FORM FIT FUNCTION

Michael-Angelo Yadao, 27415559

Nicholas Cierson, 27318014

Rahul Patel, 27199708

Kostas Zoitakis, 27393741

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Faraz Yunus, 27489994

Amir Shawwa, 29271627

MECH 490: Capstone Engineering Design Project

11/14/2017

Product Specifications

Overall dimensions of headset: 37 x 10 x 21 cm and overall weight: 470 g

Processor

ODROID-XU4 chip

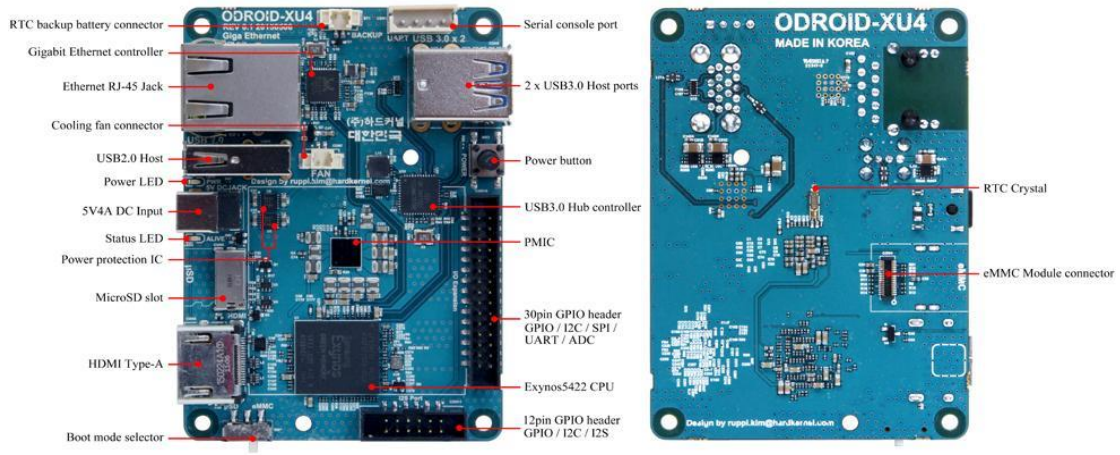


Figure 2: ODROID-XU4 board detail, adapted from [3]

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

Table 5: ODROID-XU4 chip specifications [3]

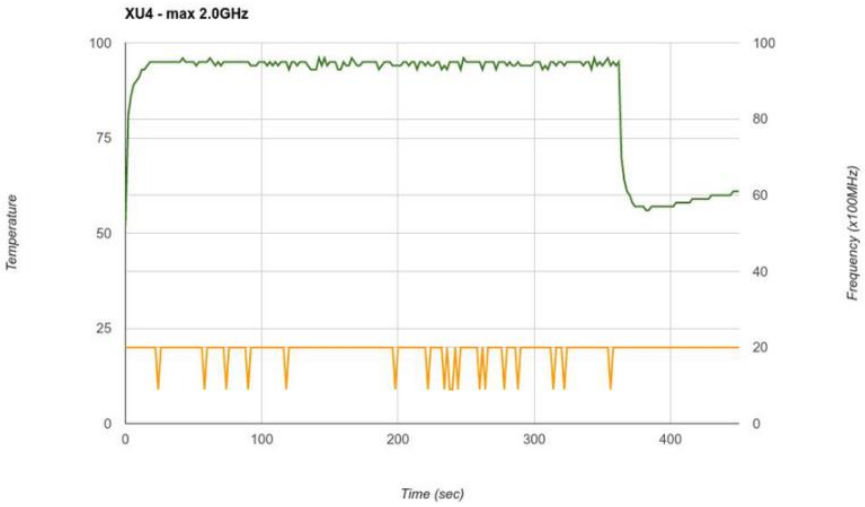


Figure 3: ODROID-XU4 operating temperature vs running time using active cooling, adapted from [3]

Sensors

Adafruit BNO055 9-DOF sensor

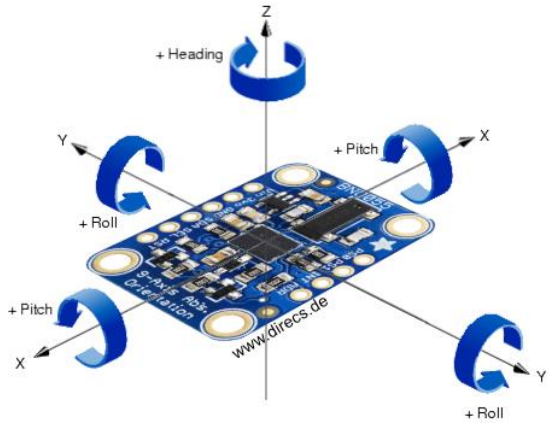


Figure 4: BNO055 axes of rotation, adapted from [4]

Absolute orientation on three axis based on a 360° 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 °C

Table 6: BNO055 Data output [5]

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 5: R200 camera specs, adapted from [6]

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

Display & Optics

5-inch LCD 800x480 HDMI touchscreen: 12 V power supply, -20 °C to 70 °C operating temperature [7].

See through plastic visor

References:

[3] 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

[4] 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/

[5] “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

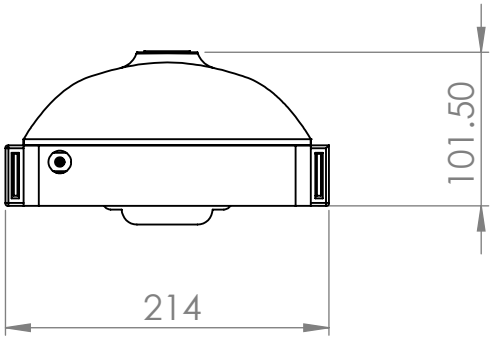
[6] “Specifications for the Intel® RealSense™ Camera R200.” *Intel*, Available at: www.intel.com/content/www/us/en/support/articles/000016214/emerging-technologies/intel-realsense-technology.html

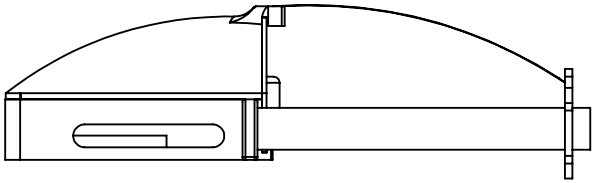
[7] *5 inch LCD Screen TFT Module,800X480 VGA Video AV Driver Board*, Available at: www.buydisplay.com/default/5-inch-lcd-screen-tft-module-800x480-vga-video-av-driver-board

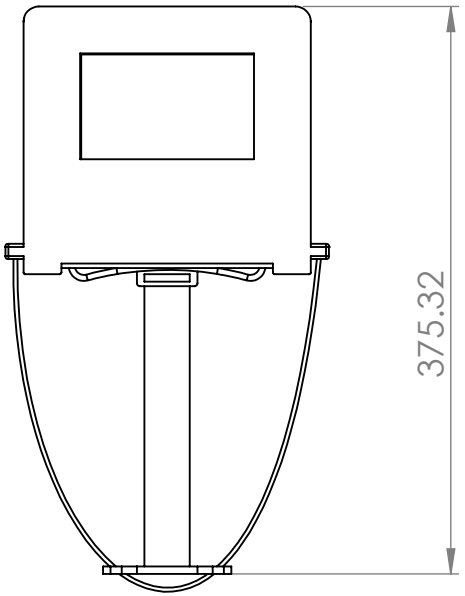
Concordia University
ENCS
Engineering & Computer Science

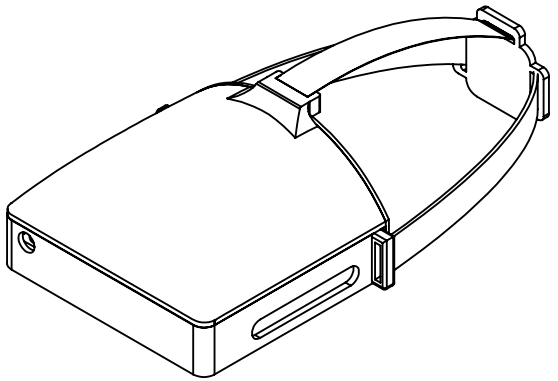
Year	2017
Team	Group #9
Device	AR Headset

CODE	Item	Description	Drawing#/Part#	MNF/OEM/SPL	QTY	CASH Material [$]	CASH Labour [$]	TIME Time[hr]	CAPCOIN CODE	CAPCOIN Capcoin$	SPONSOR In Kind
	1	HEADSET V2	11709101	EXTERNAL - 3D HUB	1	44.9	-		-	-	
	2	TOP COVER V2	11709102	EXTERNAL - 3D HUB	1	24.07	-		-	-	
	3	BACK COVER V2	11709103	EXTERNAL - 3D HUB	1	8.32	-		-	-	
	4	BACK PIECE	11709104	STUDENT - Kostas - 3D print	1		-		-	-	
	5	HEAD STRAP	11709105		2		-		-	-	
	6	SCREEN V3	11709201		1		-		-	-	Dr. Charles Kiyanda
	7	ADAFRUIT BNO 055 (motion sensor) V2	ADA2472		1		-		-	-	Dr. Charles Kiyanda
	8	INTEL REALSENSE CAMERA R200	MM#939143	INTEL REALSENSE	1	153.36	-		-	-	
	9	ODROID XU4	0007A	AMERIDROID.COM	1	120.57	-		-	-	
	10	FASTENER, FLAT, M3.5 X 0.6mm	91420A173	MCMASTER	100	3.02	-		-	-	
	11	FASTENER, FLAT, M2.5 X 0.45mm	92010A016	MCMASTER	100	4.99	-		-	-	
	12	HEX NUT, M3.5	90592A010	MCMASTER	100	2.28	-		-	-	
	13	HEX NUT, M2.5	90592A006	MCMASTER	100	1.37	-		-	-	
		SUBTOTALS				362.88	0		0	0	0

