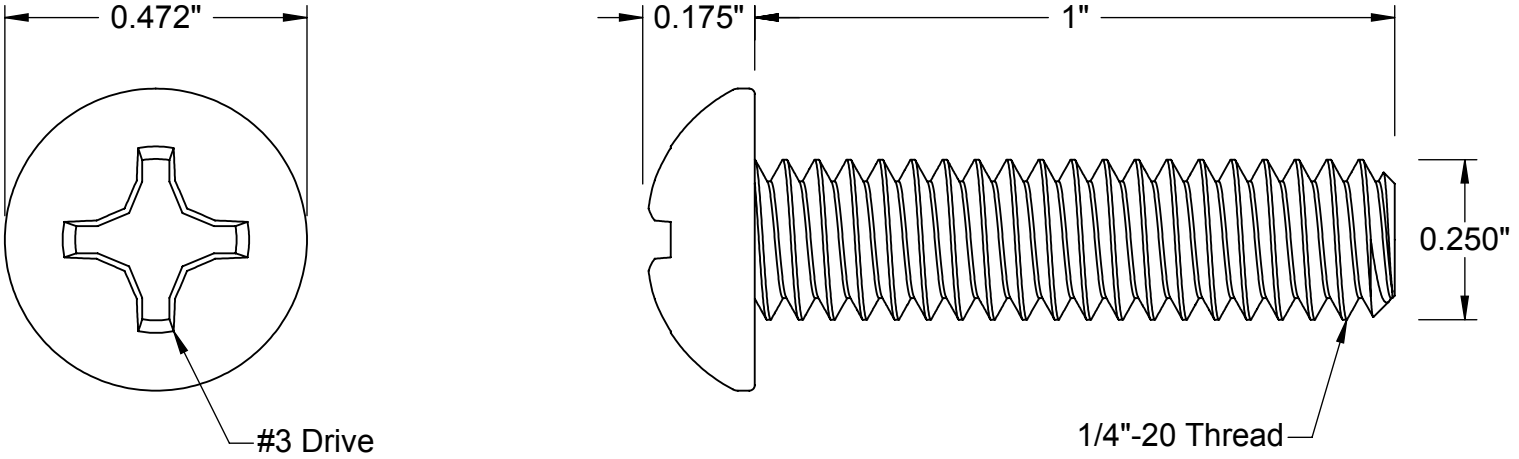
McMASTER-CARR® CAD

http://www.mcmaster.com

PART NUMBER **90279A108**

Round Head Phillips Machine Screw





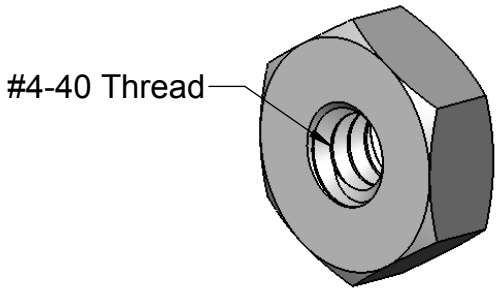
McMASTER-CARR® CAD

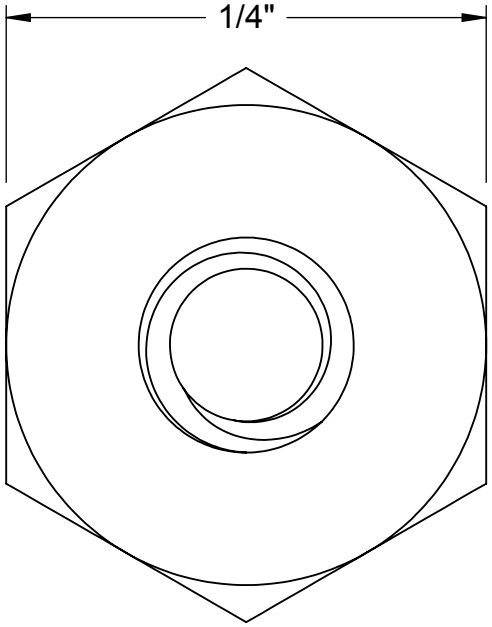
http://www.mcmaster.com

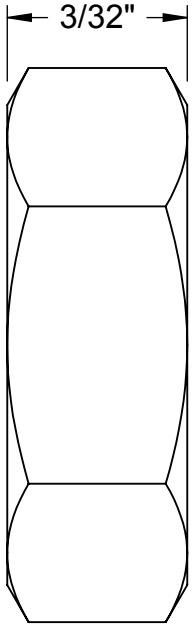
Information in this drawing is provided for reference only.

