HASP Payload Specification and Integration Plan

Payload Title: Electron Spectrometer Telescope (EST)

Payload Class: Small **Large** (circle one)

Flight Number: 11

Institution: McMaster University

Contact Name: Benjamin Dyer

Contact Phone: 289-828-5508

Contact E-mail: dyerbm@mcmaster.ca

Submit Date: June 30, 2023

I. Mechanical Specifications:

A. Measured weight of the payload in grams (not including payload plate):

i. See appendix C for a more detailed breakdown

Item	Mass (g)	Uncertainty	Measured or Estimated
Payload	2466	493	Estimated
Mechanical Structure	1120	244	Estimated and measured depending on the part, see Appendix C
Collimator shutter module (CSM)	660	130	Estimated
TOTAL	**4246**	**867**	

B. Provide a mechanical drawing detailing the major components of your payload. Mechanical drawings detailing the attach points from the payloads to the payloads plate are required.

An outline of the drawings is listed below

I. Electron Spectrometer Telescope Drawing Package
   a. EST Assembly Drawing – H23-PLD-EST-010
   b. EST Exploded View – H23-PLD-EST-010
   c. +Z Plate – H23-PLD-EST-001
   d. Payload Collimator Housing – H23-PLD-EST-002
   e. Collimator Baffle - – H23-PLD-EST-003
   f. Collimator space – H23-PLD-EST-004

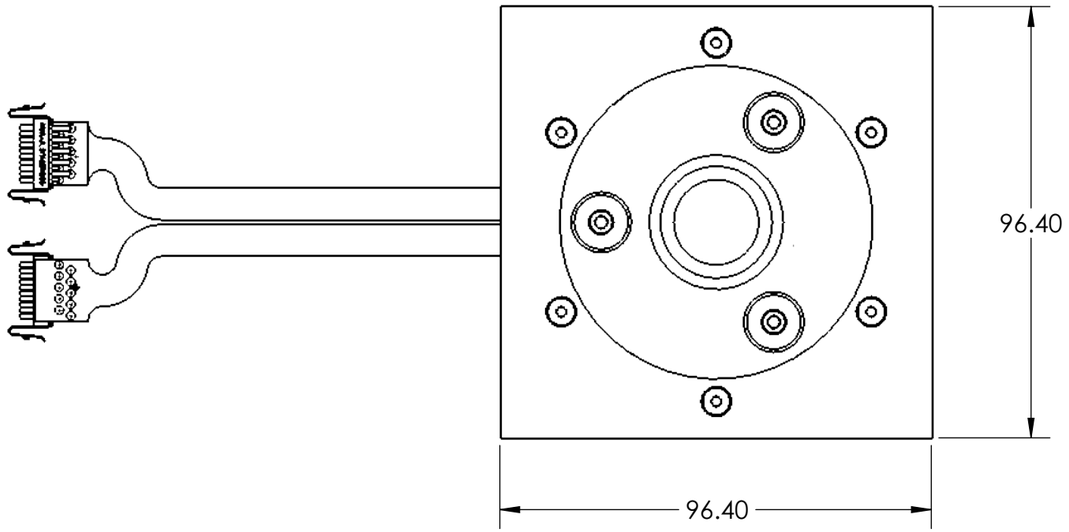
g. Shim – H23-PLD-EST-005
h. Upper Detector Spacer – H23-PLD-EST-006
i. Si Detector Compartment Lid – H23-PLD-EST-007
j. Ribbon Cable Gate A – H23-PLD-EST-008
k. Ribbon Cable Gate B – H23-PLD-EST-009
l. Collimator Lid – H23-PLD-EST-011

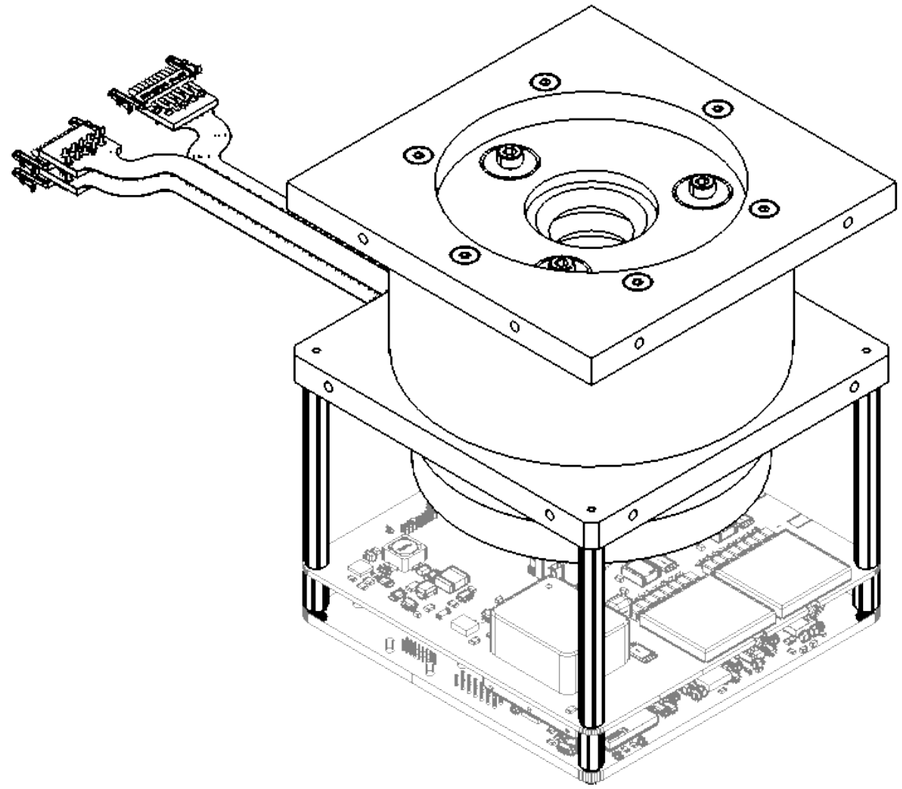
II. Case Exterior Drawing Package
a. Case exterior for HASP 2023 – H23-PRE-MEC-003-SA
b. HASP Base Plate (Large) - H23-PRE-MEC-001-PF
c. Exterior housing case X side – H23-PRE-MECH-002-PF
d. Exterior housing case Y side – H23-PRE-MECH-003-PF
e. Exterior housing case Z top – H23-PRE-MECH-004-PF
f. X Angle – H23-PRE-MEC-005-PF
g. Y Angle – H23-PRE-MEC-006-PF

III. Collimator Shutter Module Drawing Package
a. Collimator shutter module subassembly – H23-PRE-MEC-002-SA
b. CSM – case top – H23-PRE-MEC-007-PF
c. CSM – case bottom – H23-PRE-MEC-008-PF
d. CSM – case bottom – H23-PRE-MEC-008-PF
e. CSM – rotating lid – H23-PRE-MEC-009-PF
f. CSM – Spring clutch arm – H23-PRE-MEC-010-PF
g. CSM – Spacer plate for magnetic armature – H23-PRE-MEC-011-PF
h. CSM – Magnetic armature – H23-PRE-MEC-012-PF
i. Housing for magnetic latch – H23-PRE-MEC-013-PF

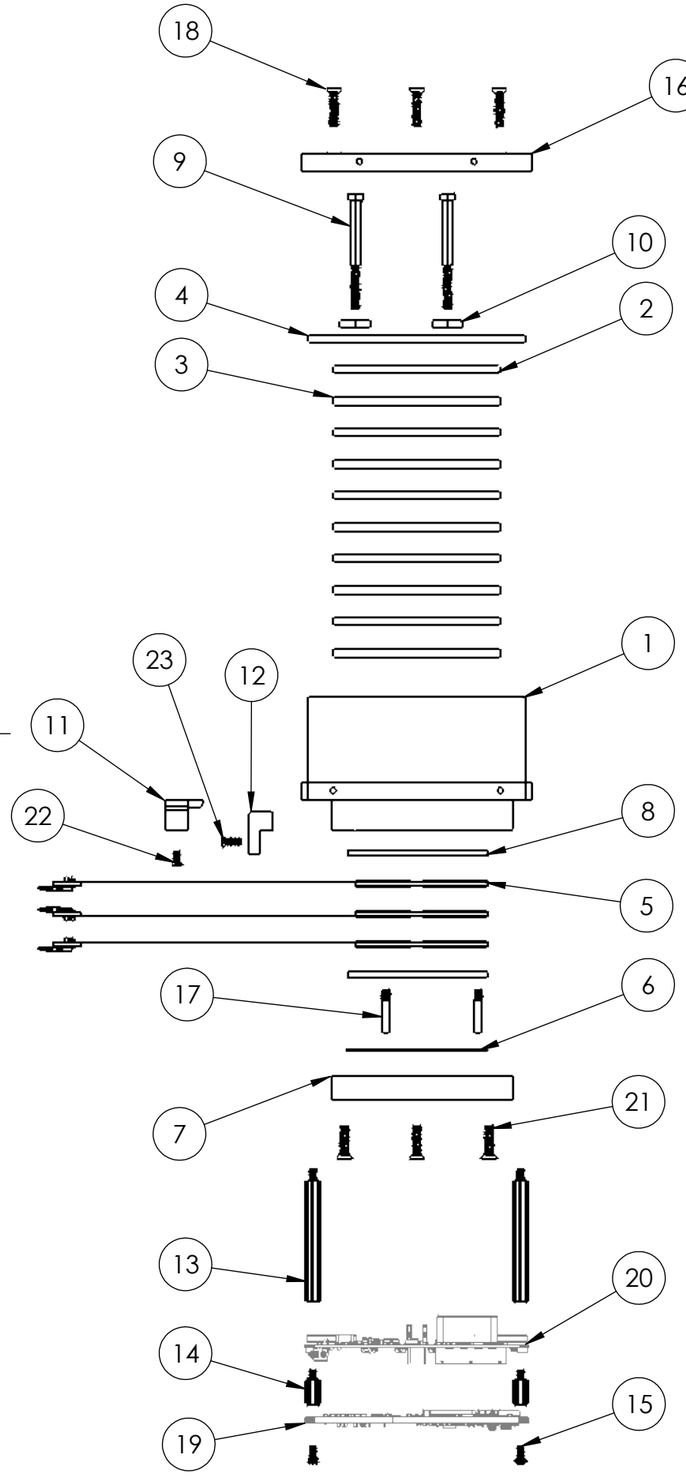
IV. Structure Drawing Package
a. Top level assembly HASP 2023 – H23-PRE-MEC-00100-AD

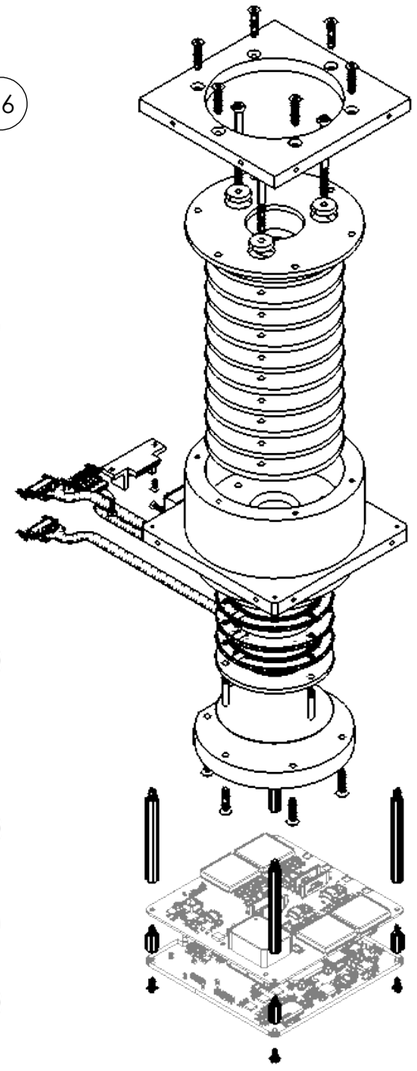
REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A1	Initial Release.	2023-04-09	
	B	Final PSIP Documentation.	2023-06-08	





METRIC				
THIRD ANGLE PROJECTION	UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS. TOLERANCES ARE: X.X ±0.25 ANGLES: ± 0°- 30' X.XX ±0.13 CHAMFERS: ±5°	DATE 2023-06-27	NEUtron DOSimetry & Exploration CubeSat Project McMaster University	
DRILL HOLE SIZE / TOLERANCE: 0.35 THRU 3.20 +0.10 / -0.03; 3.21 THRU 6.40 +0.13 / -0.03; 6.41 THRU 12.70 +0.15 / -0.05; 12.71 THRU 19.00 +0.20 / -0.05; 19.01 THRU 25.40 +0.25 / -0.08	MATERIAL 2	DRAWN P. CHIN	TITLE: EST ASSEMBLY DRAWING	
	FINISH 3	CHECKED A. TOLLIS	SIZE B / DWG. NO. H23-PLD-EST-010 / REV B	
		DESIGN	SCALE 3:4 / DO NOT SCALE DRAWING / SHEET 1 OF 2	
		APPROVED		