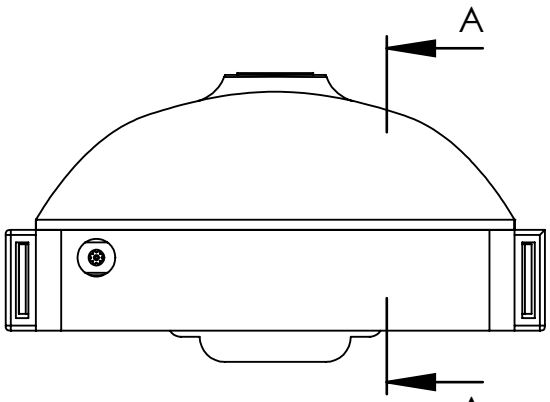


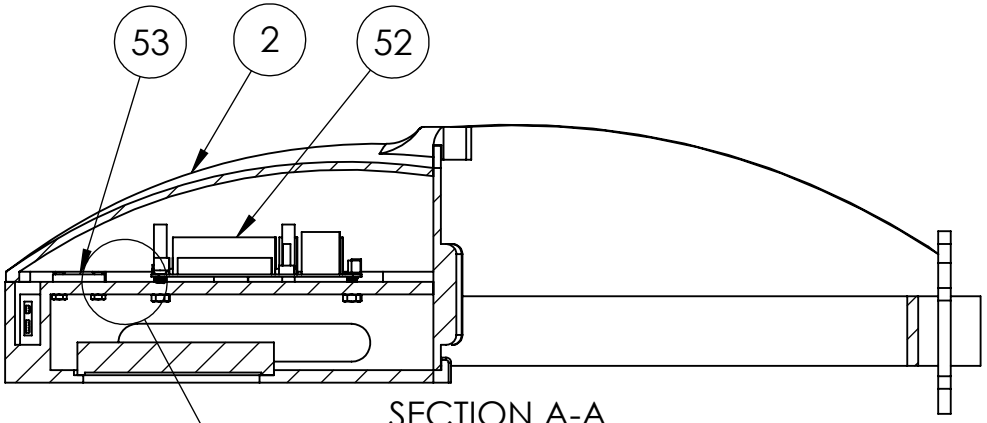






Concordia	MATERIAL -		SURFACE ROUGHNESS √	TITLE **HEADSET ASSEMBLY**			
	FINISH -		TOLERANCES X ± .1 .X ± .05 .XX ± .005 .XXX ± .002 ANGLE ± .5°				
PROPRIETARY INFORMATION NOT TO BE RELEASED WITHOUT WRITTEN AUTHORIZATION FROM CONCORDIA UNIVERSITY	DESIGNER **A.SHAWWA**	ALL DIMENSIONS IN **mm** UNLESS OTHERWISE SPECIFIED		A SIZE	DATE **11/13/2017**	USED ON **MECH 490**	
	DRAFTER **A.SHAWWA**	APPROVED **R.PATEL**	SCALE **1:5**	SHEET **1 / 1**	DWG NO. **11709301**	REV NO. **3**	





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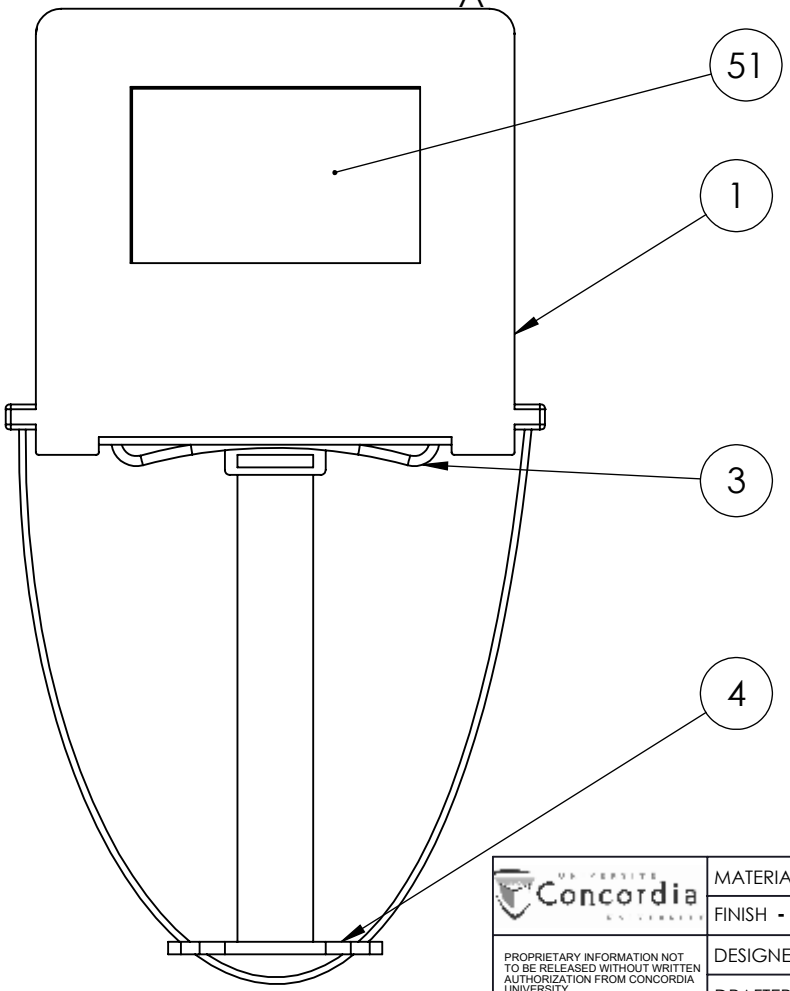
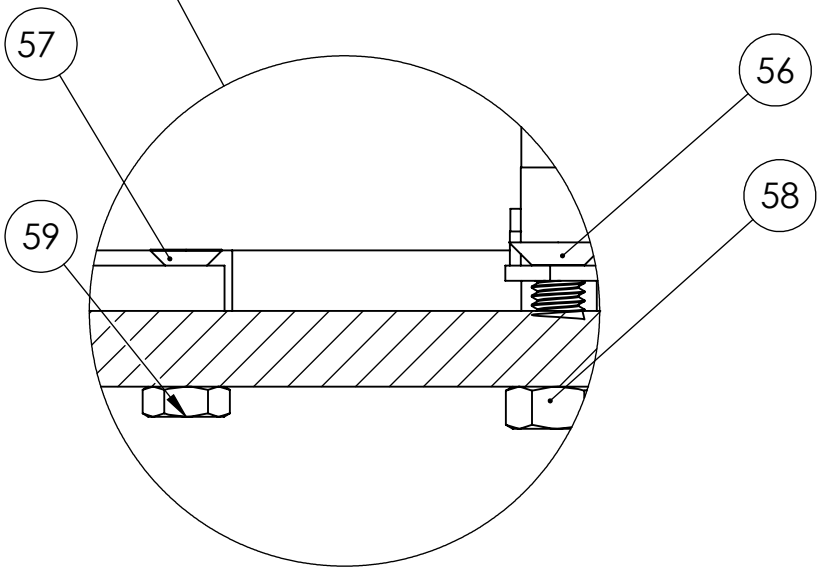
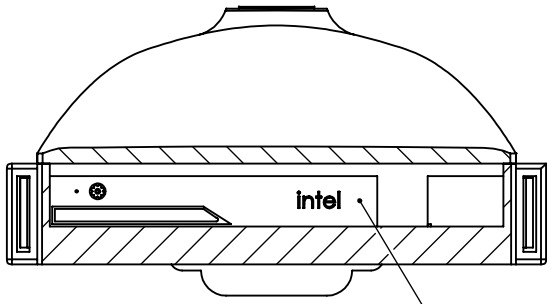


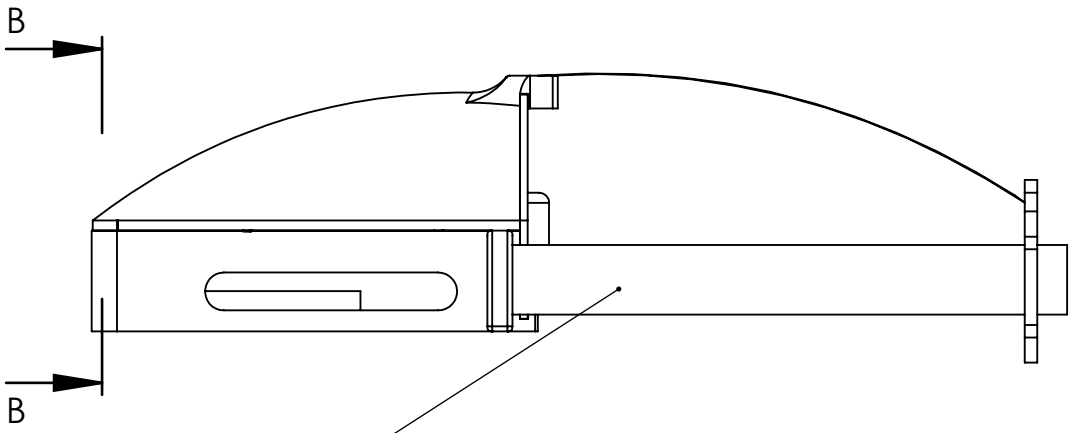


DETAIL A
SCALE 2 : 1

Concordia	MATERIAL -	SURFACE ROUGHNESS √	TITLE **AssemblyV2+BOM**		
	FINISH -	TOLERANCES X ± .1, .X ± .05, .XX ± .005, .XXX ± .002, ANGLE ± .5° (UNLESS OTHERWISE SPECIFIED)			
PROPRIETARY INFORMATION NOT TO BE RELEASED WITHOUT WRITTEN AUTHORIZATION FROM CONCORDIA UNIVERSITY	DESIGNER **A.SHAWWA**	ALL DIMENSIONS IN **mm** UNLESS OTHERWISE SPECIFIED	A SIZE	DATE **11/14/2017**	USED ON **MECH 490**
	DRAFTER **A.SHAWWA**	APPROVED **R.PATEL**	SCALE **1:3**	SHEET **1 / 3**	DWG NO. **11709302**	REV NO. **2**



SECTION B-B



54

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Concordia	MATERIAL -		SURFACE ROUGHNESS	TITLE **AssemblyV2+BOM**			
	FINISH -		TOLERANCES X ± .1, .X ± .05, .XX ± .005, .XXX ± .002, ANGLE ± .5° (UNLESS OTHERWISE SPECIFIED)				
PROPRIETARY INFORMATION NOT TO BE RELEASED WITHOUT WRITTEN AUTHORIZATION FROM CONCORDIA UNIVERSITY	DESIGNER **A.SHAWWA**	ALL DIMENSIONS IN **mm** UNLESS OTHERWISE SPECIFIED		A SIZE	DATE **11/14/2017**	USED ON **MECH 490**	
	DRAFTER **A.SHAWWA**	APPROVED **R.PATEL**	SCALE **1:3**	SHEET **2 / 3**	DWG NO. **11709303**	REV NO. **2**	

ITEM NO.	PART NUMBER	DESCRIPTION	MNF /OEM/ SPL	QTY.
1	11709101	Headset V2	EXTERNAL	1
2	11709102	Top Cover V2	EXTERNAL	1
3	11709103	Back Cover V2	EXTERNAL	1
4	11709104	Back piece	EXTERNAL	1
51	11709201	Screen V3	EXTERNAL	1
52	0007A	Odroid XU4	HARDKERNEL	1
53	ADA2472	Adafruit BNO055 motion sensor V2	ADAFRUIT	1
54	MM#939143	Intel real sense camera R200	INTEL	1
55	11709105	Head strap	EXTERNAL	1
56	91420A173	FASTENER, FLAT, M3.5 X 0.6mm	MCMASTER	4
57	92010A016	FASTENER, FLAT, M2.5 X 0.45mm	MCMASTER	4
58	90592A010	HEX NUT, M3.5	MCMASTER	4
59	90592A006	HEX NUT, M2.5	MCMASTER	4