PART NUMBER **90279A542**

Round Head Phillips Machine Screw





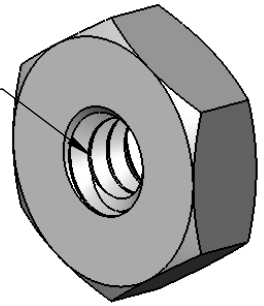


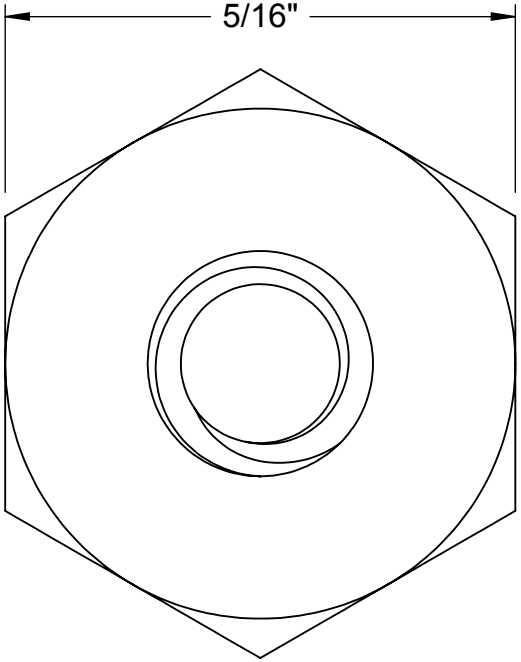
McMASTER-CARR® CAD

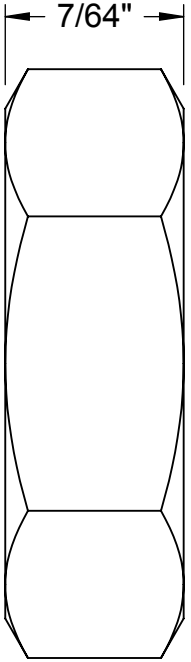
http://www.mcmaster.com

PART NUMBER **90480A005**

Hex Nut







McMASTER-CARR® CAD

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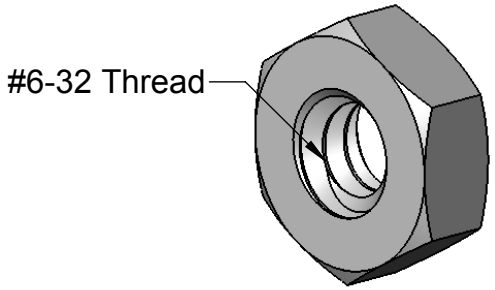
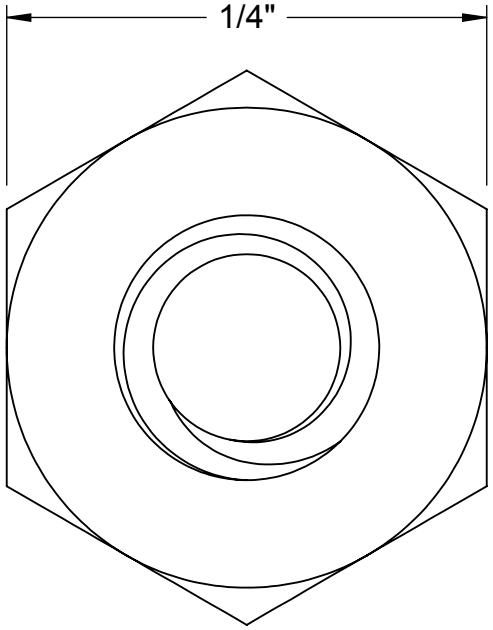
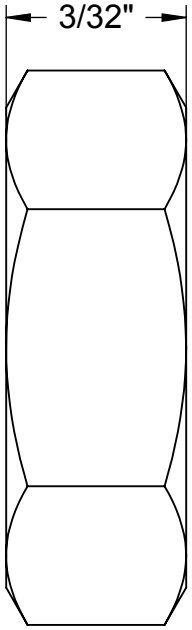
PART NUMBER **90480A007**