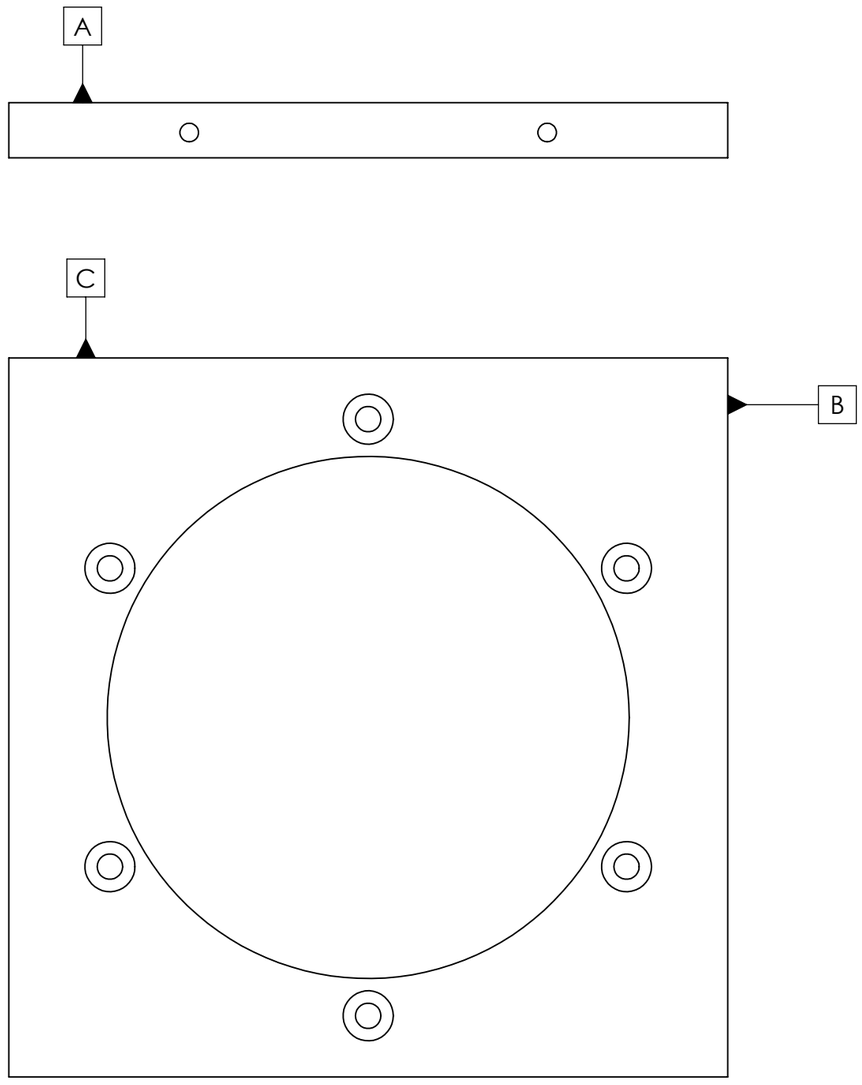


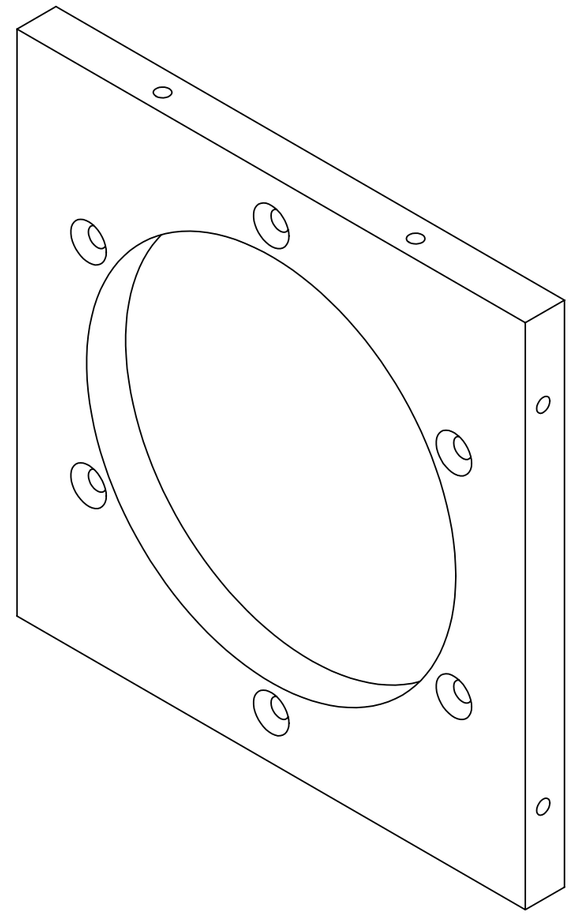


ITEM NO.	PART NUMBER	DESCRIPTION	MATERIAL	Mass	VALIDATION METHOD	QTY.
1	H23-PRE-PLD-002-PF	Payload Housing	6061-T6 (SS)	473.54	Analysis	1
2	H23-PRE-PLD-003-PF	Collimator Baffle	Copper	88.90	Analysis	6
3	H23-PRE-PLD-004-PF	Collimator Spacer	Polyetheretherketone (PEEK)	13.47	Analysis	5
4	H23-PRE-PLD-011-PF	Collimator Lid	6061-T6 (SS)	41.88	Analysis	1
5	A-5258					3
6	H23-PRE-PLD-005-PF	Peelable Aluminum Shim	6061-T6 (SS)	2.90	Analysis	1
7	H23-PRE-PLD-007-PF	Si Detector Compartment Lid	6061-T6 (SS)	131.05	Analysis	1
8	H23-PRE-PLD-006-PF	Upper Detector Spacer	6061-T6 (SS)	11.71	Analysis	2
9	91292A025	18-8 Stainless Steel Socket Head Screw	18-8 Stainless Steel	0.35	Analysis	3
10	94768A101	18-8 Stainless Steel Oversized Washer	18-8 Stainless Steel	0.31	Analysis	3
11	H23-PRE-PLD-008-PF	Ribbon Cable Gate A	6061-T6 (SS)	5.70	Analysis	1
12	H23-PRE-PLD-009-PF	Ribbon Cable Gate B	6061-T6 (SS)	5.46	Analysis	1
13	91075A224	Male-Female Threaded Hex Standoff	18-8 Stainless Steel	7.58	Analysis	4
14	91075A517	Male-Female Threaded Hex Standoff	18-8 Stainless Steel	0.20	Analysis	4
15	91772A326	Passivated 18-8 Stainless Steel Pan Head Phillips Screw	18-8 Stainless Steel	0.23	Analysis	4
16	H23-PRE-PLD-001-PF	+Z Plate	6061-T6 (SS)	106.29	Analysis	1
17	95966A686	Socket Head Captive Panel Screw	18-8 Stainless Steel	0.07	Analysis	3
18	91294A134	Black-Oxide Alloy Steel Hex Drive Flat Head Screw	Alloy Steel	0.822	Analysis	6
19	CCP-PRE-PLD-001-PC-REV-A	DAM Board	N/A	200.00	Similarity	1
20	CCP-PRE-PLD-002-REV-A	FEM Board	N/A	200.00	Similarity	1
21	91263A863	Zinc-Plated Alloy Steel Hex Drive Flat Head Screw	Alloy Steel	0.74	Analysis	6
22	91263A413	Zinc-Plated Alloy Steel Hex Drive Flat Head Screw	Alloy Steel	0.15	Analysis	2
23	91263A414	Zinc-Plated Alloy Steel Hex Drive Flat Head Screw	Alloy Steel	0.19	Analysis	2

NEUtron DOSimetry & Exploration CubeSat Project McMaster University		
TITLE: EST EXPLODED VIEW		
SIZE B	DWG. NO. H23-PLD-EST-010	REV B
SCALE 2:5	DO NOT SCALE DRAWING	SHEET 2 OF 2

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A1	Initial Release	2023-04-14	
2-A3, 2-C5, 2-D3	B	Final PSIP Documentation. Simplified geometry to a rectangular plate. Reduced thickness and removed fillets on corners.	2023-05-07	





3 FINISH: DEBURR

2 MATERIAL:6061-T6 ALUMINUM

1. DIMENSIONAL LIMITS APPLY AFTER 3 .

NOTES:

METRIC

THIRD ANGLE PROJECTION	
DRILL HOLE SIZE	TOLERANCE
0.35 THRU 3.20	+0.10 / -0.03
3.21 THRU 6.40	+0.13 / -0.03
6.41 THRU 12.70	+0.15 / -0.05
12.71 THRU 19.00	+0.20 / -0.05
19.01 THRU 25.40	+0.25 / -0.08

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES ARE:
X.X ±0.25 ANGLES: ± 0°- 30'
X.XX ±0.13 CHAMFERS: ±5°

MATERIAL 2

FINISH 3

DATE 2023-04-14

DRAWN K.DI LORETO

CHECKED A.TOLLIS

DESIGN

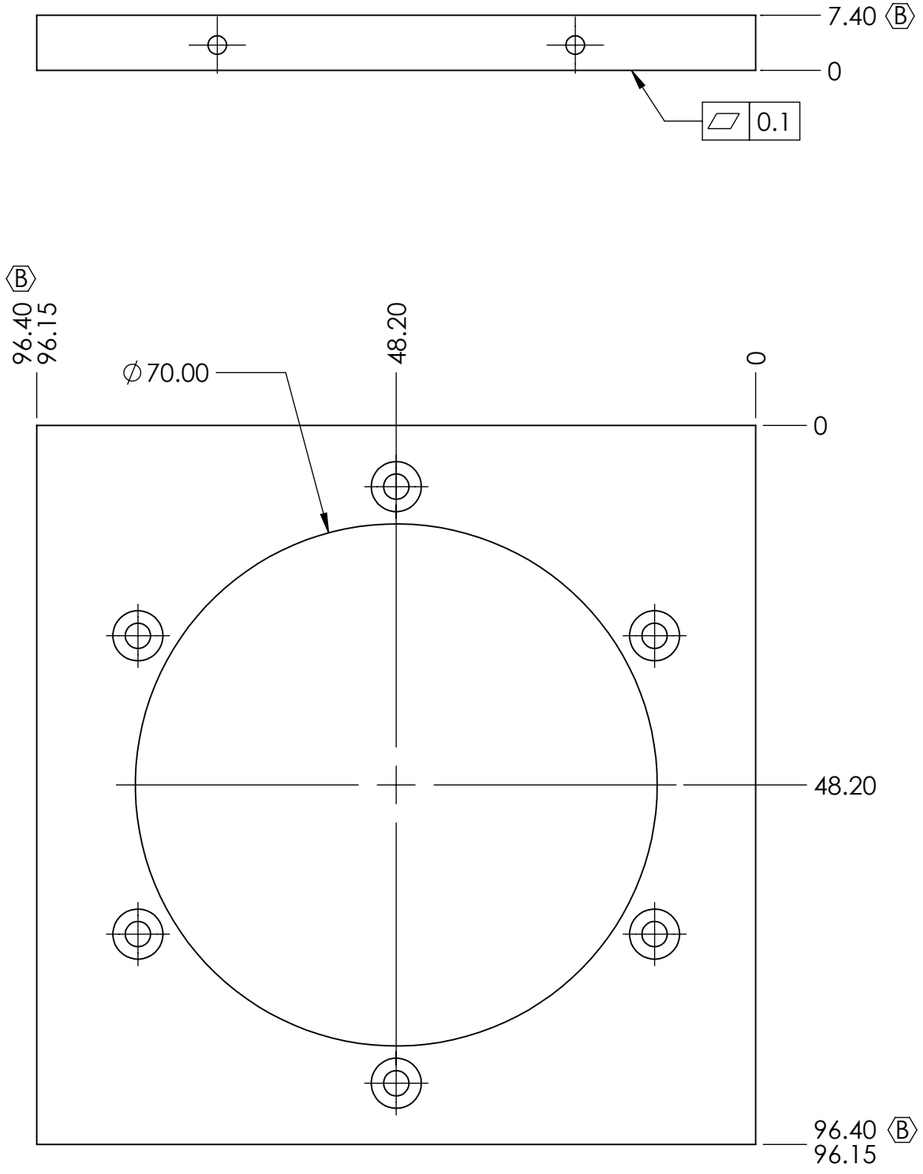
APPROVED

NEUtron DOSimetry & Exploration CubeSat Project
McMaster University

TITLE: +Z PLATE

SIZE **B** | DWG. NO. H23-PLD-EST-001 | REV B

SCALE 5:4 | DO NOT SCALE DRAWING | SHEET 1 OF 3



3 FINISH: DEBURR

2 MATERIAL:6061-T6 ALUMINUM

1. DIMENSIONAL LIMITS APPLY AFTER 3 .

NOTES:

METRIC

THIRD ANGLE PROJECTION	
DRILL HOLE SIZE	TOLERANCE
0.35 THRU 3.20	+0.10 / -0.03
3.21 THRU 6.40	+0.13 / -0.03
6.41 THRU 12.70	+0.15 / -0.05
12.71 THRU 19.00	+0.20 / -0.05
19.01 THRU 25.40	+0.25 / -0.08

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES ARE:
X.X ±0.25 ANGLES: ± 0°- 30'
X.XX ±0.13 CHAMFERS: ±5°