Concordia

MATERIAL -

FINISH -

DESIGNER **A.SHAWWA**

DRAFTER **A.SHAWWA**

ALL DIMENSIONS IN **mm** UNLESS OTHERWISE SPECIFIED

APPROVED **R.PATEL**

UNLESS OTHERWISE SPECIFIED

SURFACE ROUGHNESS √

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

TITLE **AssemblyV2+BOM**

A SIZE

DATE **11/14/2017**

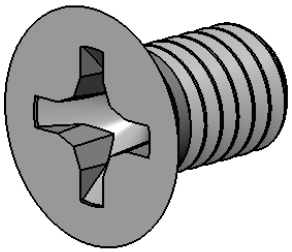
USED ON **MECH 490**

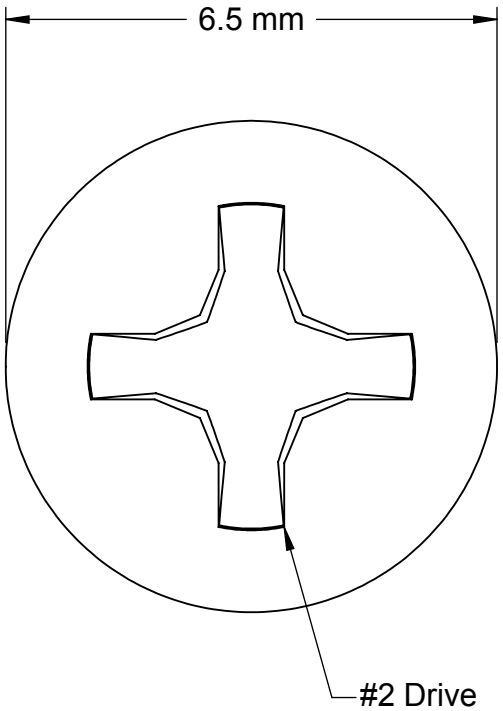
SCALE **1:5**

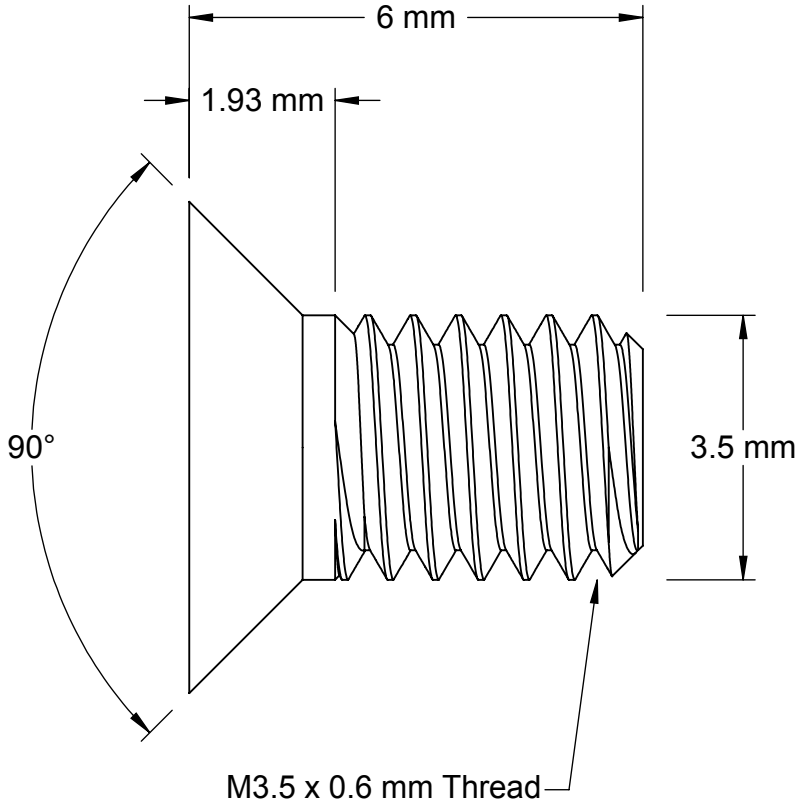
SHEET **3 / 3**

DWG NO. **11709304**

REV NO. **2**





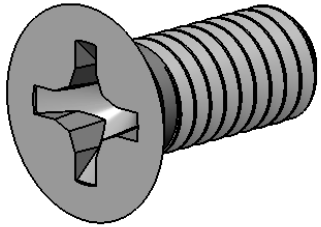


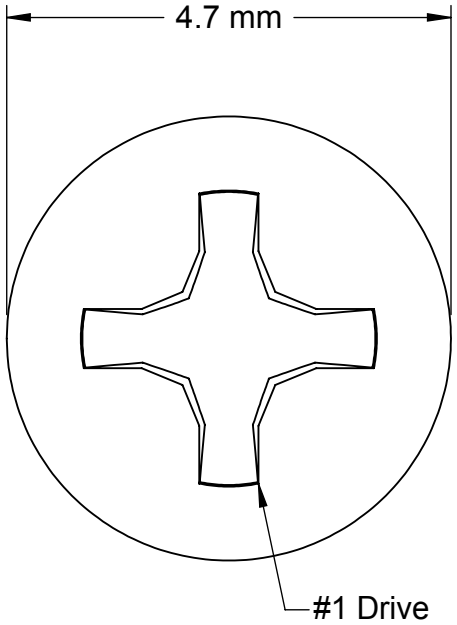
McMASTER-CARR® CAD

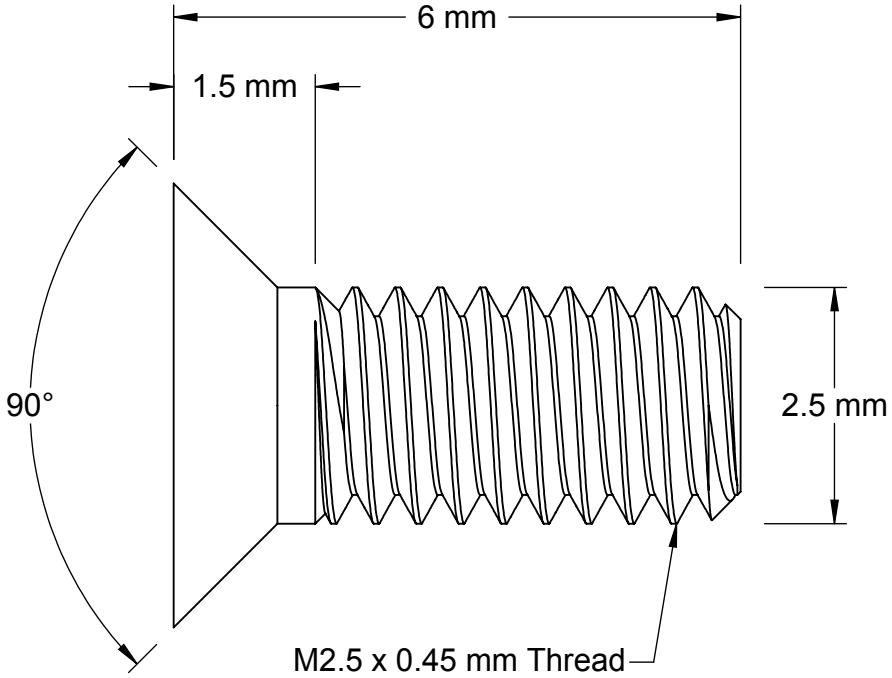
http://www.mcmaster.com

PART NUMBER **91420A173**

Flat Head Phillips Machine Screw





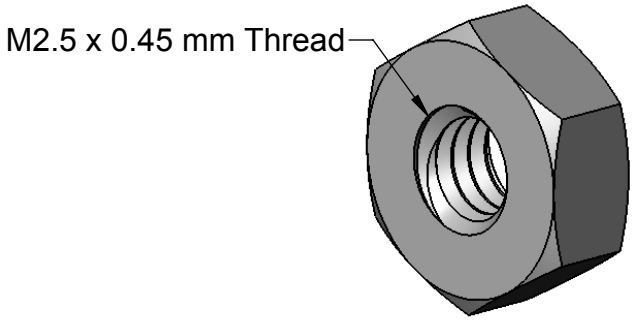


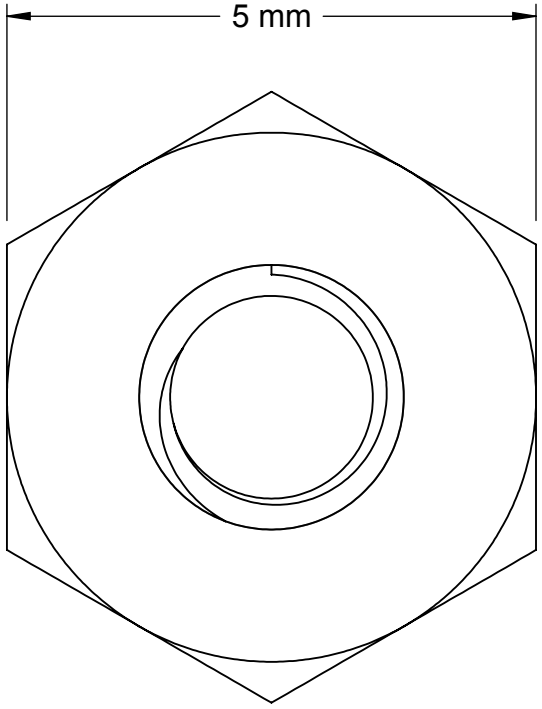
McMASTER-CARR® CAD

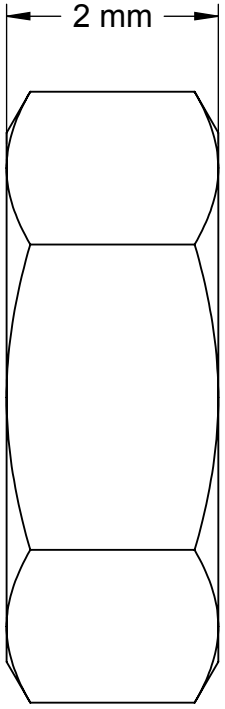
http://www.mcmaster.com

PART NUMBER **92010A016**

Flat Head Phillips Machine Screw







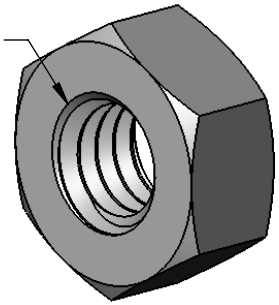