Hex Nut





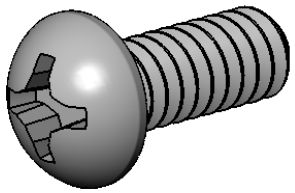


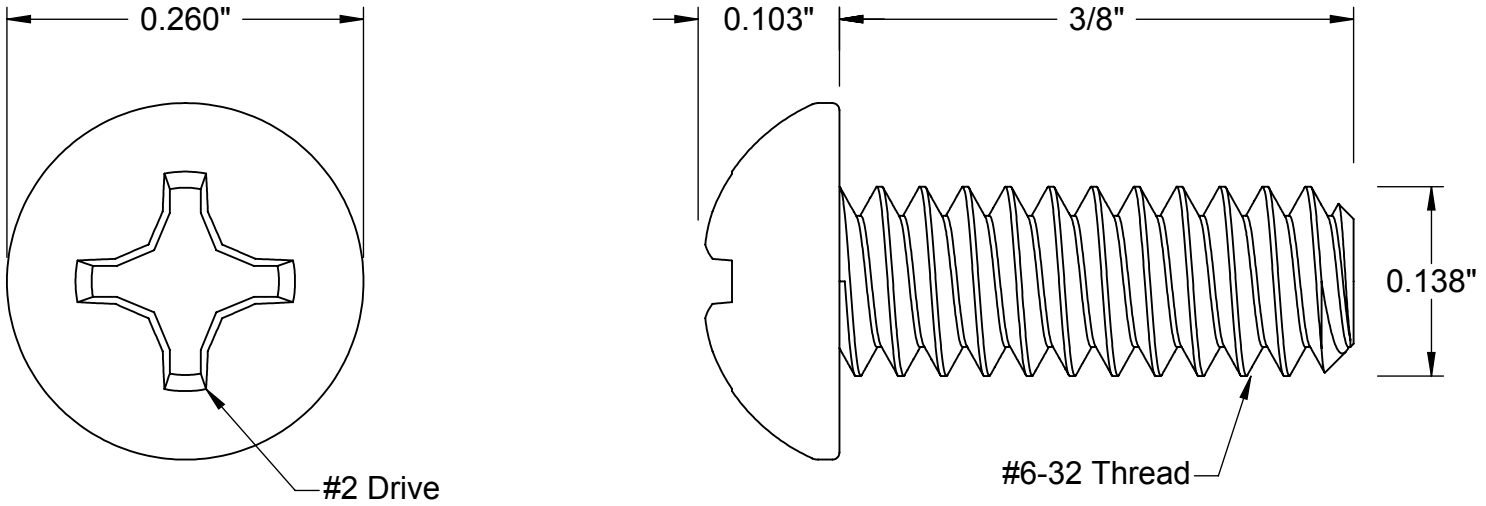
McMASTER-CARR® CAD

http://www.mcmaster.com

PART NUMBER **90760A007**

Narrow
Hex Nut





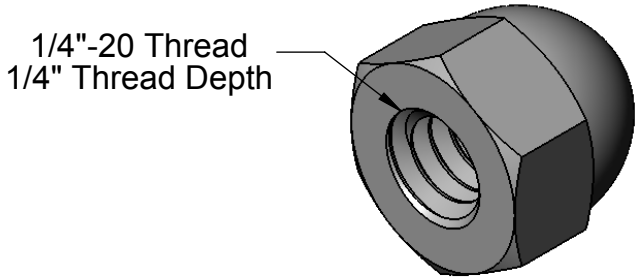
McMASTER-CARR® CAD

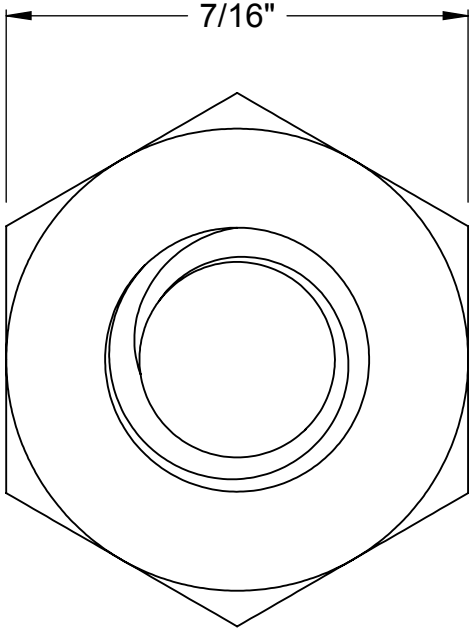
http://www.mcmaster.com

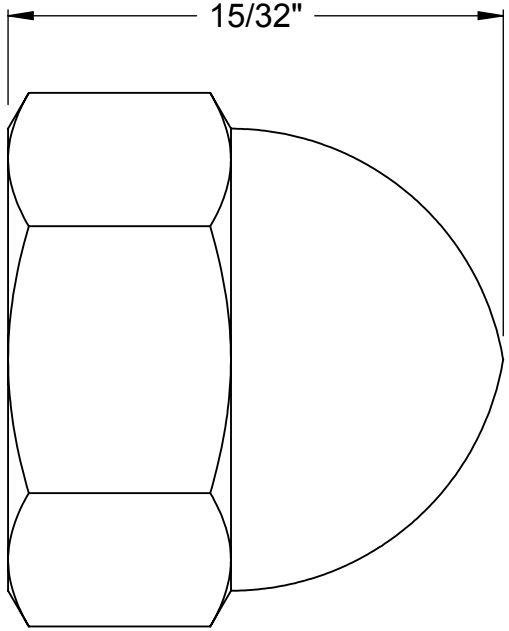
Information in this drawing is provided for reference only.

PART NUMBER **91773A146**

Round Head Phillips Machine Screw





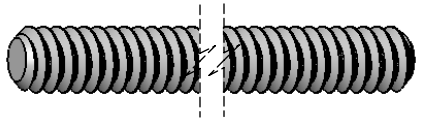


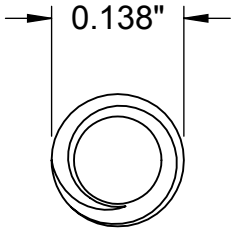
McMASTER-CARR® CAD

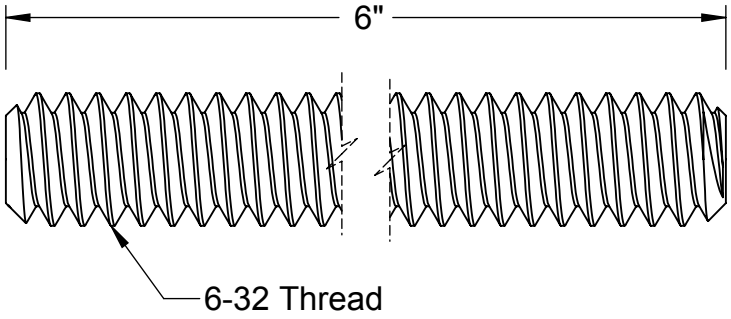
http://www.mcmaster.com

PART NUMBER **91875A130**

Cap
Nut







McMASTER-CARR® CAD http://www.mcmaster.com	PART NUMBER **95475A244**
 	Low-Strength Steel Threaded Stud

Concordia University
ENCS
Engineering & Computer Science

Team	#9
Device	Augmented Reality Headset
Test date	TBD
Location	Concordia University
Test LEAD	Faraz Yunus
Test co-lead	Nicholas Cierson
Test STAFF	TBD
Observers	

	Approvals for testing	VERSION
Program Manager		1.0
Professor		

ENGINEERING VALIDATION TESTS

	Name of analysis	Description of test	Expected	Observed	Date
VAL1	Drop Test	Drop the AR headset at different heights and observe whether device failure occurs	No Failure Occurs		
VAL2	Thermal Test Part A	The AR headset will be run to its maximum capacity to demonstrate its baseline temperature			
VAL3	Thermal Test Part B	The AR headset will be placed in the wind tunnel to find the optimal air speed required to bring the temperature to 30C			
VAL4	Vibration Test	Vibrate the AR headset in a vibration machine and observe whether the harware comes loose	No Hardware comes Loose		

PREOPERATION CHECKS FOR VAL 1

SAFETY

	Name of Task	Description	Checked	Initials	Date
SFT1	Test Brief	Inform everyone of the test taking place (As per standard UL60950)			
SFT2	Test Procedure	Ensure testers have reviewed standard UL60950.			
SFT3	Personal Protective Equipment	Ensure all test personnel are wearing the appropriate protective equipment (Safety Glasses)			
SFT4	Projectile	Ensure a barrier is placed to limit the movement of projectiles			
SFT5	Infrastructure				
SFT6	Fire				

DEVICE INTEGRITY

DEV1	Structural	Ensure that the AR headset is free from structural damage			
DEV2	Assembly - BOM	Assembly is complete - no missing components.			