MATERIAL 2

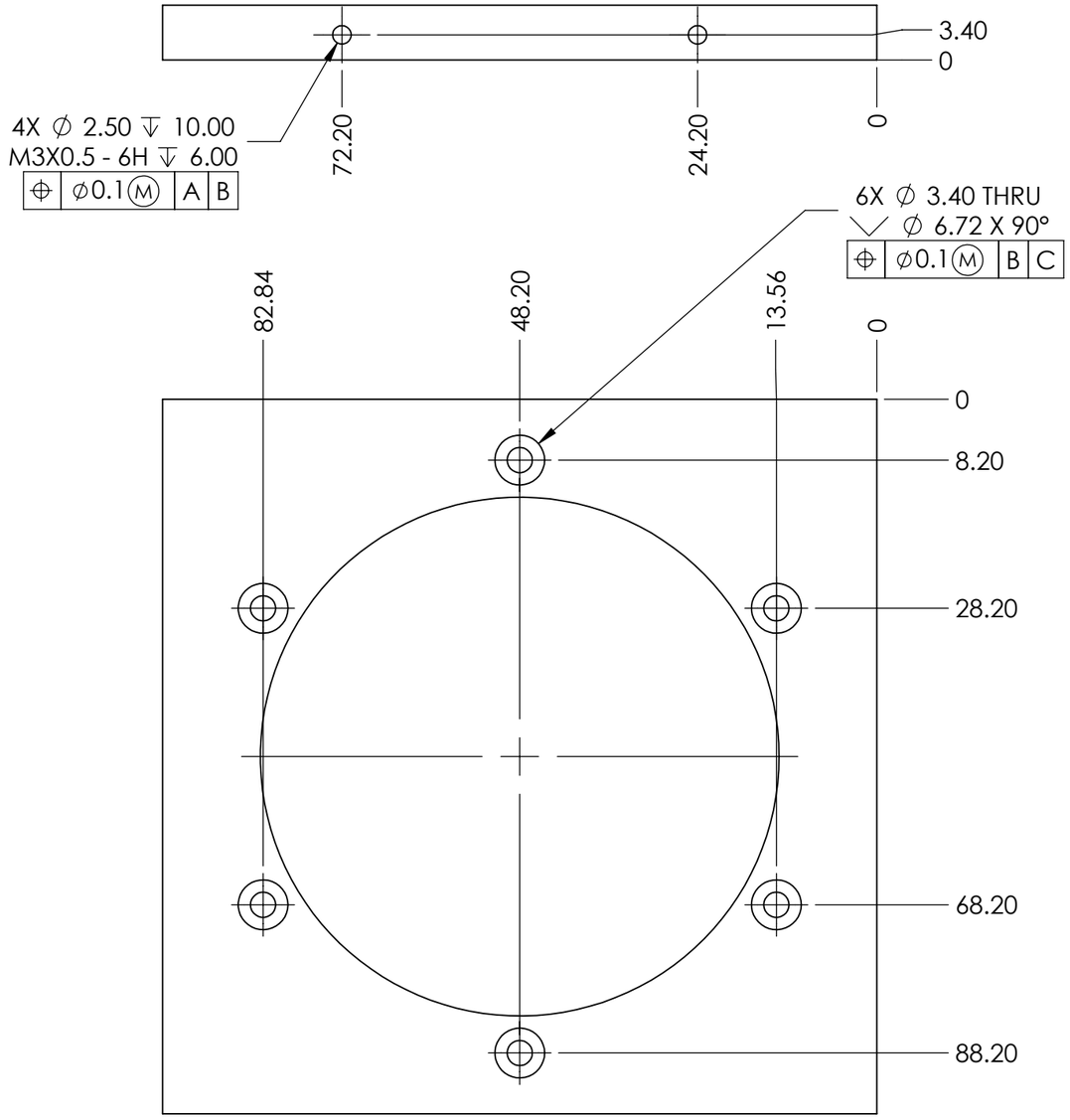
FINISH 3

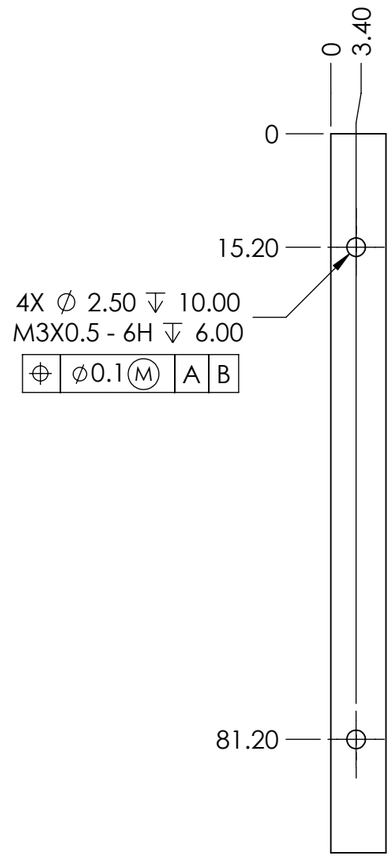
DATE	2023-04-14
DRAWN	K. DI LORETO
CHECKED	A.TOLLIS
DESIGN	
APPROVED	

NEUtron DOSimetry & Exploration CubeSat Project
McMaster University

TITLE: +Z PLATE

SIZE	DWG. NO.	REV
B	H23-PLD-EST-001	B
SCALE 5:4	DO NOT SCALE DRAWING	SHEET 2 OF 3





△3 FINISH: DEBURR

△2 MATERIAL:6061-T6 ALUMINUM

1. DIMENSIONAL LIMITS APPLY AFTER △3 .

NOTES:

METRIC

THIRD ANGLE PROJECTION	
DRILL HOLE SIZE	TOLERANCE
0.35 THRU 3.20	+0.10 / -0.03
3.21 THRU 6.40	+0.13 / -0.03
6.41 THRU 12.70	+0.15 / -0.05
12.71 THRU 19.00	+0.20 / -0.05
19.01 THRU 25.40	+0.25 / -0.08

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES ARE:
X.X ±0.25 ANGLES: ± 0° - 30'
X.XX ±0.13 CHAMFERS: ±5°

MATERIAL △2

FINISH △3

DATE 2023-04-14

DRAWN K. DI LORETO

CHECKED A.TOLLIS

DESIGN

APPROVED

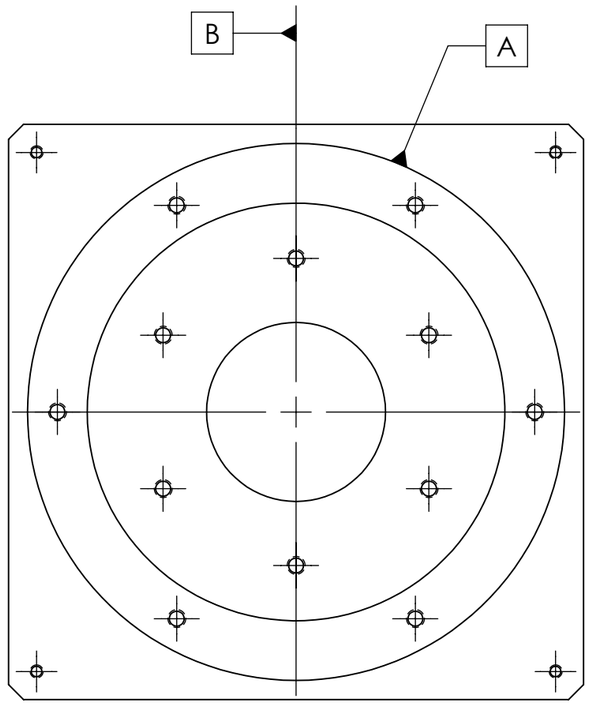
NEUtron DOSimetry & Exploration CubeSat Project
McMaster University

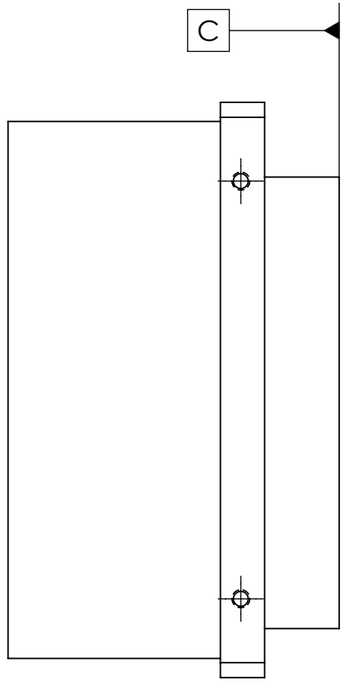
TITLE: +Z PLATE

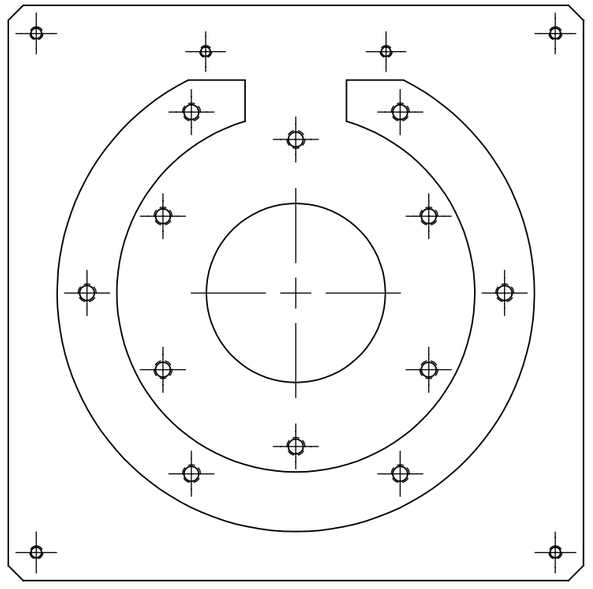
SIZE **B** DWG. NO. H23-PLD-EST-001 REV B

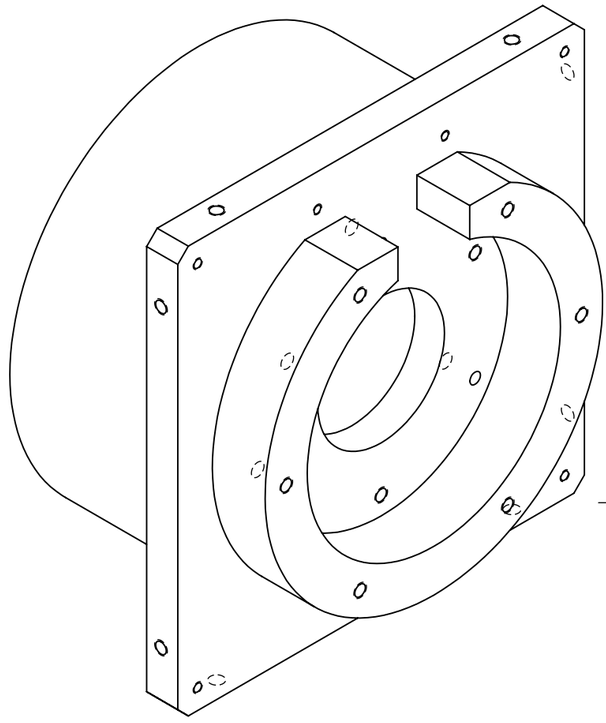
SCALE 5:4 DO NOT SCALE DRAWING SHEET 3 OF 3

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A1	Initial Release	2023-04-13	
	B	Final PSIP Documentation.	2023-06-12	









3 FINISH: DEBURR

2 MATERIAL: 6061-T6 ALUMINUM

1. DIMENSIONAL LIMITS APPLY AFTER 3 .

NOTES:

METRIC

THIRD ANGLE PROJECTION	
DRILL HOLE SIZE	TOLERANCE
0.35 THRU 3.20	+0.10 / -0.03
3.21 THRU 6.40	+0.13 / -0.03
6.41 THRU 12.70	+0.15 / -0.05
12.71 THRU 19.00	+0.20 / -0.05
19.01 THRU 25.40	+0.25 / -0.08

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES ARE:
X.X ±0.25 ANGLES: ± 0°- 30'
X.XX ±0.13 CHAMFERS: ±5°

MATERIAL 2

FINISH 3

DATE 2023-04-13

DRAWN J. WANG

CHECKED A.TOLLIS

DESIGN

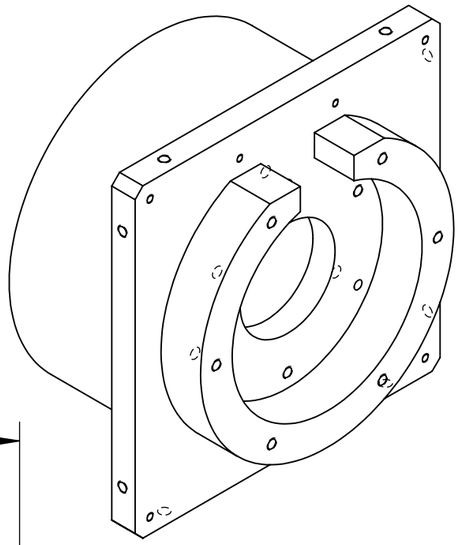
APPROVED

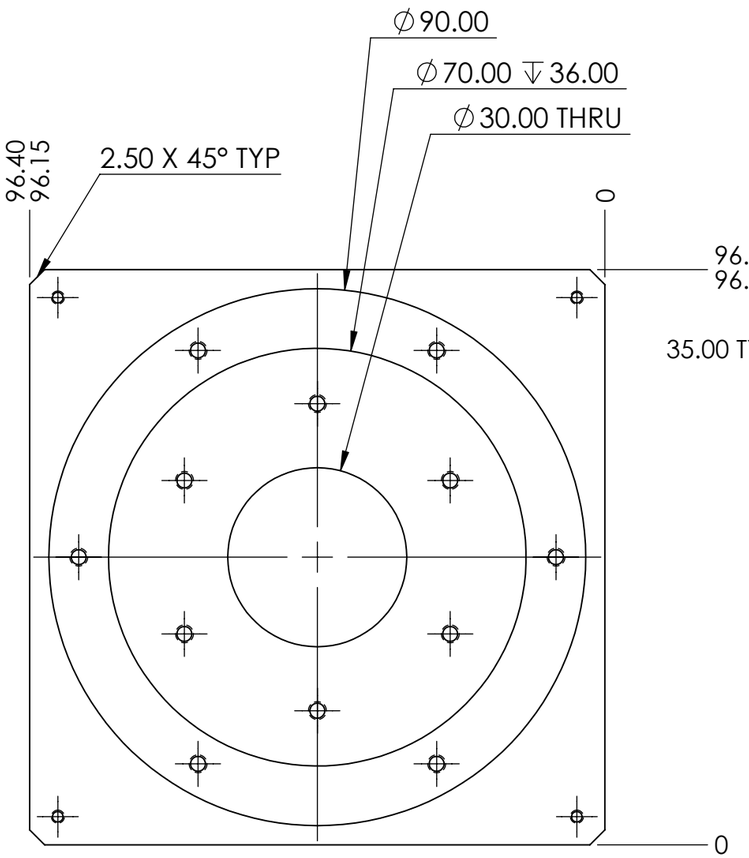
NEUtron DOSimetry & Exploration CubeSat Project
McMaster University