McMASTER-CARR® CAD

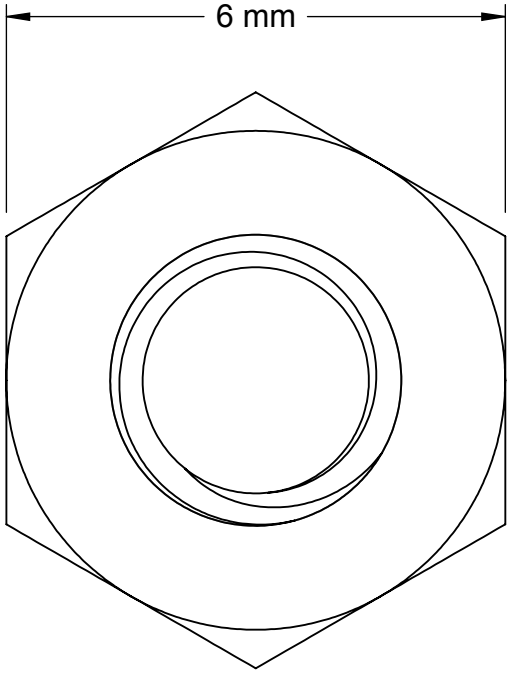
http://www.mcmaster.com

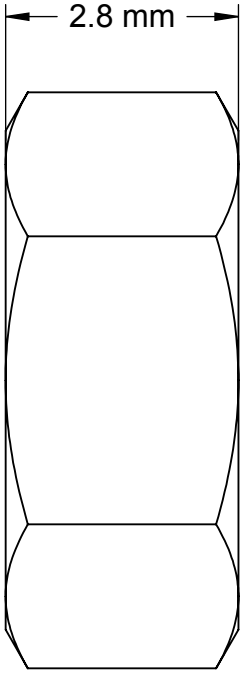
PART NUMBER **90592A006**

Metric

Hex Nut







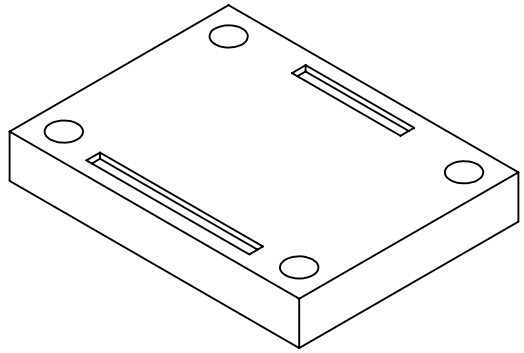
McMASTER-CARR® CAD

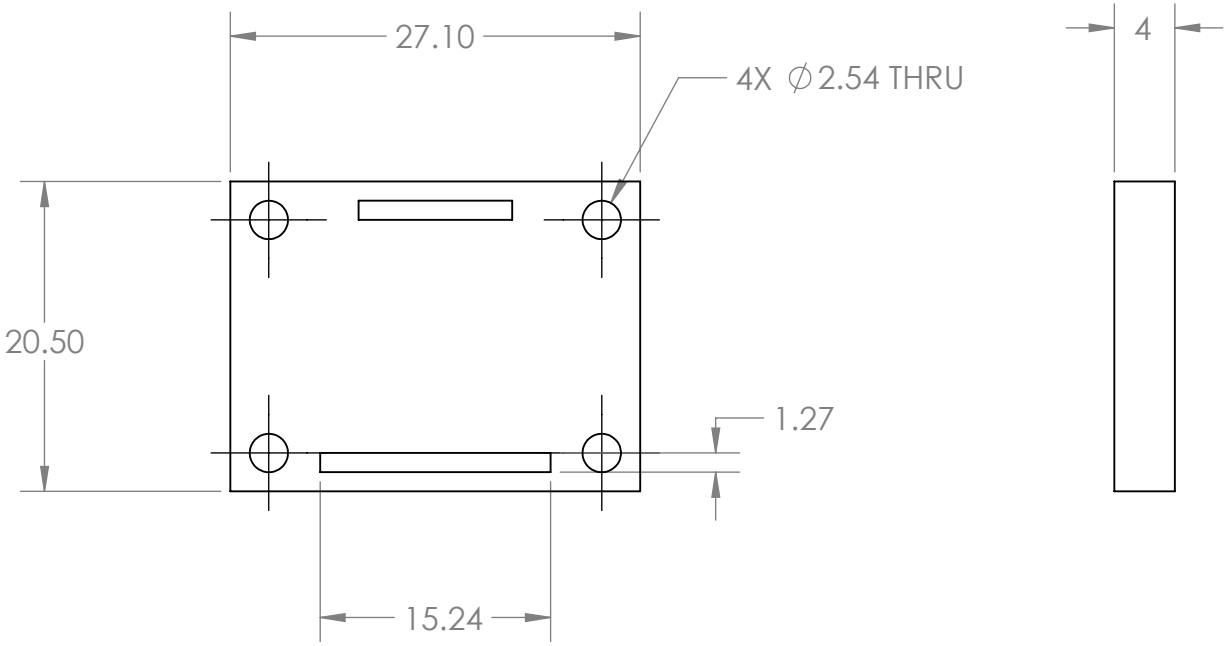
http://www.mcmaster.com

PART NUMBER **90592A010**

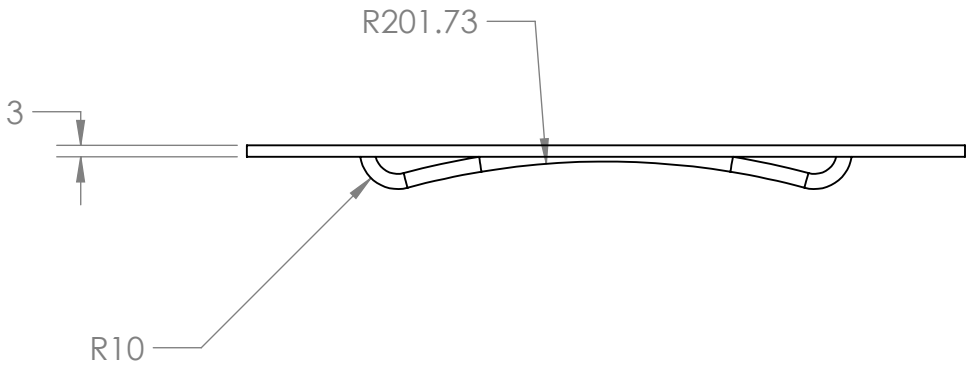
Metric

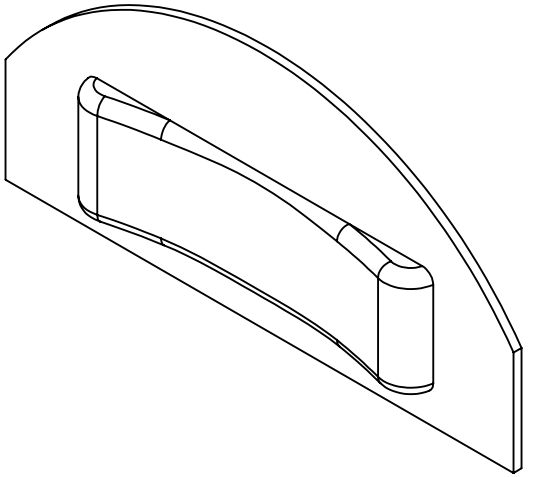
Hex Nut

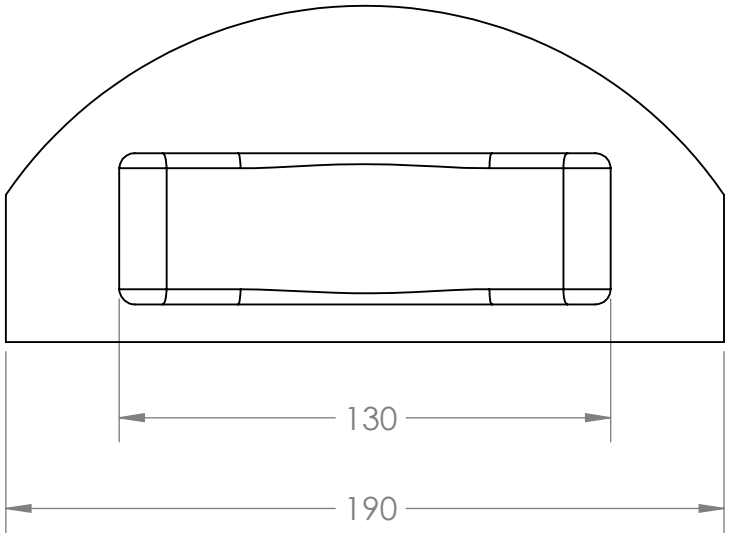


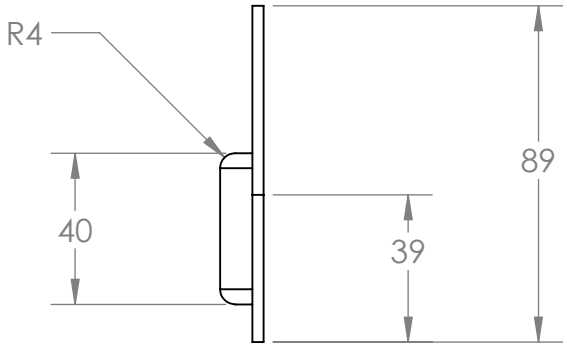


Concordia	MATERIAL		SURFACE ROUGHNESS √	TITLE **Adafruit BNO055 motion sensor v2**			
	FINISH		TOLERANCES X ± .1, .X ± .05, .XX ± .005, .XXX ± .002, ANGLE ± .5° (UNLESS OTHERWISE SPECIFIED)				
PROPRIETARY INFORMATION NOT TO BE RELEASED WITHOUT WRITTEN AUTHORIZATION FROM CONCORDIA UNIVERSITY	DESIGNER **ONLINE**	ALL DIMENSIONS IN **METRIC** UNLESS OTHERWISE SPECIFIED		A SIZE	DATE **11/13/2017**	USED ON **MECH 490**	
	DRAFTER **ONLINE**	APPROVED	SCALE **2:1**	SHEET **1 / 1**	DWG NO. **ADA2472**	REV NO. **01**	