SYSTEM INTEGRITY					
SYS1	shock				
SYS2	vibration				
SYS3	temperature				
SYS4	pressure				
SYS5	other				

INSPECTION

INS1	Device Inspection	Engineer or Staff signature :		

PREOPERATION CHECKS FOR VAL 2

SAFETY

	Name of Task	Description	Checked	Initials	Date
SFT1	Test Brief	Inform everyone of the test taking place (As per standard GR-63-Core)			
SFT2	Test Procedure	Ensure testers have reviewed standard GR-63-Core.			
SFT3	Fire	Ensure a fire extinguisher is near by in case of a fire			
SFT4	Personal Protective Equipment				

DEVICE INTEGRITY

HAZARD and MISHAP ANALYSIS

Hazard types (ref 2) Movement	stored energy	sharp edges	electricity	substanc	radiation	physical agent	Description	Severity	Probability	Corrective or Control Actio	Action verified	Implementation Date
	No	Yes	Yes	No	No	No	Danger of flying objects	Medium	High	Proper protective equipment worn during test. Fire extinguisher is nearby.		
	No	No	Yes	No	No	No	Danger of Fire	Medium	Low			
	No	No	Yes	No	No	No	Danger of flying objects and burning yourself	Medium	Low			
	No	No	Yes	No	No	No	Danger of flying objects	Medium	Medium			

DEV1	Structural	Ensure that the AR headset is free from structural damage			
DEV2	Assembly - BOM	Assembly is complete - no missing components.			

SYSTEM INTEGRITY

SYS1	Temperature	Ensure a thermocouple is placed inside of the AR headset			
SYS2	vibration				
SYS3	shock				
SYS4	pressure				
SYS5	other				

INSPECTION

INS1	Device Inspection	Engineer or Staff signature :		

PREOPERATION CHECKS FOR VAL 3

SAFETY

	Name of Task	Description	Checked	Initials	Date
SFT1	Test Brief	Inform everyone of the test taking place (As per standard JESD 51-6)			
SFT2	Test Procedure	Ensure testers have reviewed standard JESD 51-6			
SFT3	Fire				
SFT4	Personal protective equipment				

DEVICE INTEGRITY

DEV1	Structural	Ensure that the AR headset is free from structural damage			
DEV2	Assembly - BOM	Assembly is complete - no missing components.			
DEV3	Fasteners	Ensure that the AR headset is properly fastened to the windtunnel			

SYSTEM INTEGRITY

SYS1	Temperature	Ensure a thermocouple is placed inside of the AR headset			
SYS2	Wind Tunnel	Ensure that the Wind tunnel is working			
SYS3	Kill Switch	Ensure that the kill switch for the wind tunnel is free of obstruction and operational. TEST			
SYS4	vibration				
SYS5	shock				
SYS6	pressure				
SYS7	other				

INSPECTION

INS1	Device Inspection	Engineer or Staff signature :		

PREOPERATION CHECKS FOR VAL 4

SAFETY

	Name of Task	Description	Checked	Initials	Date
SFT1	Test Brief	Inform everyone of the test taking place			
SFT2	Personal protective equipment	Ensure all test personnel are wearing the appropriate protective equipment (Safety Glasses)			
SFT3	Fire				

DEVICE INTEGRITY

DEV1	Structural	Ensure that the AR headset is free from structural damage			
DEV2	Assembly - BOM	Assembly is complete - no missing components.			
DEV3	Fasteners	Ensure that the AR headset is properly fastened to the vibration machine			

SYSTEM INTEGRITY

SYS1	Vibration	Ensure that the vibration machine is woking			
SYS2	Kill Switch	Ensure that the kill switch for the vibration machine is free of obstruction and operational. TEST			
SYS3	shock				
SYS4	temperature				
SYS5	pressure				
SYS6	other				

INSPECTION

INS1	Device Inspection	Engineer or Staff signature :		

PRE-TEST			Checked	Initials	Date
	Objective	**Description of Test**			
OPS1	Baseline Temperature	Bring the AR headset to its baseline temperature, required for "Thermal Test Part B"			

References

1 MIL-STD-882D
2 Safey with Machinery, John Ridley and Dick Pearce, 2006