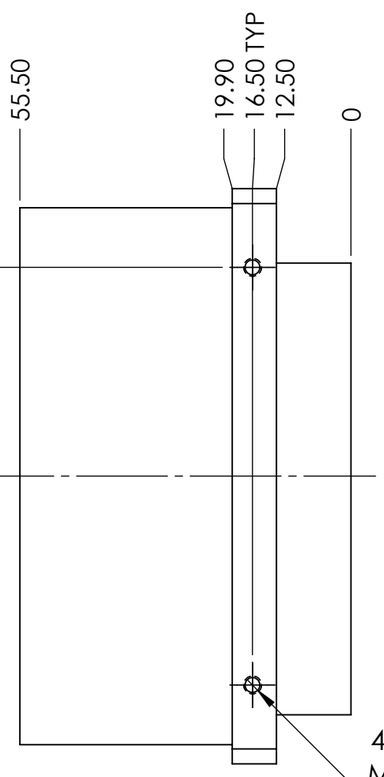
TITLE: PAYLOAD COLLIMATOR HOUSING

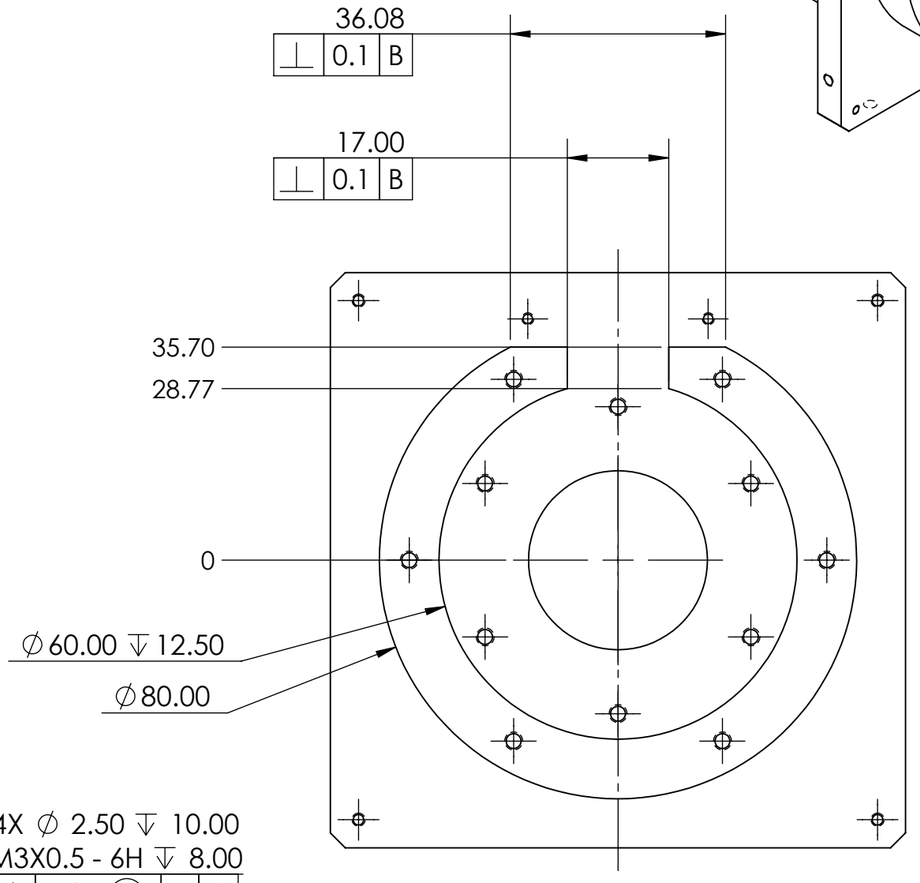
SIZE **B** | DWG. NO. H23-PLD-EST-002 | REV B

SCALE 1:1 | DO NOT SCALE DRAWING | SHEET 1 OF 4









3 FINISH: DEBURR

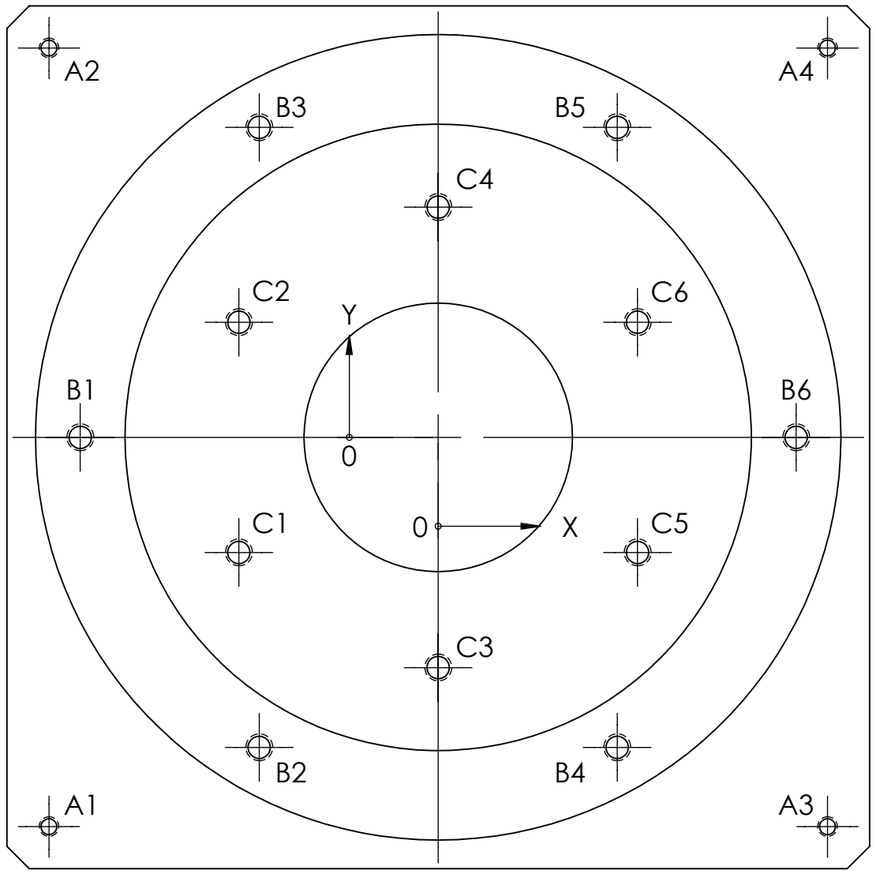
2 MATERIAL: 6061-T6 ALUMINUM

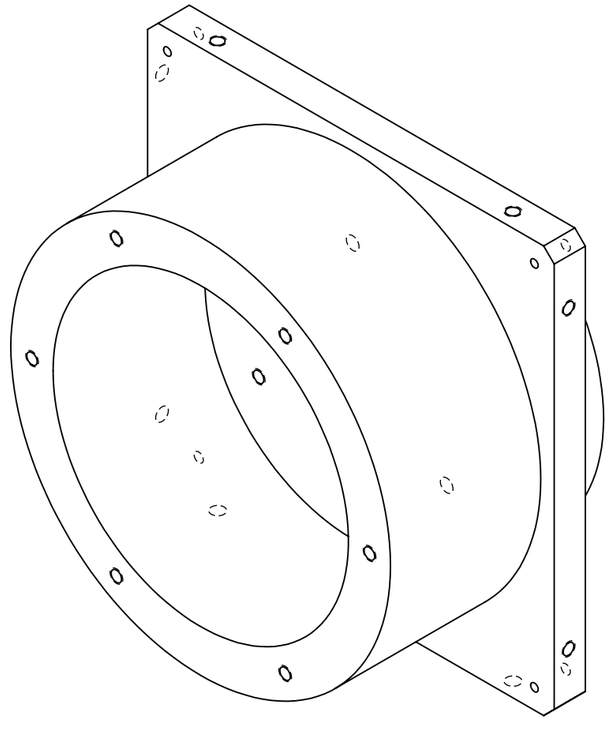
1. DIMENSIONAL LIMITS APPLY AFTER 3 .

NOTES:

NEUtron DOSimetry & Exploration CubeSat Project McMaster University		
TITLE: PAYLOAD COLLIMATOR HOUSING		
SIZE B	DWG. NO. H23-PLD-EST-002	REV B
SCALE 1:1	DO NOT SCALE DRAWING	SHEET 2 OF 4

TAG	X LOC	Y LOC	SIZE
A1	-43.50	-43.50	∅ 1.78 THRU 2-56 UNC THRU
A2	-43.50	43.50	
A3	43.50	-43.50	
A4	43.50	43.50	
B1	-40	0	∅ 2.50 ↧ 7.50 M3X0.5 - 6H ↧ 6.00
B2	-20	-34.64	
B3	-20	34.64	
B4	20	-34.64	
B5	20	34.64	
B6	40	0	
C1	-22.28	-12.86	∅ 2.50 THRU M3X0.5 - 6H THRU
C2	-22.28	12.86	
C3	0	-25.73	
C4	0	25.73	
C5	22.28	-12.86	
C6	22.28	12.86	





3 FINISH: DEBURR

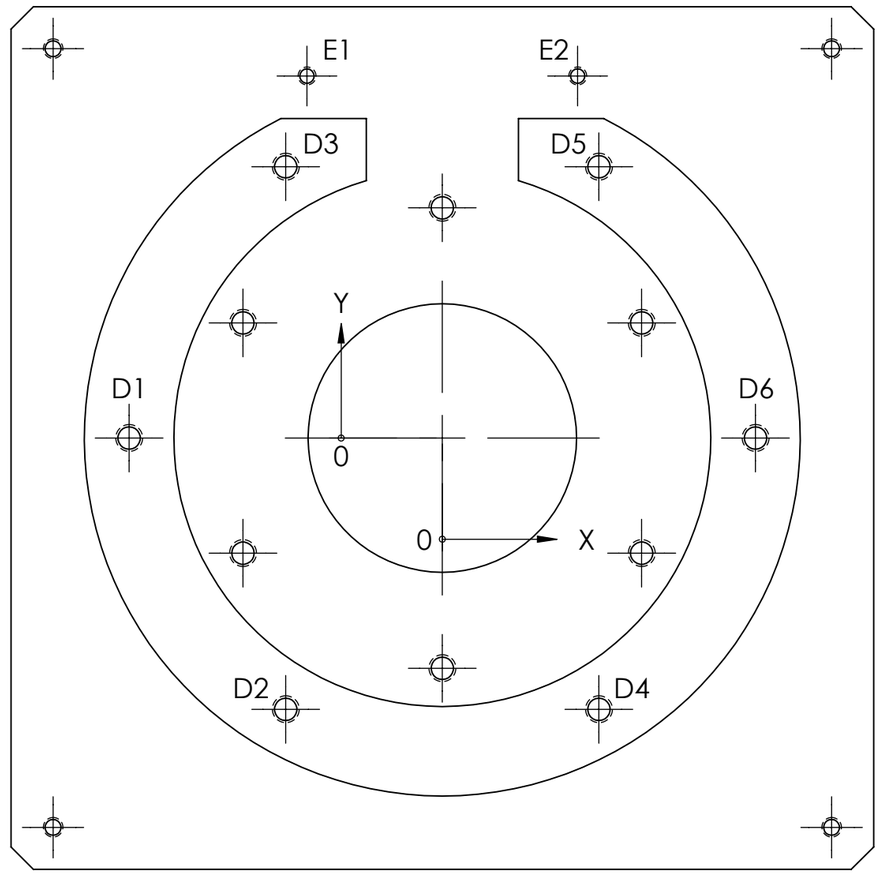
2 MATERIAL: 6061-T6 ALUMINUM

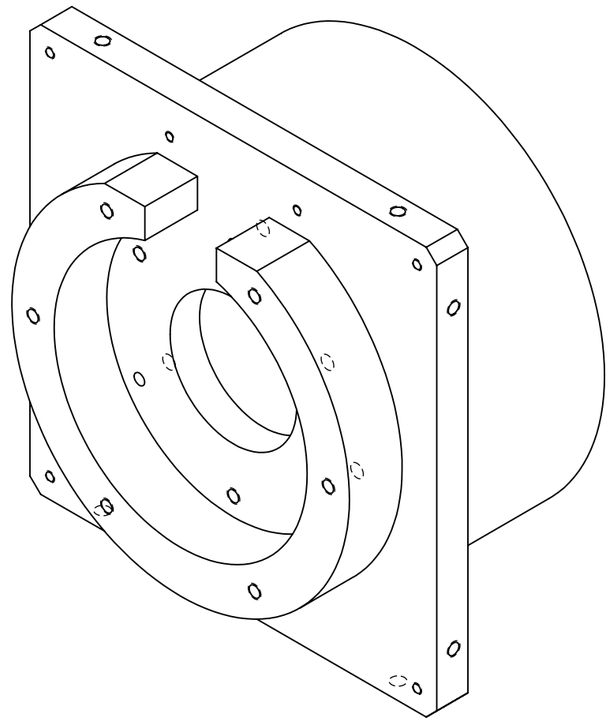
1. DIMENSIONAL LIMITS APPLY AFTER 3 .

NOTES:

NEUtron DOSimetry & Exploration CubeSat Project McMaster University		
TITLE: PAYLOAD COLLIMATOR HOUSING		
SIZE B	DWG. NO. H23-PLD-EST-002	REV B
SCALE 3:2	DO NOT SCALE DRAWING	SHEET 3 OF 4

TAG	X LOC	Y LOC	SIZE
D1	-35	0	⌀ 2.50 ↧ 7.50 M3X0.5 - 6H ↧ 6.00
D2	-17.50	-30.31	
D3	-17.50	30.31	
D4	17.50	-30.31	
D5	17.50	30.31	
D6	35	0	
E1	-15.13	40.45	⌀ 1.60 ↧ 5.20 M2X0.4 - 6H ↧ 4.00
E2	15.13	40.45	