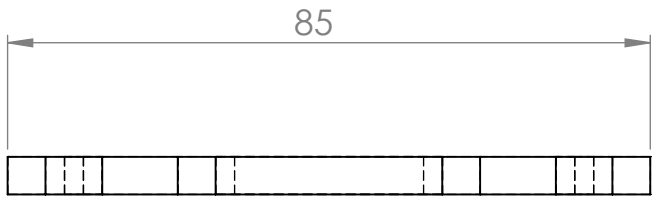


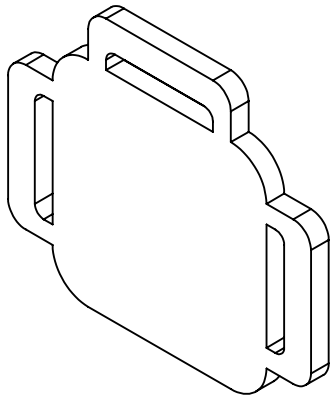


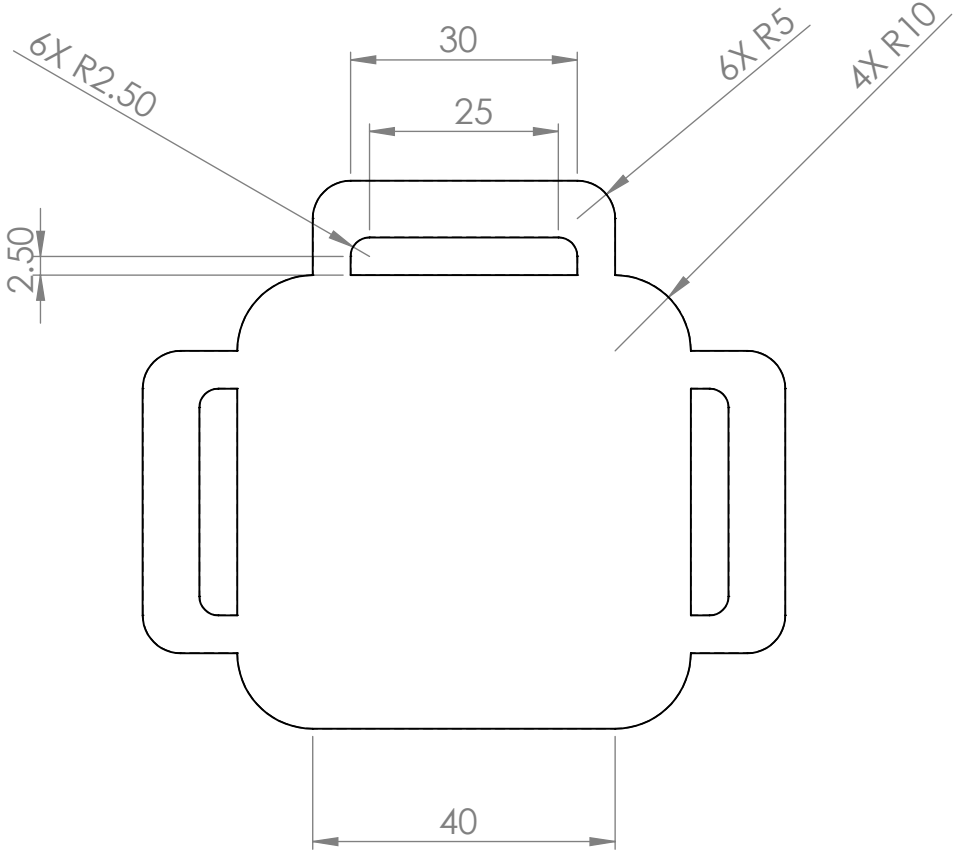


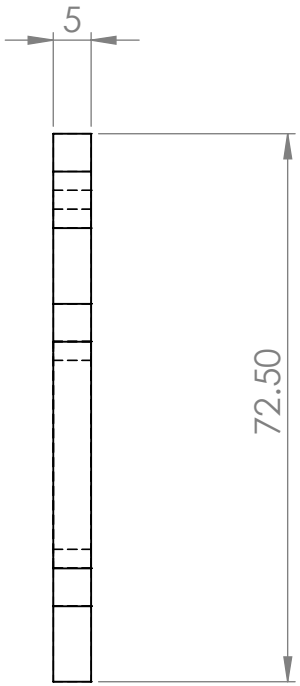


Concordia	MATERIAL **Acrylonitrile butadiene styrene (ABS)**		SURFACE ROUGHNESS	TITLE **Back Cover V2**			
	FINISH		TOLERANCES X ± .1, .X ± .05, .XX ± .005, .XXX ± .002, ANGLE ± .5°				
PROPRIETARY INFORMATION NOT TO BE RELEASED WITHOUT WRITTEN AUTHORIZATION FROM CONCORDIA UNIVERSITY	DESIGNER **A. SHAWWA**	ALL DIMENSIONS IN **METRIC** UNLESS OTHERWISE SPECIFIED		A SIZE	DATE **11/13/2017**	USED ON **MECH 490**	
	DRAFTER **M. A. YADAO**	APPROVED **R. PATEL**	SCALE **1:2**	SHEET **1 / 1**	DWG NO. **11709103**	REV NO. **01**	

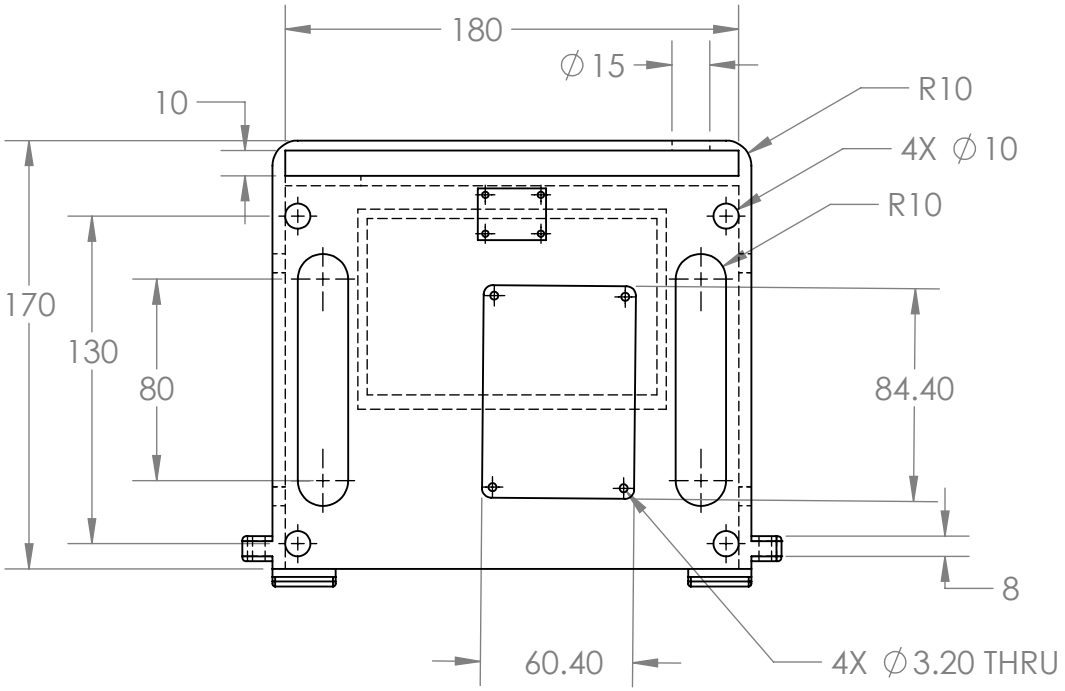


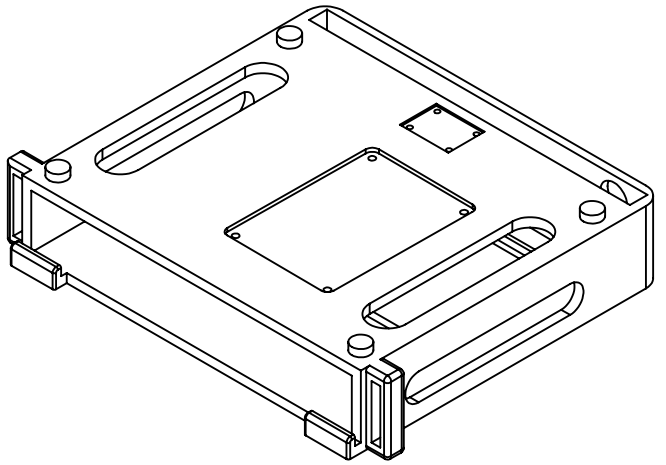


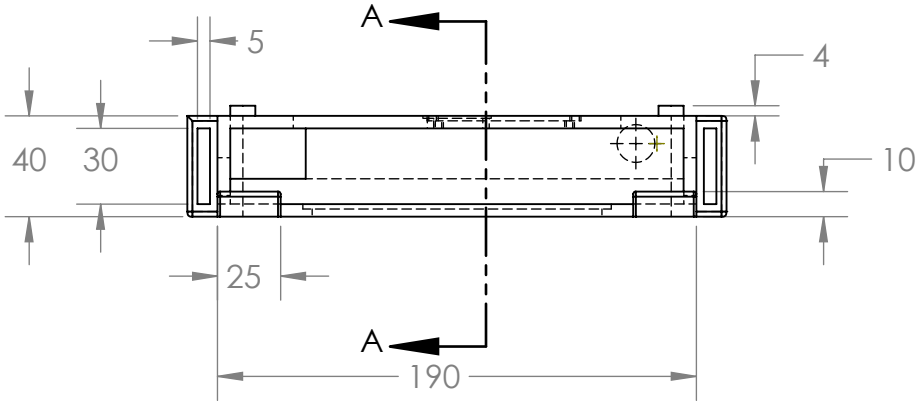


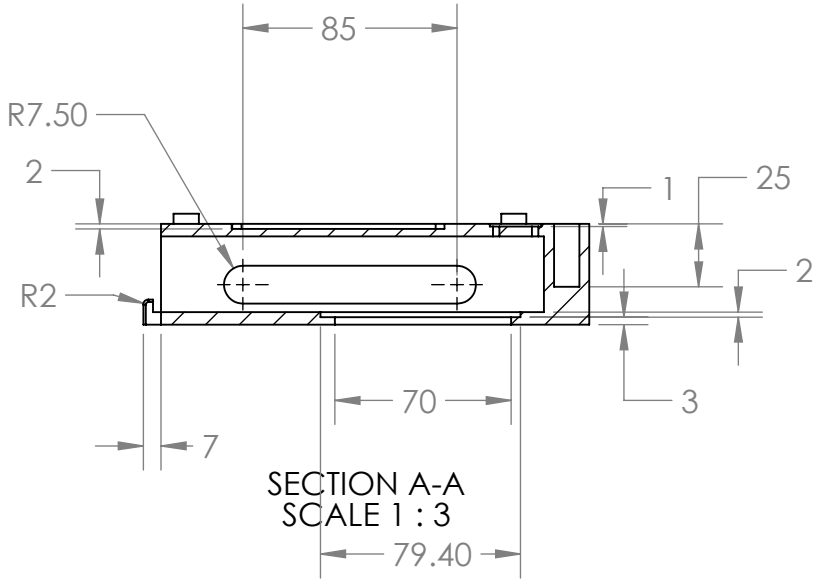


Concordia	MATERIAL **POLYLACTIC ACID (PLA - 3D PRINT)**		SURFACE ROUGHNESS √	TITLE **Back piece**			
	FINISH **-**		TOLERANCES X ± .1, .X ± .05, .XX ± .005, .XXX ± .002, ANGLE ± .5° (UNLESS OTHERWISE SPECIFIED)				
PROPRIETARY INFORMATION NOT TO BE RELEASED WITHOUT WRITTEN AUTHORIZATION FROM CONCORDIA UNIVERSITY	DESIGNER **N. CIERSON**	ALL DIMENSIONS IN **METRIC** UNLESS OTHERWISE SPECIFIED		A SIZE	DATE **11/13/2017**	USED ON	**MECH 490**
	DRAFTER **M. A. YADAO**	APPROVED **R. PATEL**	SCALE **1:1**	SHEET **1 / 1**	DWG NO. **11709104**	REV NO.	**01**



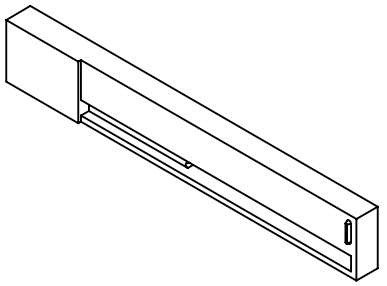


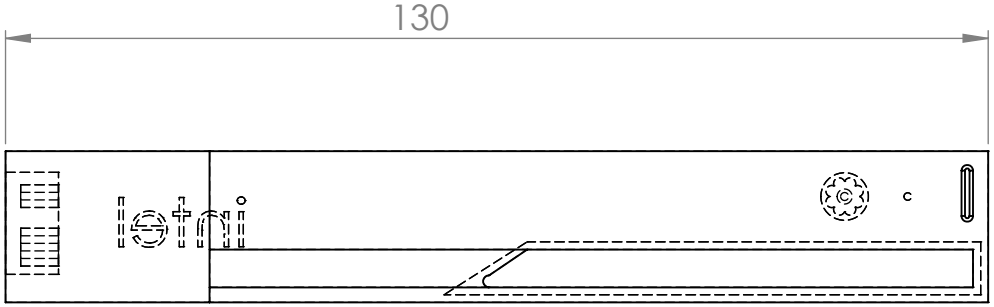


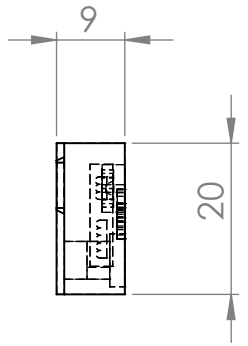


SECTION A-A
SCALE 1 : 3

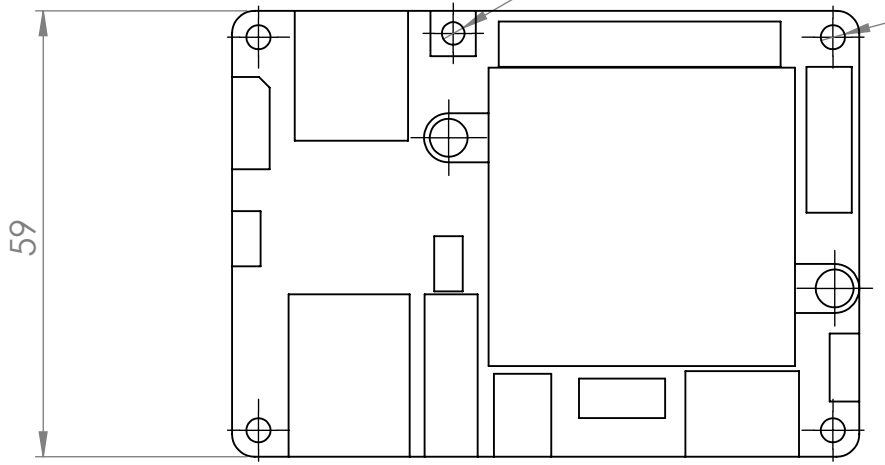
Concordia	MATERIAL **Acrylonitrile butadiene styrene (ABS)**	SURFACE ROUGHNESS √	TITLE **Headset V2**			
	FINISH	TOLERANCES X ± .1, .X ± .05, .XX ± .005, .XXX ± .002, ANGLE ± .5° (UNLESS OTHERWISE SPECIFIED)				
PROPRIETARY INFORMATION NOT TO BE RELEASED WITHOUT WRITTEN AUTHORIZATION FROM CONCORDIA UNIVERSITY	DESIGNER **A. SHAWWA.**	ALL DIMENSIONS IN **METRIC** UNLESS OTHERWISE SPECIFIED	A SIZE	DATE **11/13/2017**	USED ON **MECH 490**	
	DRAFTER **M. A. YADAO**	APPROVED **R. PATEL**	SCALE **1:3**	SHEET **1 / 1**	DWG NO. **11709101**	REV NO. **01**

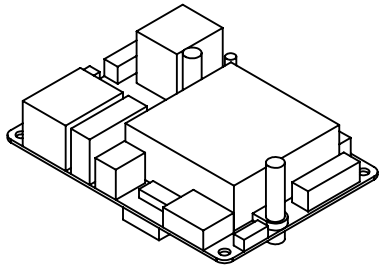


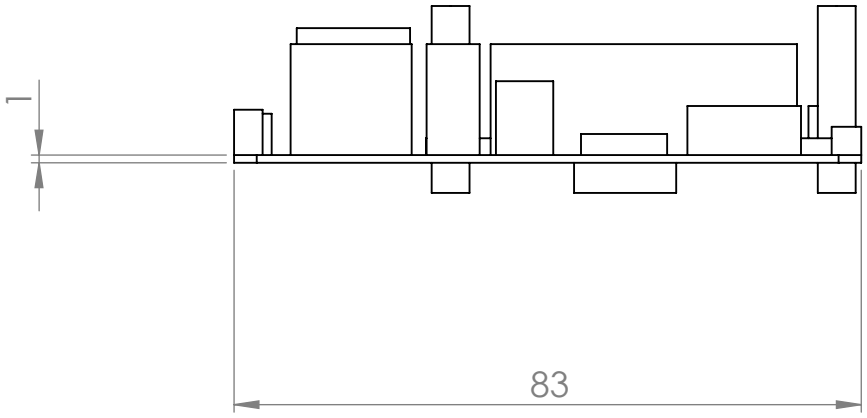


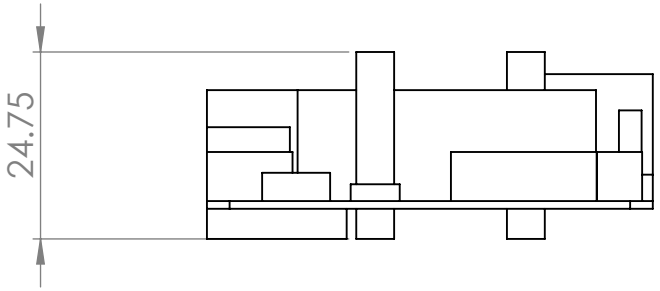


Concordia	MATERIAL -		SURFACE ROUGHNESS √	TITLE **Intel real sense camera R200**			
	FINISH -		TOLERANCES X ± .1 .X ± .05 .XX ± .005 .XXX ± .002 ANGLE ± .5°				
PROPRIETARY INFORMATION NOT TO BE RELEASED WITHOUT WRITTEN AUTHORIZATION FROM CONCORDIA UNIVERSITY	DESIGNER **ONLINE**	ALL DIMENSIONS IN **METRIC** UNLESS OTHERWISE SPECIFIED		A SIZE	DATE **11/13/2017**	USED ON **MECH 490**	
	DRAFTER **ONLINE**	APPROVED	SCALE **1:1**	SHEET **1 / 1**	DWG NO. **MM#939143**	REV NO. **01**	









Concordia	MATERIAL -		SURFACE ROUGHNESS	TITLE **Odroid XU4**		
	FINISH -		TOLERANCES X ± .1, .X ± .05, .XX ± .005, .XXX ± .002, ANGLE ± .5° (UNLESS OTHERWISE SPECIFIED)			
PROPRIETARY INFORMATION NOT TO BE RELEASED WITHOUT WRITTEN AUTHORIZATION FROM CONCORDIA UNIVERSITY	DESIGNER **ONLINE**	ALL DIMENSIONS IN **METRIC** UNLESS OTHERWISE SPECIFIED		A SIZE	DATE **11/13/2017**	USED ON **MECH 490**
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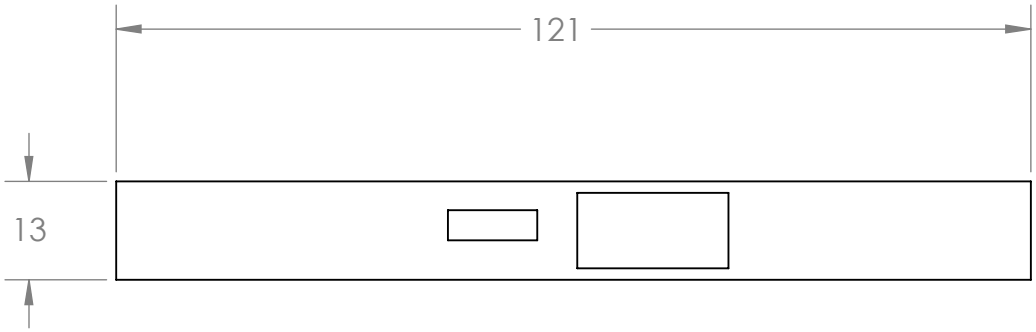