3 FINISH: DEBURR

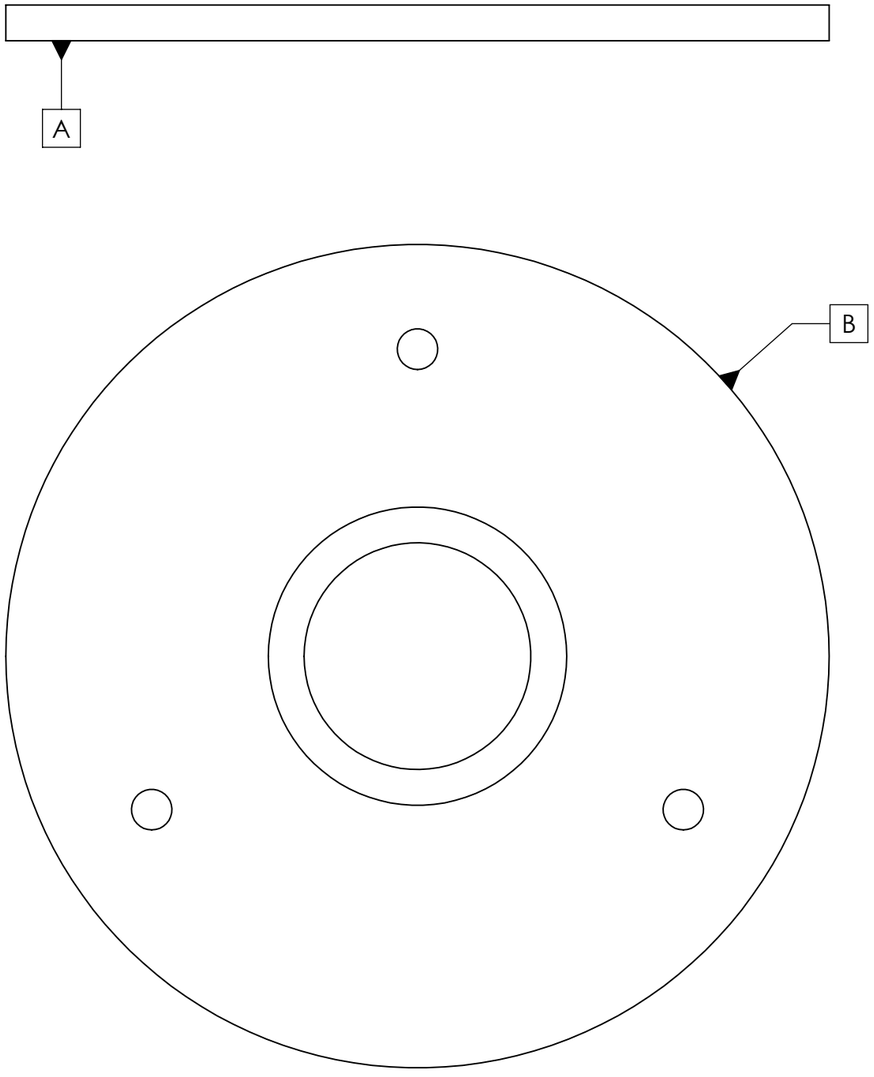
2 MATERIAL: 6061-T6 ALUMINUM

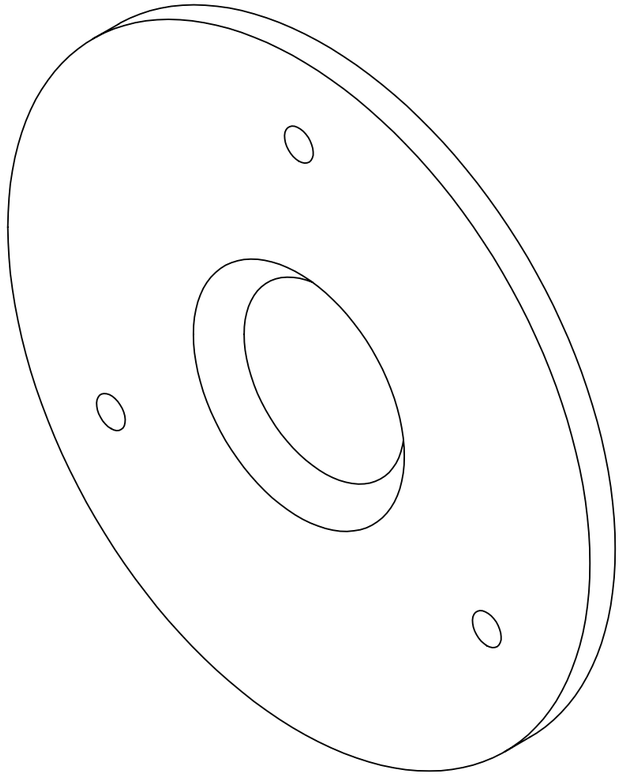
1. DIMENSIONAL LIMITS APPLY AFTER 3 .

NOTES:

NEUtron DOSimetry & Exploration CubeSat Project **McMaster University**		
TITLE: PAYLOAD COLLIMATOR HOUSING		
SIZE **B**	DWG. NO. H23-PLD-EST-002	REV B
SCALE 3:2	DO NOT SCALE DRAWING	SHEET 4 OF 4

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A	Initial Release	2023-04-14	
	B	Final PSIP Documentation.	2023-06-12	





3 FINISH: DEBURR

2 MATERIAL: COPPER

1. DIMENSIONAL LIMITS APPLY AFTER 3 .

NOTES:

METRIC

THIRD ANGLE PROJECTION	
DRILL HOLE SIZE	TOLERANCE
0.35 THRU 3.20	+0.10 / -0.03
3.21 THRU 6.40	+0.13 / -0.03
6.41 THRU 12.70	+0.15 / -0.05
12.71 THRU 19.00	+0.20 / -0.05
19.01 THRU 25.40	+0.25 / -0.08

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES ARE:
X.X ±0.25 ANGLES: ± 0°- 30'
X.XX ±0.13 CHAMFERS: ±5°

MATERIAL 2

FINISH 3

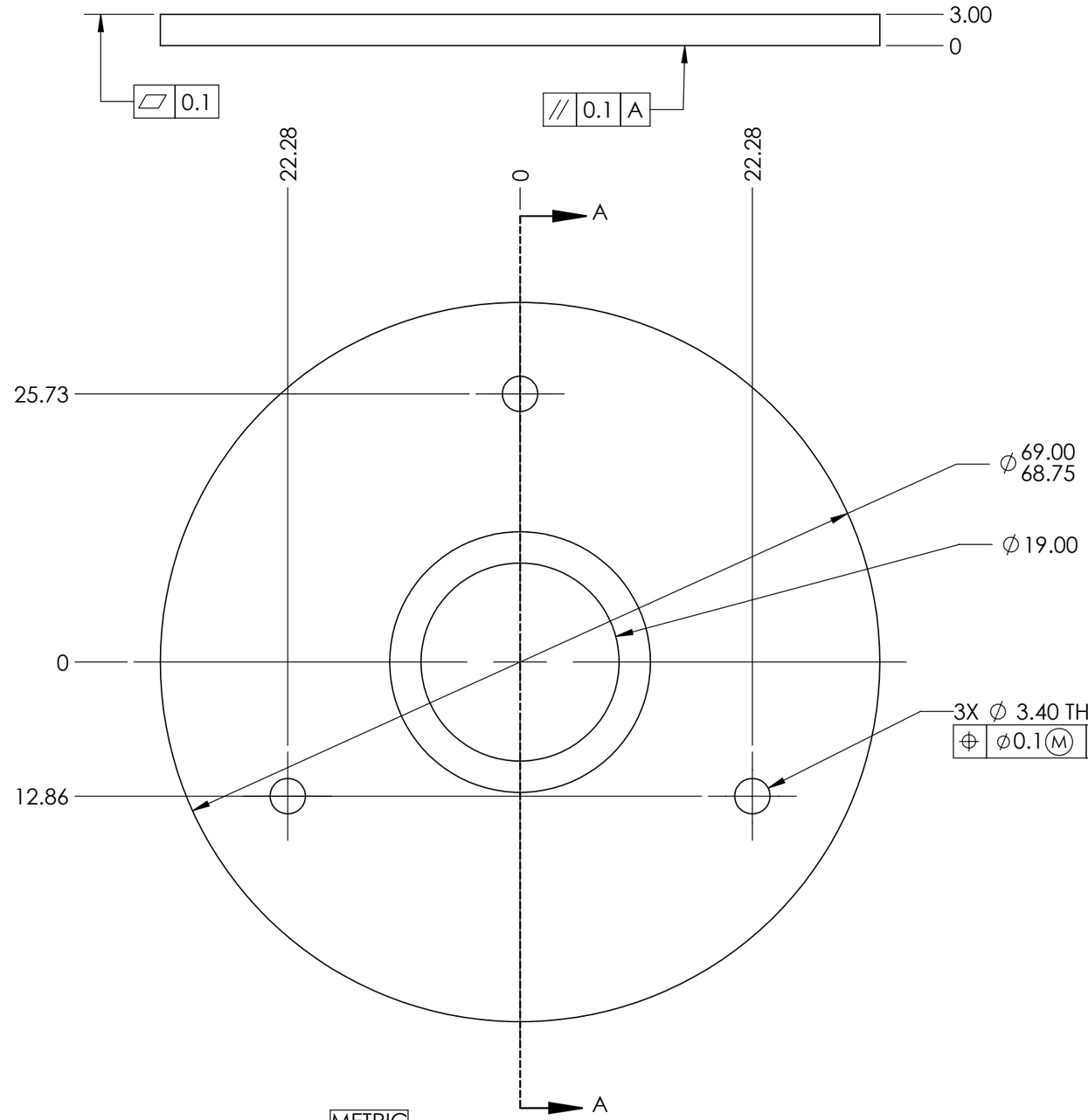
DATE 2023-04-14
DRAWN K. DI LORETO
CHECKED A.TOLLIS
DESIGN
APPROVED

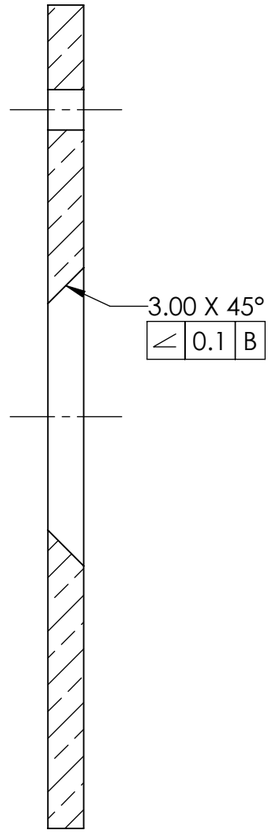
NEUtron DOSimetry & Exploration CubeSat Project
McMaster University

TITLE: COLLIMATOR BAFFLE

SIZE **B** | DWG. NO. H23-PLD-EST-003 | REV B

SCALE 2:1 | DO NOT SCALE DRAWING | SHEET 1 OF 2





SECTION A-A
SCALE 2 : 1

△3 FINISH: DEBURR

△2 MATERIAL: COPPER

1. DIMENSIONAL LIMITS APPLY AFTER △3 .

NOTES:

METRIC

THIRD ANGLE PROJECTION

DRILL HOLE SIZE	TOLERANCE
0.35 THRU 3.20	+0.10 / -0.03
3.21 THRU 6.40	+0.13 / -0.03
6.41 THRU 12.70	+0.15 / -0.05
12.71 THRU 19.00	+0.20 / -0.05
19.01 THRU 25.40	+0.25 / -0.08

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES ARE:
X.X ±0.25 ANGLES: ± 0°- 30'
X.XX ±0.13 CHAMFERS: ±5°

MATERIAL △2

FINISH △3

DATE 2023-04-14

DRAWN K. DI LORETO

CHECKED A.TOLLIS

DESIGN

APPROVED

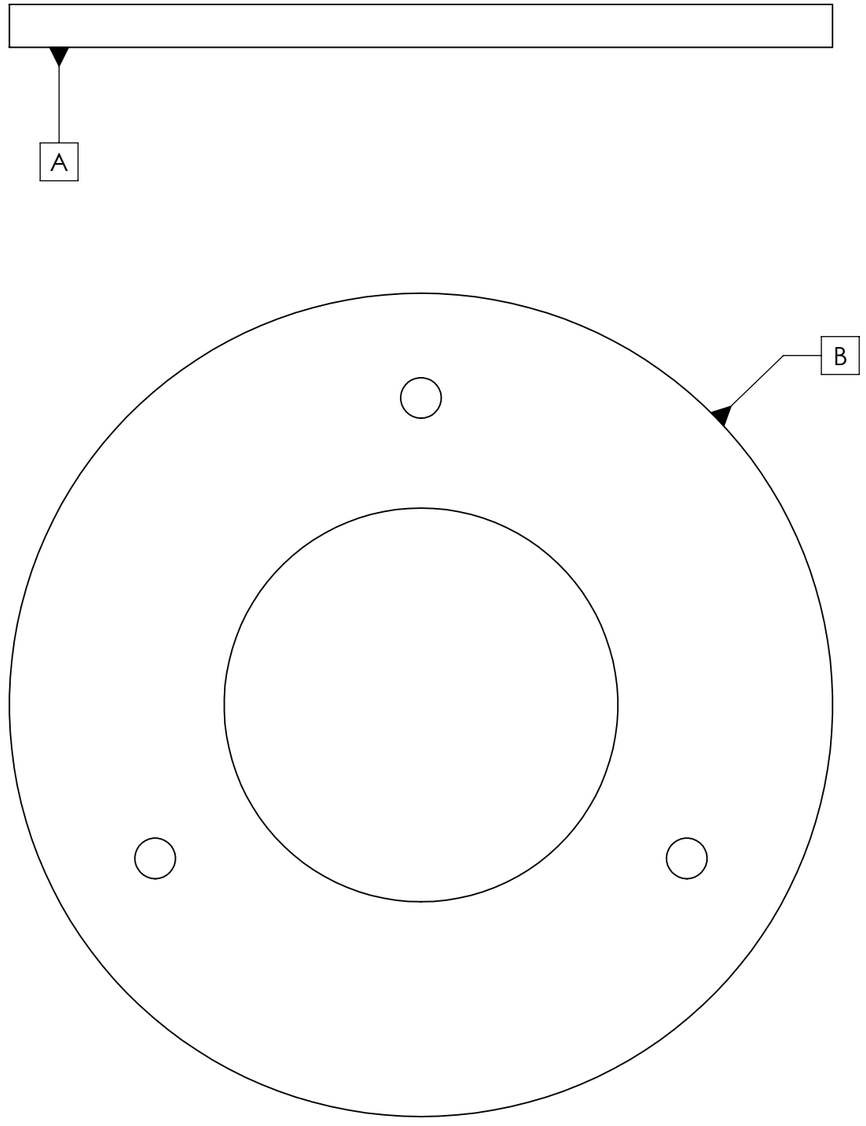
NEUtron DOSimetry & Exploration CubeSat Project
McMaster University

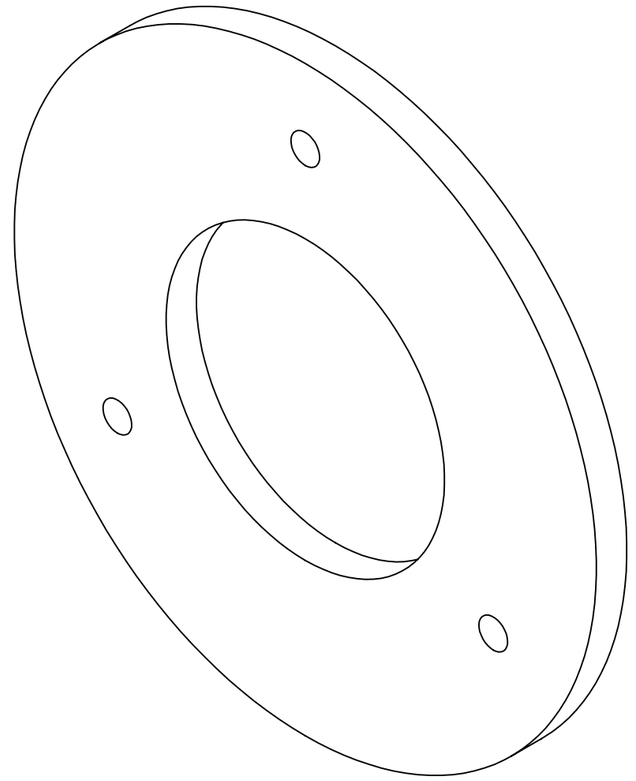
TITLE: COLLIMATOR BAFFLE

SIZE **B** | DWG. NO. H23-PLD-EST-003 | REV B

SCALE 2:1 | DO NOT SCALE DRAWING | SHEET 2 OF 2

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A	Initial Release	2023-04-14	
	B	Final PSIP Documentation.	2023-06-12	