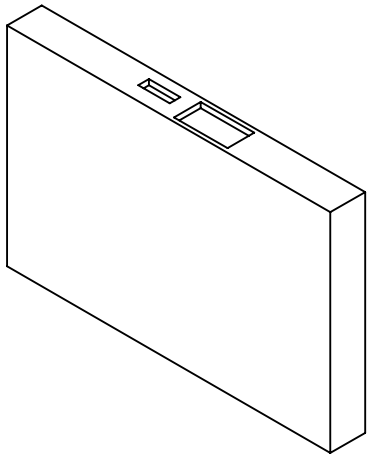

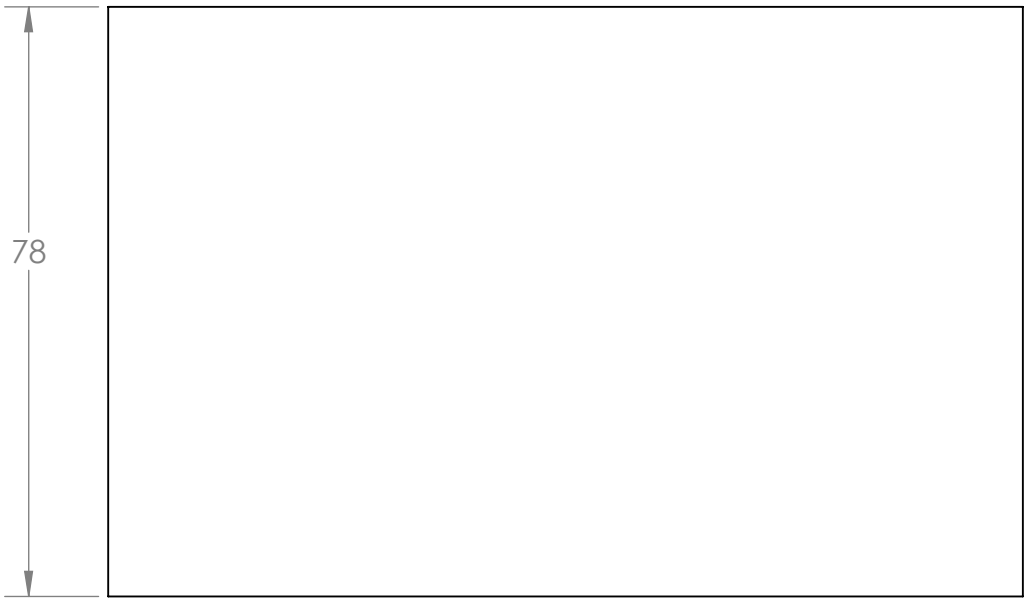

Concordia	MATERIAL		SURFACE ROUGHNESS √	TITLE **Screen v3**		
	FINISH		TOLERANCES X ± .1, .X ± .05, .XX ± .005, .XXX ± .002, ANGLE ± .5° (UNLESS OTHERWISE SPECIFIED)			
PROPRIETARY INFORMATION NOT TO BE RELEASED WITHOUT WRITTEN AUTHORIZATION FROM CONCORDIA UNIVERSITY	DESIGNER **ONLINE**	ALL DIMENSIONS IN **METRIC** UNLESS OTHERWISE SPECIFIED		A SIZE	DATE **11/13/2017**	USED ON **MECH 490**
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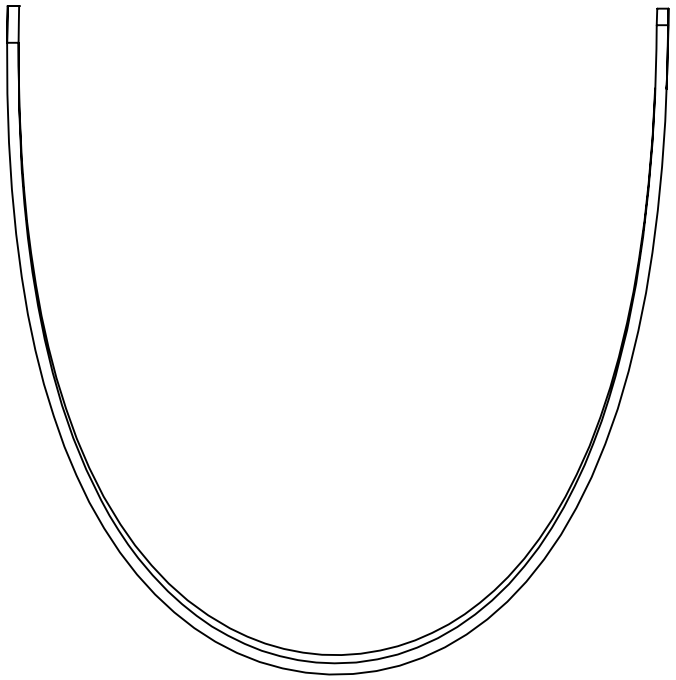
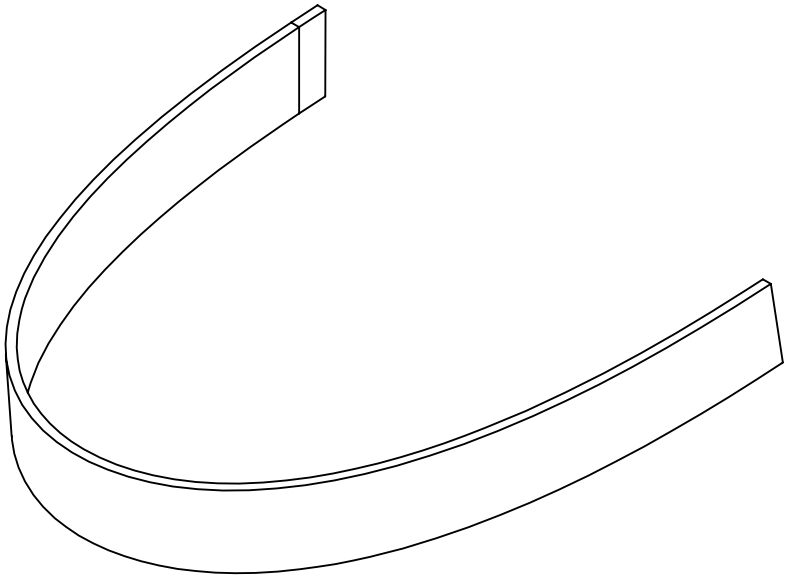
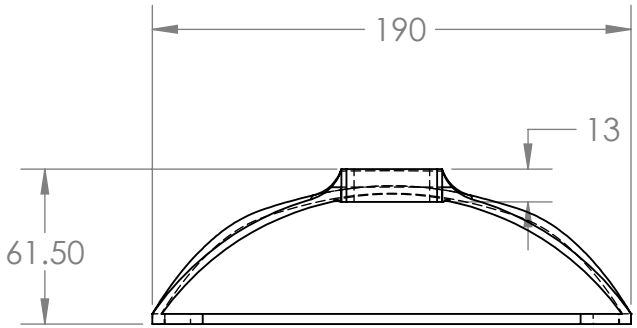
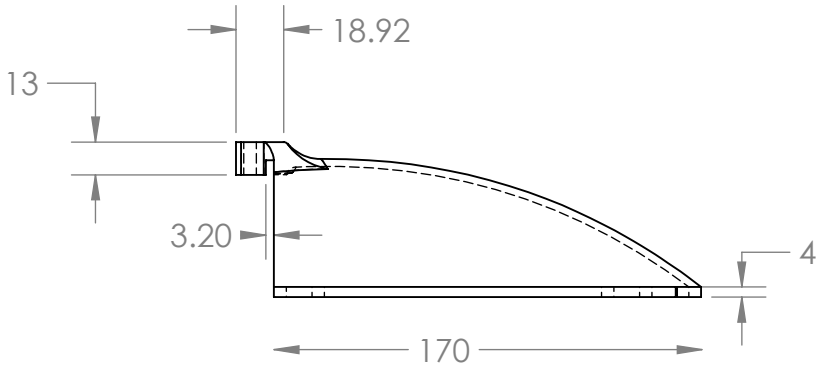
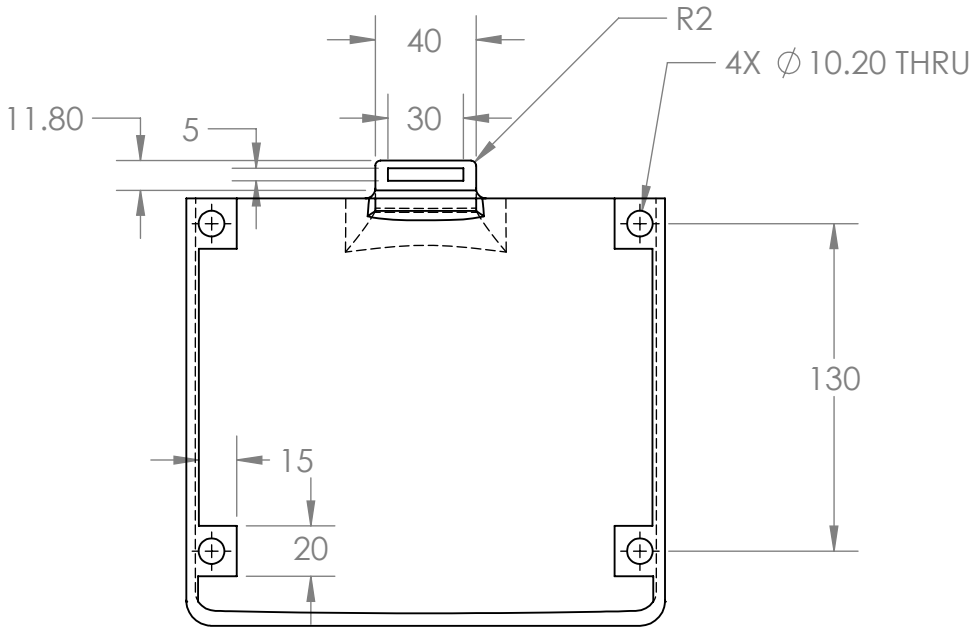


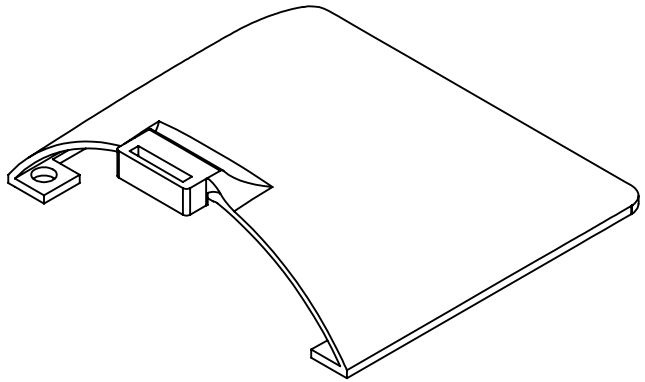


Concordia	MATERIAL **VELCRO**		SURFACE ROUGHNESS √	TITLE **HEAD STRAP**		
	FINISH **-**		TOLERANCES X ± .1, .X ± .05, .XX ± .005, .XXX ± .002, ANGLE ± .5° (UNLESS OTHERWISE SPECIFIED)			
PROPRIETARY INFORMATION NOT TO BE RELEASED WITHOUT WRITTEN AUTHORIZATION FROM CONCORDIA UNIVERSITY	DESIGNER **A. SHAWWA**	ALL DIMENSIONS IN **METRIC** UNLESS OTHERWISE SPECIFIED		A SIZE	DATE **11/13/2017**	USED ON **MECH 490**
	DRAFTER **A.SHAWWA**	APPROVED **R. PATEL**	SCALE **1:2**	SHEET **1 / 1**	DWG NO. **11709105**	REV NO. **01**





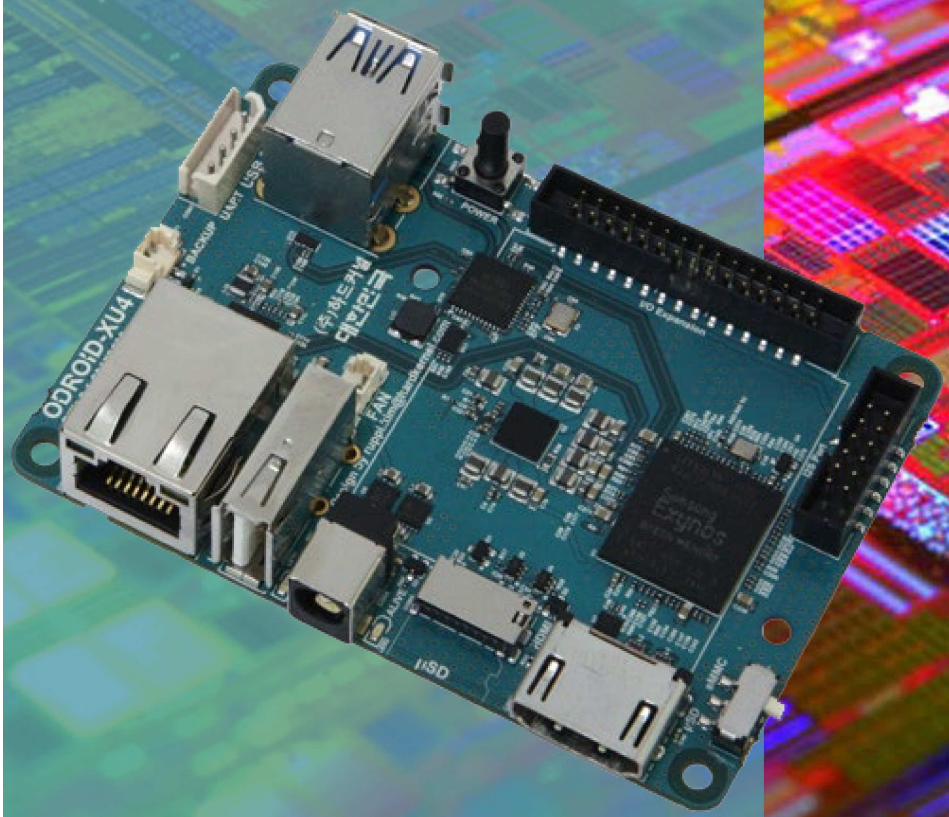




Concordia	MATERIAL **Acrylonitrile Butadiene Styrene (ABS)**		SURFACE ROUGHNESS √	TITLE **Top Cover V2**			
	FINISH		TOLERANCES X ± .1 .X ± .05 .XX ± .005 .XXX ± .002 ANGLE ± .5°				
PROPRIETARY INFORMATION NOT TO BE RELEASED WITHOUT WRITTEN AUTHORIZATION FROM CONCORDIA UNIVERSITY	DESIGNER **A. SHAWWA**	ALL DIMENSIONS IN **METRIC** UNLESS OTHERWISE SPECIFIED		A SIZE	DATE **11/13/2017**	USED ON	**MECH 490**
	DRAFTER **M. A. YADAO**	APPROVED **R. PATEL**	SCALE **1:3**	SHEET **1 / 1**	DWG NO. **11709102**	REV NO.	**01**