△3 FINISH: DEBURR

△2 MATERIAL: POLYETHERETHERKETONE (PEEK)

1. DIMENSIONAL LIMITS APPLY AFTER △3 .

NOTES:

METRIC

THIRD ANGLE PROJECTION	
DRILL HOLE SIZE	TOLERANCE
0.35 THRU 3.20	+0.10 / -0.03
3.21 THRU 6.40	+0.13 / -0.03
6.41 THRU 12.70	+0.15 / -0.05
12.71 THRU 19.00	+0.20 / -0.05
19.01 THRU 25.40	+0.25 / -0.08

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES ARE:
X.X ±0.25 ANGLES: ± 0°- 30'
X.XX ±0.13 CHAMFERS: ±5°

MATERIAL △2

FINISH △3

DATE	2023-04-14
DRAWN	K. DI LORETO
CHECKED	A.TOLLIS
DESIGN	
APPROVED	

NEUtron DOSimetry & Exploration CubeSat Project
McMaster University

TITLE: COLLIMATOR SPACER

SIZE	DWG. NO.	REV
B	H23-PLD-EST-004	B
SCALE 2:1	DO NOT SCALE DRAWING	SHEET 1 OF 2

6	5	4	3	2	1

D

C

B

⌖ | ∅0.1 Ⓜ | B

A

△3 FINISH: DEBURR

△2 MATERIAL: POLYETHERETHERKETONE (PEEK)

1. DIMENSIONAL LIMITS APPLY AFTER △3 .

NOTES:

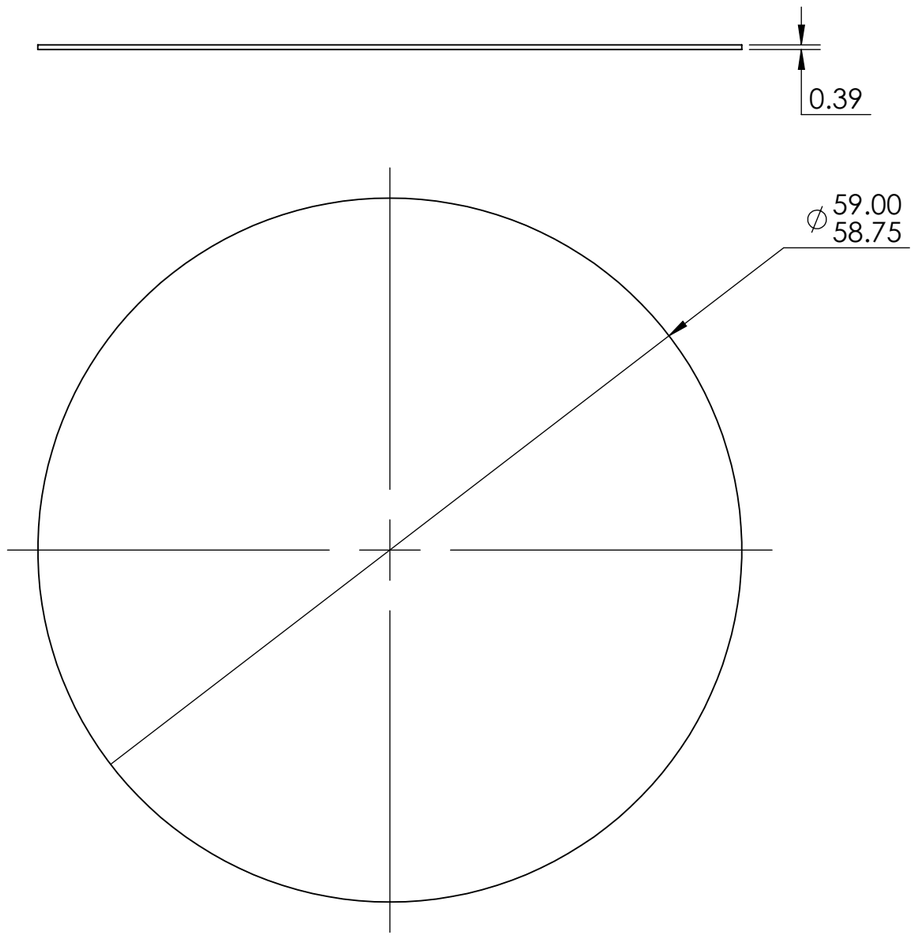
METRIC

THIRD ANGLE PROJECTION	
DRILL HOLE SIZE	TOLERANCE
0.35 THRU 3.20	+0.10 / -0.03
3.21 THRU 6.40	+0.13 / -0.03
6.41 THRU 12.70	+0.15 / -0.05
12.71 THRU 19.00	+0.20 / -0.05
19.01 THRU 25.40	+0.25 / -0.08

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS. TOLERANCES ARE: X.X±0.25 ANGLES: ± 0°- 30' X.XX±0.13 CHAMFERS: ±5°	DATE 2023-04-14	NEUtron DOSimetry & Exploration CubeSat Project McMaster University
	DRAWN K. DI LORETO	TITLE: COLLIMATOR SPACER
MATERIAL △2	CHECKED A.TOLLIS	
	DESIGN	SIZE B · DWG. NO. H23-PLD-EST-004 · REV B
FINISH △3	APPROVED	SCALE 2:1 · DO NOT SCALE DRAWING · SHEET 2 OF 2

MCMASTER NEUDOSE

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A1	Initial Release	2023-04-13	
	B	Final PSIP Documentation.	2023-06-12	



3 FINISH: DEBURR

2 MATERIAL: ALUMINUM

1. DIMENSIONAL LIMITS APPLY AFTER 3 .

NOTES: CUT TO SIZE FROM PEELABLE SHIM SHEET STOCK

METRIC

THIRD ANGLE PROJECTION

DRILL HOLE SIZE	TOLERANCE
0.35 THRU 3.20	+0.10 / -0.03
3.21 THRU 6.40	+0.13 / -0.03
6.41 THRU 12.70	+0.15 / -0.05
12.71 THRU 19.00	+0.20 / -0.05
19.01 THRU 25.40	+0.25 / -0.08

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES ARE:
X.X ±0.25 ANGLES: ± 0°- 30'
X.XX ±0.13 CHAMFERS: ±5°

MATERIAL 2

FINISH 3

DATE 2023-04-13

DRAWN J. WANG

CHECKED A.TOLLIS

DESIGN

APPROVED

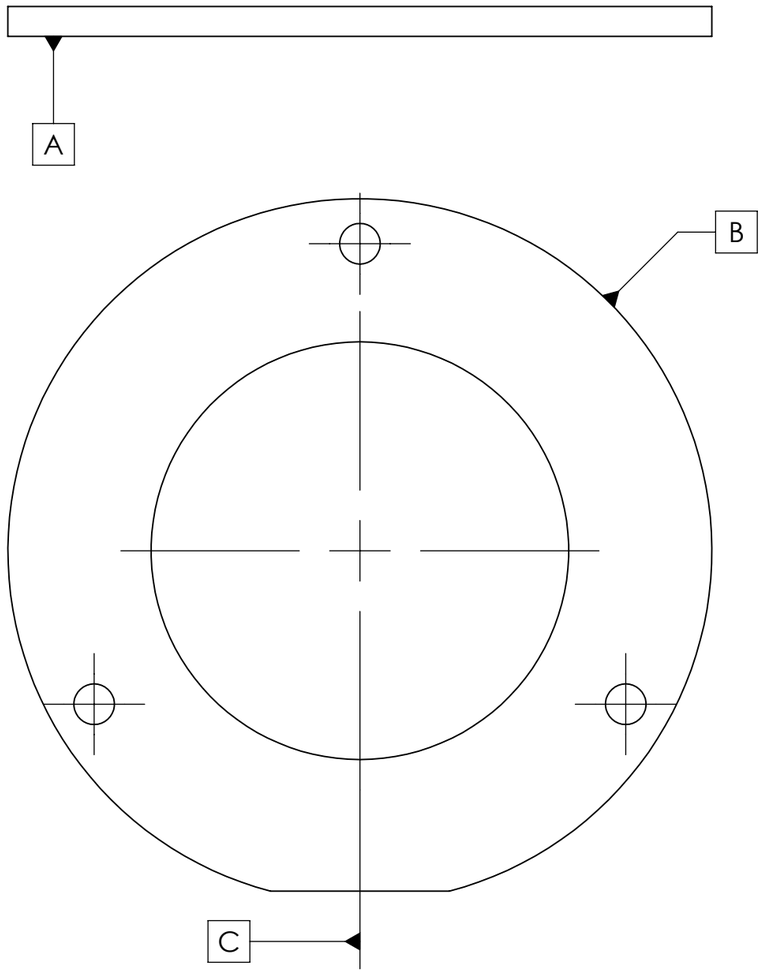
NEUtron DOSimetry & Exploration CubeSat Project
McMaster University

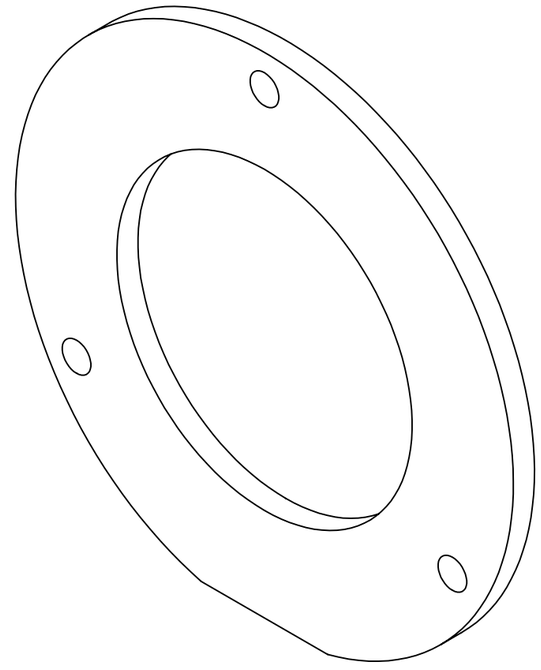
TITLE: PEELABLE ALUMINUM SHIM

SIZE **B** | DWG. NO. H23-PLD-EST-005 | REV B

SCALE 2:1 | DO NOT SCALE DRAWING | SHEET 1 OF 1

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A1	Initial Release.	2023-04-13	
	B	Final PSIP Documentation.	2023-06-12	





3 FINISH: DEBURR

2 MATERIAL: 6061-T6 ALUMINUM

1. DIMENSIONAL LIMITS APPLY AFTER 3 .

NOTES:

METRIC

THIRD ANGLE PROJECTION	
DRILL HOLE SIZE	TOLERANCE
0.35 THRU 3.20	+0.10 / -0.03
3.21 THRU 6.40	+0.13 / -0.03
6.41 THRU 12.70	+0.15 / -0.05
12.71 THRU 19.00	+0.20 / -0.05
19.01 THRU 25.40	+0.25 / -0.08

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES ARE:
X.X ±0.25 ANGLES: ± 0°- 30'
X.XX ±0.13 CHAMFERS: ±5°

MATERIAL 2

FINISH 3

DATE 2023-04-13

DRAWN J. WANG

CHECKED A.TOLLIS

DESIGN

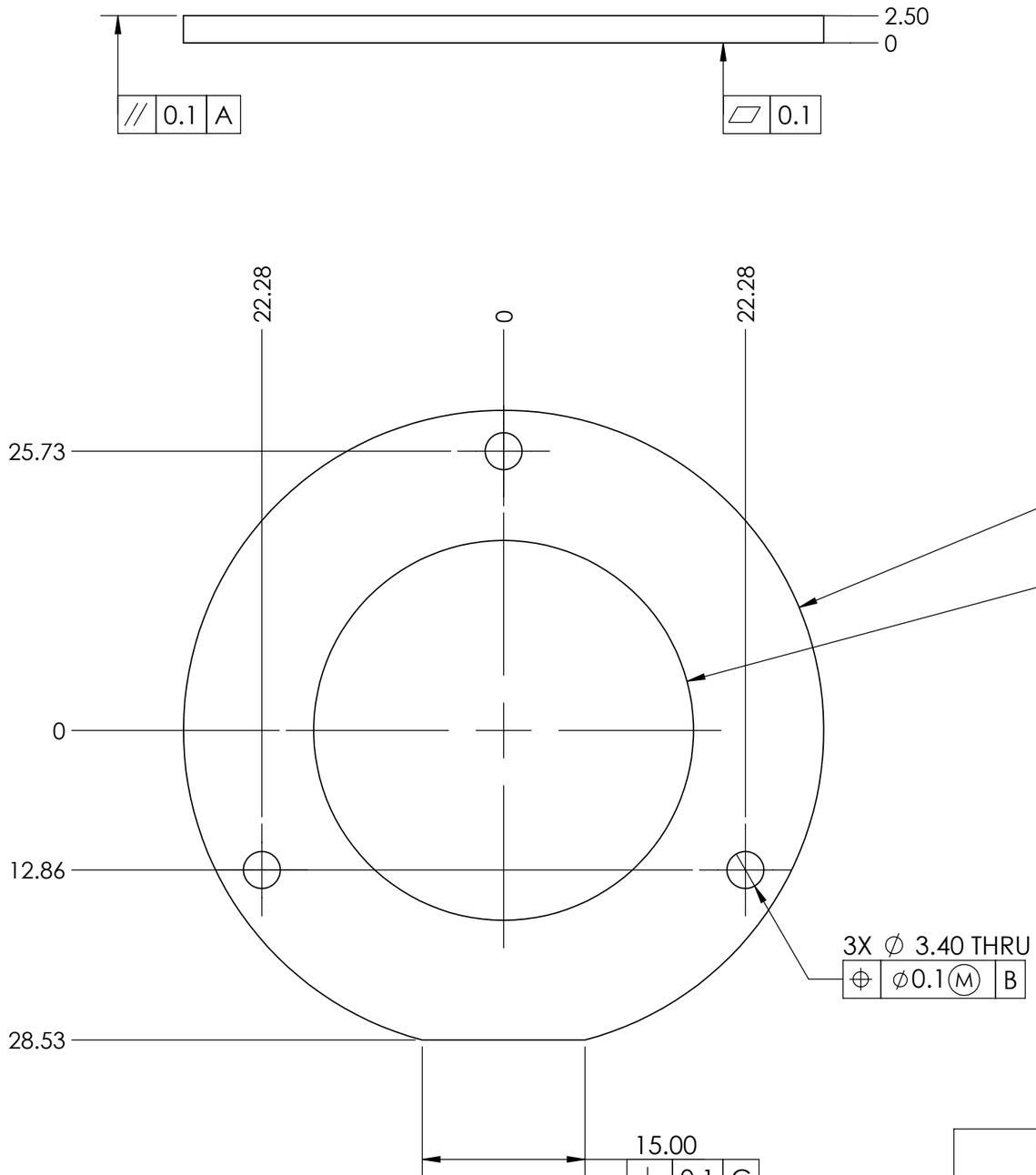
APPROVED

NEUtron DOSimetry & Exploration CubeSat Project
McMaster University

TITLE: UPPER DETECTOR SPACER

SIZE **B** | DWG. NO. H23-PLD-EST-005 | REV B

SCALE 2:1 | DO NOT SCALE DRAWING | SHEET 1 OF 2



3 FINISH: DEBURR

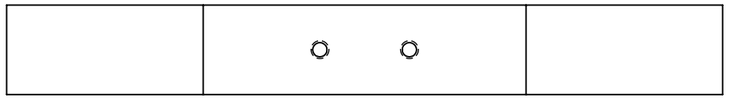
2 MATERIAL: 6061-T6 ALUMINUM

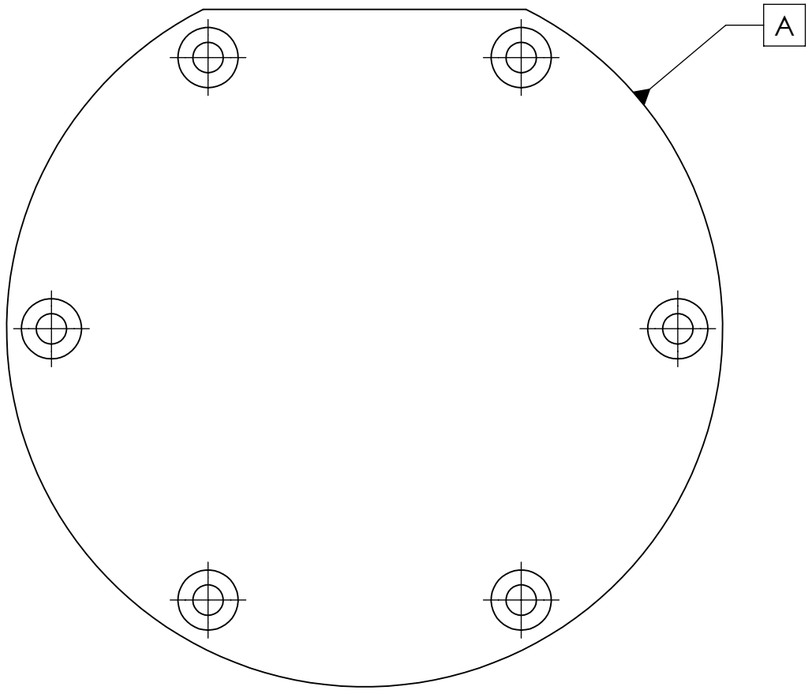
1. DIMENSIONAL LIMITS APPLY AFTER 3 .

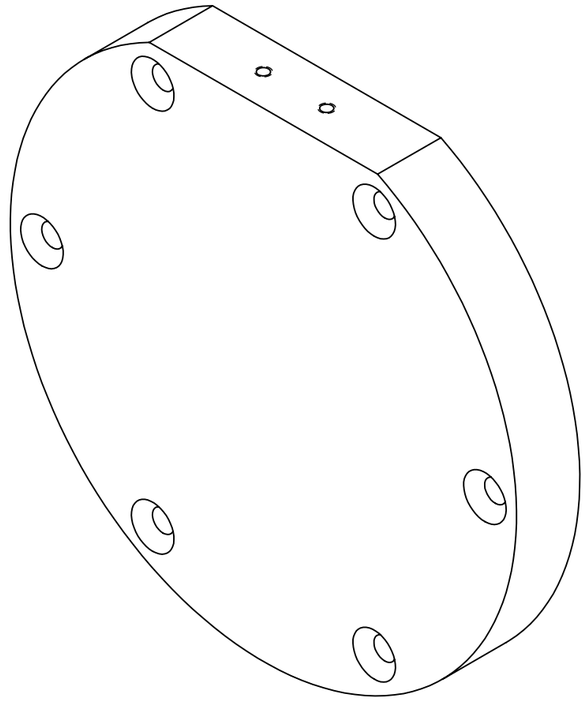
NOTES:

NEUtron DOSimetry & Exploration CubeSat Project McMaster University		
TITLE: UPPER DETECTOR SPACER		
SIZE **B**	DWG. NO. H23-PLD-EST-006	REV B
SCALE 2:1	DO NOT SCALE DRAWING	SHEET 2 OF 2

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A1	Initial Release.	2023-04-12	
	B	Final PSIP Documentation.	2023-06-12	







3. FINISH: DEBURR
2. MATERIAL: 6061-T6 ALUMINUM
1. DIMENSIONAL LIMITS APPLY AFTER 3 .

NOTES:

METRIC

THIRD ANGLE PROJECTION

DRILL HOLE SIZE	TOLERANCE
0.35 THRU 3.20	+0.10 / -0.03
3.21 THRU 6.40	+0.13 / -0.03
6.41 THRU 12.70	+0.15 / -0.05
12.71 THRU 19.00	+0.20 / -0.05
19.01 THRU 25.40	+0.25 / -0.08

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES ARE:
X.X ±0.25 ANGLES: ± 0°- 30'
X.XX ±0.13 CHAMFERS: ±5°

MATERIAL 2

FINISH 3

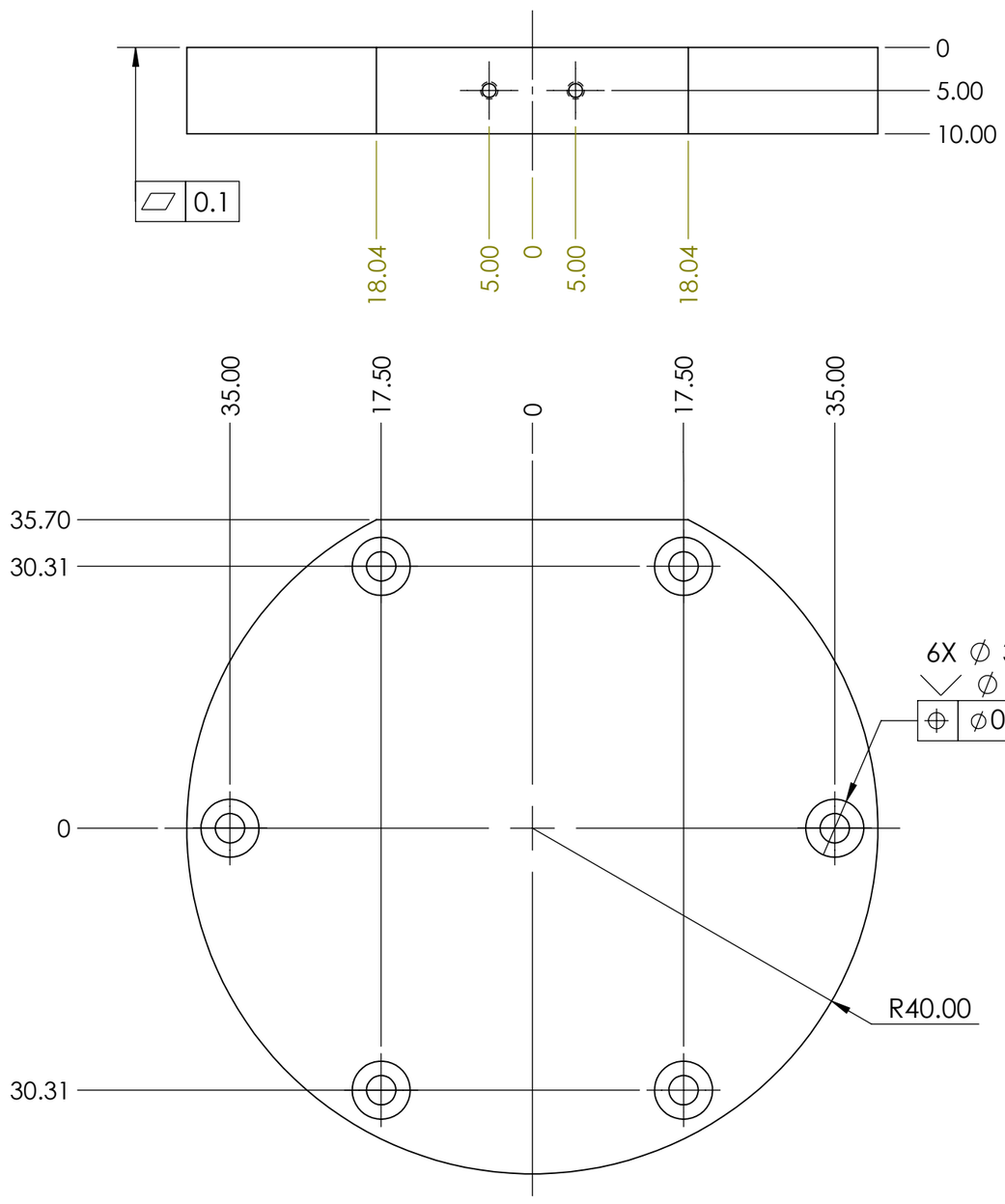
DATE 2023-04-12
DRAWN M.ALTALI
CHECKED A.TOLLIS
DESIGN
APPROVED

NEUtron DOSimetry & Exploration CubeSat Project
McMaster University

TITLE: Si DETECTOR COMPARTMENT LID

SIZE **B** | DWG. NO. H23-PLD-EST-007 | REV B

SCALE 3:2 | DO NOT SCALE DRAWING | SHEET 1 OF 2



△3 FINISH: DEBURR

△2 MATERIAL: 6061-T6 ALUMINUM

1. DIMENSIONAL LIMITS APPLY AFTER △3 .

NOTES:

METRIC

THIRD ANGLE PROJECTION

DRILL HOLE SIZE	TOLERANCE
0.35 THRU 3.20	+0.10 / -0.03
3.21 THRU 6.40	+0.13 / -0.03
6.41 THRU 12.70	+0.15 / -0.05
12.71 THRU 19.00	+0.20 / -0.05
19.01 THRU 25.40	+0.25 / -0.08

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES ARE:
X.X ±0.25 ANGLES: ± 0°- 30'
X.XX ±0.13 CHAMFERS: ±5°

MATERIAL △2

FINISH △3

DATE 2023-04-12
DRAWN M. ALTALI
CHECKED A.TOLLIS
DESIGN
APPROVED

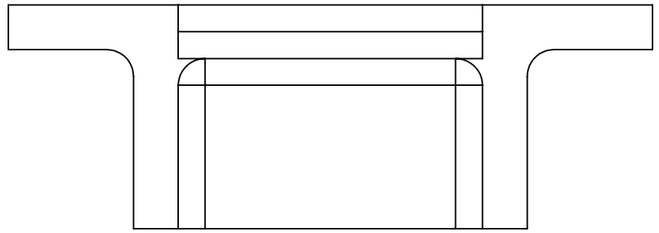
NEUtron DOSimetry & Exploration CubeSat Project
McMaster University

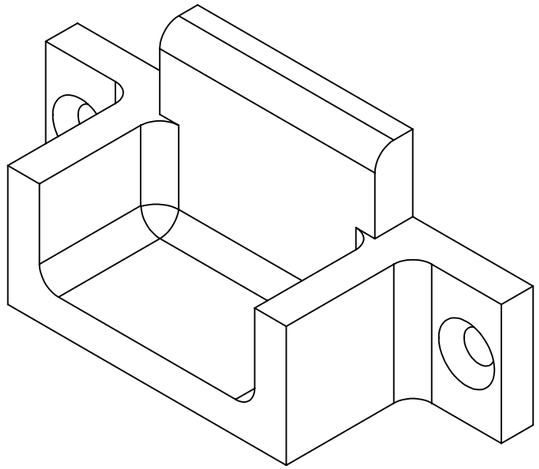
TITLE: Si DETECTOR COMPARTMENT LID

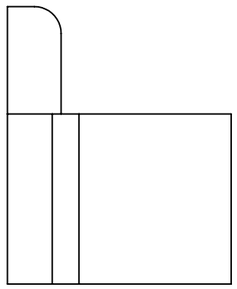
SIZE B | DWG. NO. H23-PLD-EST-007 | REV B

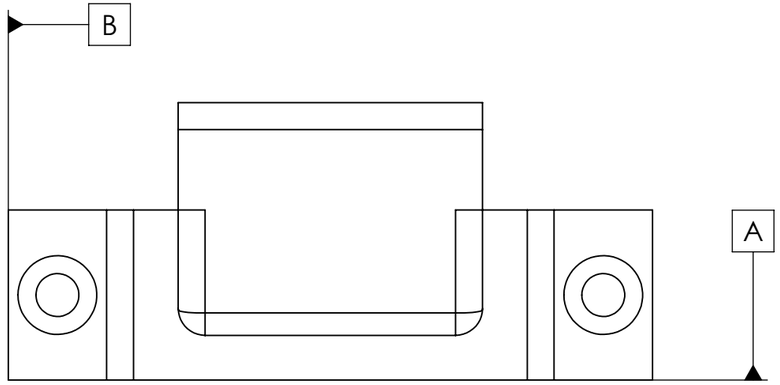
SCALE 3:2 | DO NOT SCALE DRAWING | SHEET 2 OF 2