HARDKERNEL

USER MANUAL

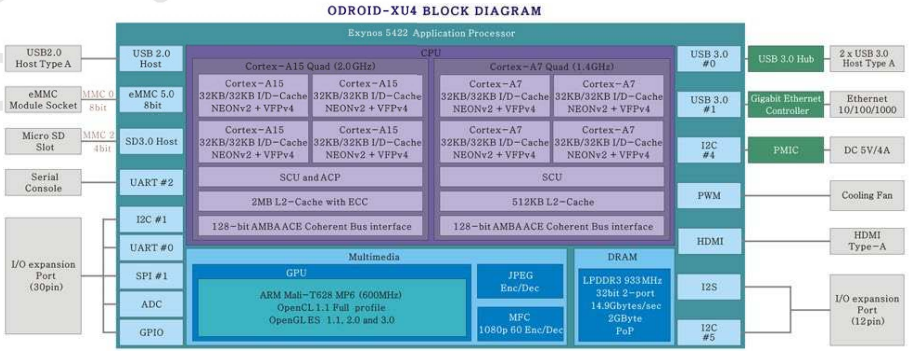


ODROID-XU4

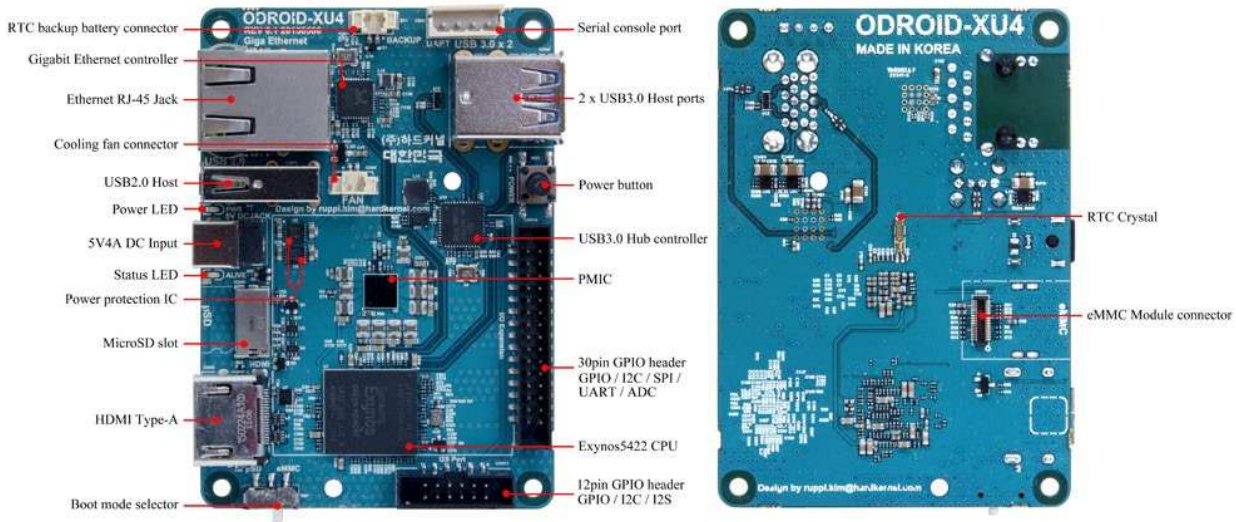
rev. 20170310

Block Diagram

The following diagram illustrates conceptually how the components of the XU4 fit together:



XU4 Block Diagram and Annotated Board Image



Intel® RealSense™ Camera R200

Embedded Infrared Assisted Stereovision 3D Imaging System with Color Camera

Product Datasheet

R200 Intel Production Part Number: MM#939143

†(X) Numeric characters representing configuration or programmed firmware at manufacturing

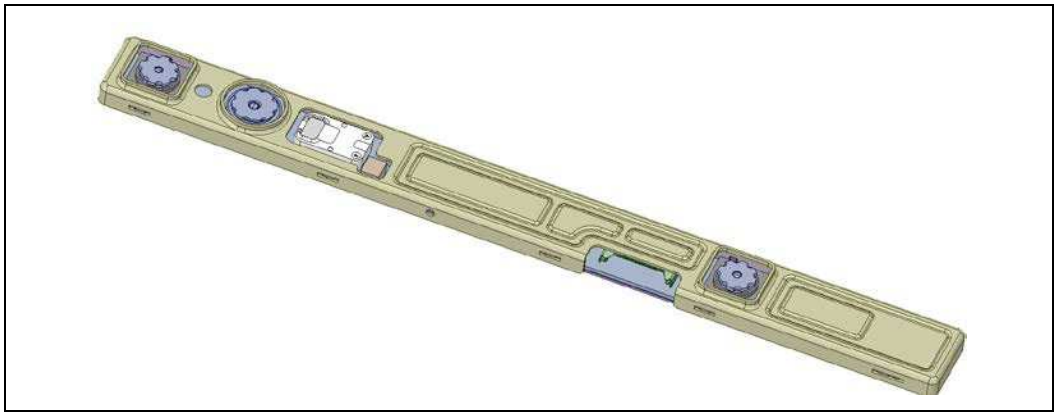
June 2016

Revision 001

Document: 334616-001

1 Description and Features

Figure 1-1. R200 Module Assembly



R200 Description

The Intel® RealSense™ Camera R200 is a module that implements a long range, stereovision 3D imaging system.

The small size of the R200 module provides system integrators flexibility to design into a wide range of products.

Features

- Onboard Imaging ASIC.
- VGA resolution depth capture from 0.4 to 2.8m(1)
- Infrared (IR) Laser Projector System (Class 1)
- Dimensions 101.56mm length x 9.55mm height x 3.8mm width.
- Full HD RGB color stream.

(1) Software may optimize within this range.

Minimum System Requirements

- 1GB Disk Storage Space(1)
- 2GB Memory(1)
- USB3
- R200 Interconnect Cable(2)

(1) Additional disk space and memory may be required for certain applications. Refer to application minimum requirements.

(2) Provided by the system integrator. Cable design is specific to system definition and meets R200 cable design specifications.

(3) Contact local Intel representative for latest OS and platform support.

§ §

Team	#9			
Device	Augmented Reality Headset			
Test date	TBD		**Approvals for testing**	VERSION
Location	Concordia University	Program Manager		1.0
Test LEAD	Faraz Yunus	Professor		
Test co-lead	Nicholas Cierson			
Test STAFF	TBD			
Observers				

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			
SFT2	Personal Protective Equipment	Ensure all test personnel are wearing the appropriate protective equipment (Safety Glasses)			
SFT3	Projectile	Ensure a barrier is placed to limit the movement of projectiles			

DEVICE INTEGRITY

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

INSPECTION

INS1	Device Inspection	Engineer or Staff signature :		

HAZARD and MISHAP ANALYSIS

Hazard types (ref 2) Movement	stored energy	sharp edges	electricity	substances	radiation	physical agents	Description	Severity	Probability	Corrective or Control Action	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			

PREOPERATION CHECKS FOR VAL 2

SAFETY

	Name of Task	Description	Checked	Initials	Date
SFT1	Test Brief	Inform everyone of the test taking place			
SFT2	Fire	Ensure a fire extinguisher is near by in case of a 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	Temperature	Ensure a thermocouple is placed inside of the AR headset			

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			

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			

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)			

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			

INSPECTION

INS1	Device Inspection	Engineer or Staff signature :		

PRE-TEST

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

COMMENTS

References

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

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

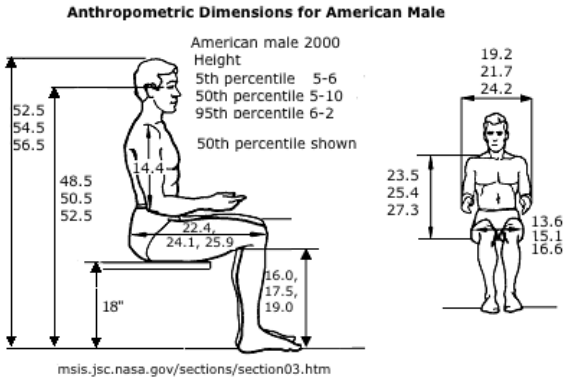


Figure 1: Heights of Males at Different Percentile [1]

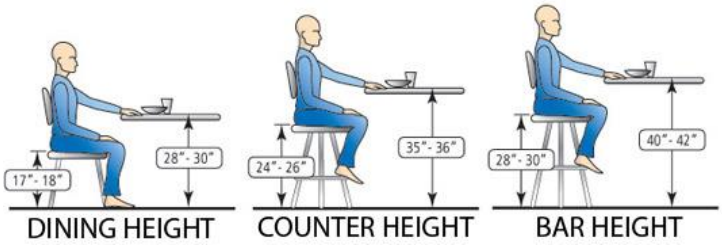


Figure 2: Average Height of Counters [2]

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.

Thermal Test

Figure 2: Thermocouple

Figure 3: 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.

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.

Reference

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

[2] 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].

[3] Brannan.co.uk. (2017). Thermocouple Thermometer | Brannan. [online] Available at: https://www.brannan.co.uk/thermocouple-thermometer [Accessed 14 Nov. 2017].

[4] Rmcc-cmrc.ca. (2017). Wind Tunnels. [online] Available at: https://www.rmcc-cmrc.ca/en/mechanical-and-aerospace-engineering/wind-tunnels [Accessed 14 Nov. 2017].