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A1	Initial Release.	2023-04-12	
2-D4	B	Final PSIP Documentation. Added fillets to internal edges, adjust all fillets to be 1.5 mm in radius.	2023-05-07	









△3 FINISH: DEBURR

△2 MATERIAL:6061-T6 ALUMINUM

1. DIMENSIONAL LIMITS APPLY AFTER △3 .

NOTES:

METRIC

THIRD ANGLE PROJECTION	
DRILL HOLE SIZE	TOLERANCE
0.35 THRU 3.20	+0.10 / -0.03
3.21 THRU 6.40	+0.13 / -0.03
6.41 THRU 12.70	+0.15 / -0.05
12.71 THRU 19.00	+0.20 / -0.05
19.01 THRU 25.40	+0.25 / -0.08

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES ARE:
X.X ±0.25 ANGLES: ± 0°- 30'
X.XX ±0.13 CHAMFERS: ±5°

MATERIAL △2

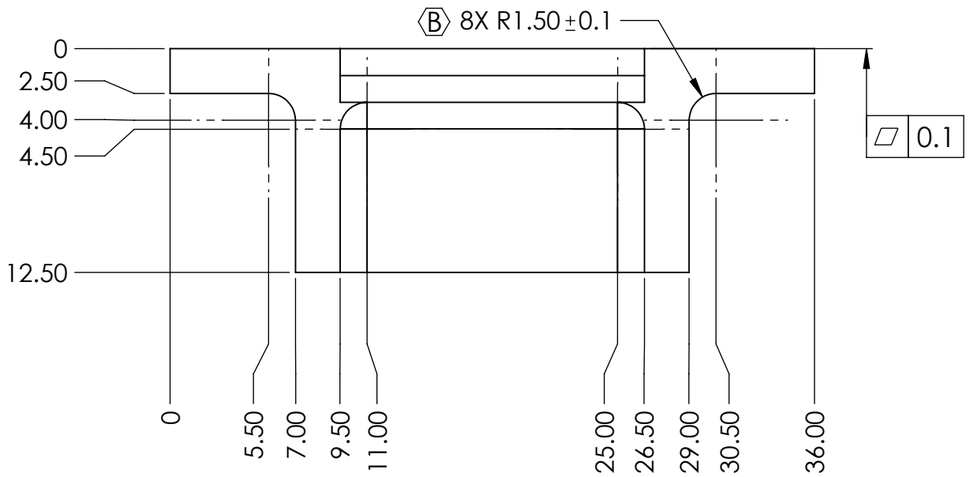
FINISH △3

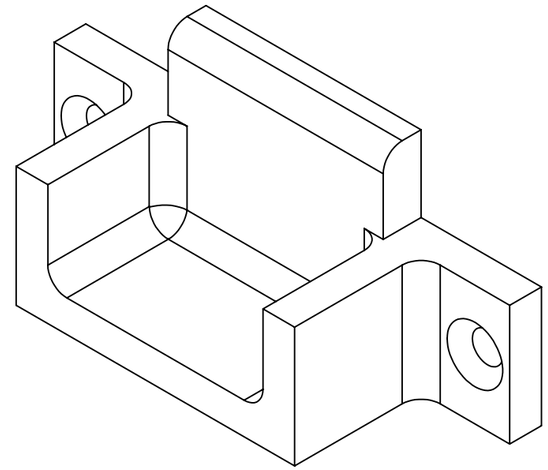
DATE	2023-04-12
DRAWN	P. CHIN
CHECKED	A.TOLLIS
DESIGN	
APPROVED	

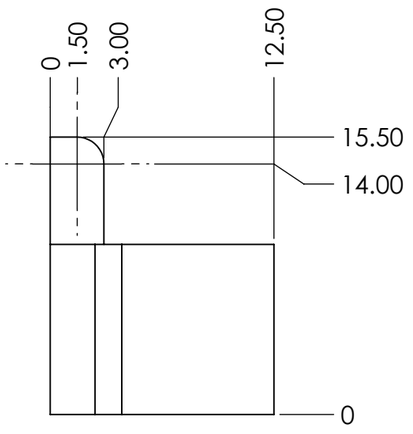
NEUtron DOSimetry & Exploration CubeSat Project
McMaster University

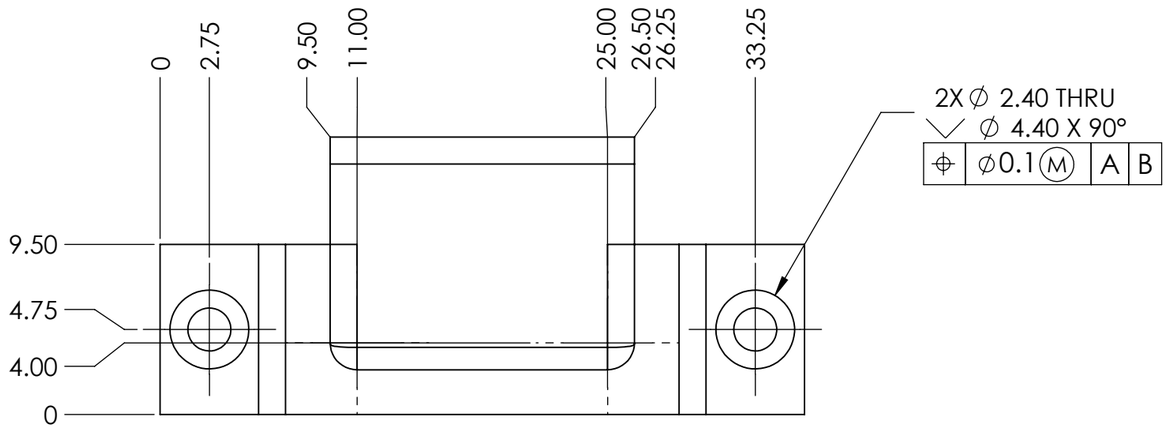
TITLE: RIBBON CABLE GATE A

SIZE	DWG. NO.	REV
B	H23-PLD-EST-008	B
SCALE 3:1	DO NOT SCALE DRAWING	SHEET 1 OF 2









3 FINISH: DEBURR

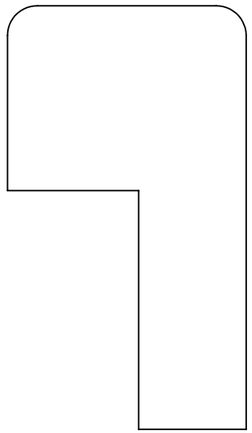
2 MATERIAL:6061-T6 ALUMINUM

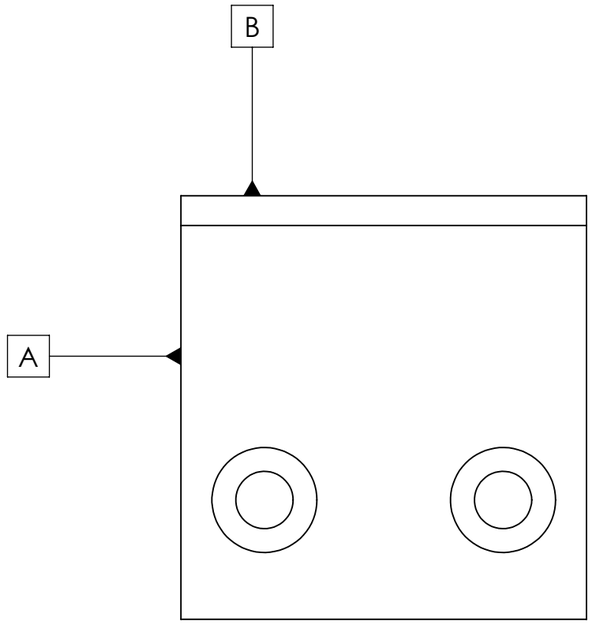
1. DIMENSIONAL LIMITS APPLY AFTER 3 .

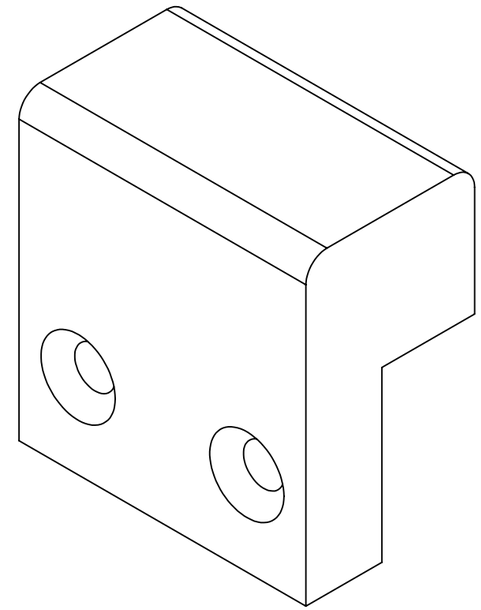
NOTES:

NEUtron DOSimetry & Exploration CubeSat Project McMaster University		
TITLE: RIBBON CABLE GATE A		
SIZE B	DWG. NO. H23-PLD-EST-008	REV B
SCALE 3:1	DO NOT SCALE DRAWING	SHEET 2 OF 2

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A1	Initial Release	2023-04-12	
2-A5	B	Final PSIP Documentation. Simplified geometry by removing flange.	2023-06-01	







△3 FINISH: DEBURR

△2 MATERIAL:6061-T6 ALUMINUM

1. DIMENSIONAL LIMITS APPLY AFTER △3 .

NOTES:

METRIC

THIRD ANGLE PROJECTION	
DRILL HOLE SIZE	TOLERANCE
0.35 THRU 3.20	+0.10 / -0.03
3.21 THRU 6.40	+0.13 / -0.03
6.41 THRU 12.70	+0.15 / -0.05
12.71 THRU 19.00	+0.20 / -0.05
19.01 THRU 25.40	+0.25 / -0.08

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES ARE:
X.X ±0.25 ANGLES: ± 0°- 30'
X.XX ±0.13 CHAMFERS: ±5°

MATERIAL △2

FINISH △3

DATE 2023-04-12

DRAWN P. CHIN

CHECKED A.TOLLIS

DESIGN

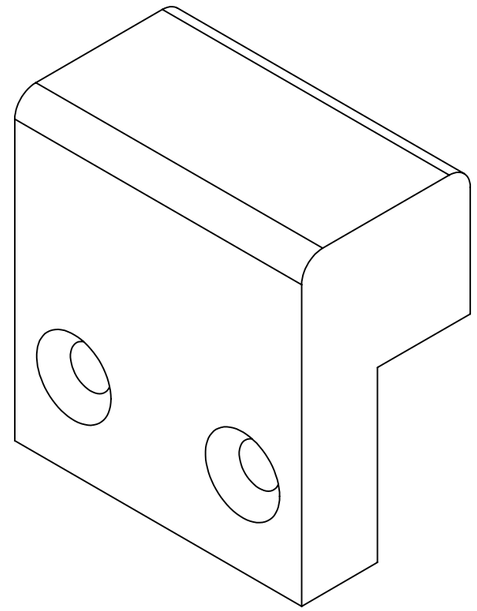
APPROVED

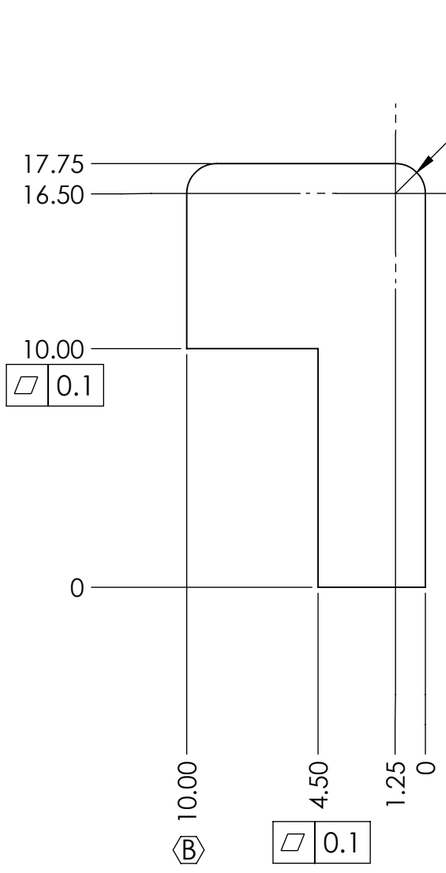
NEUtron DOSimetry & Exploration CubeSat Project
McMaster University

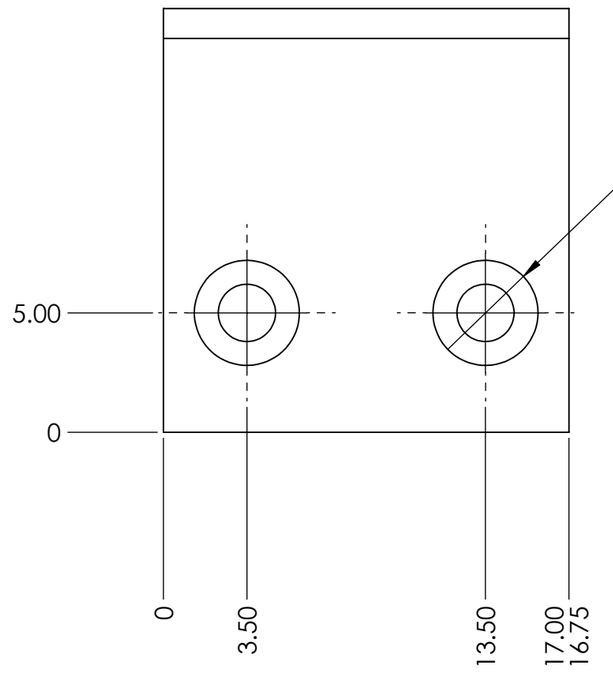
TITLE: RIBBON CABLE GATE B

SIZE **B** | DWG. NO. H29-PLD-EST-009 | REV B

SCALE 4:1 | DO NOT SCALE DRAWING | SHEET 1 OF 2







3 FINISH: DEBURR

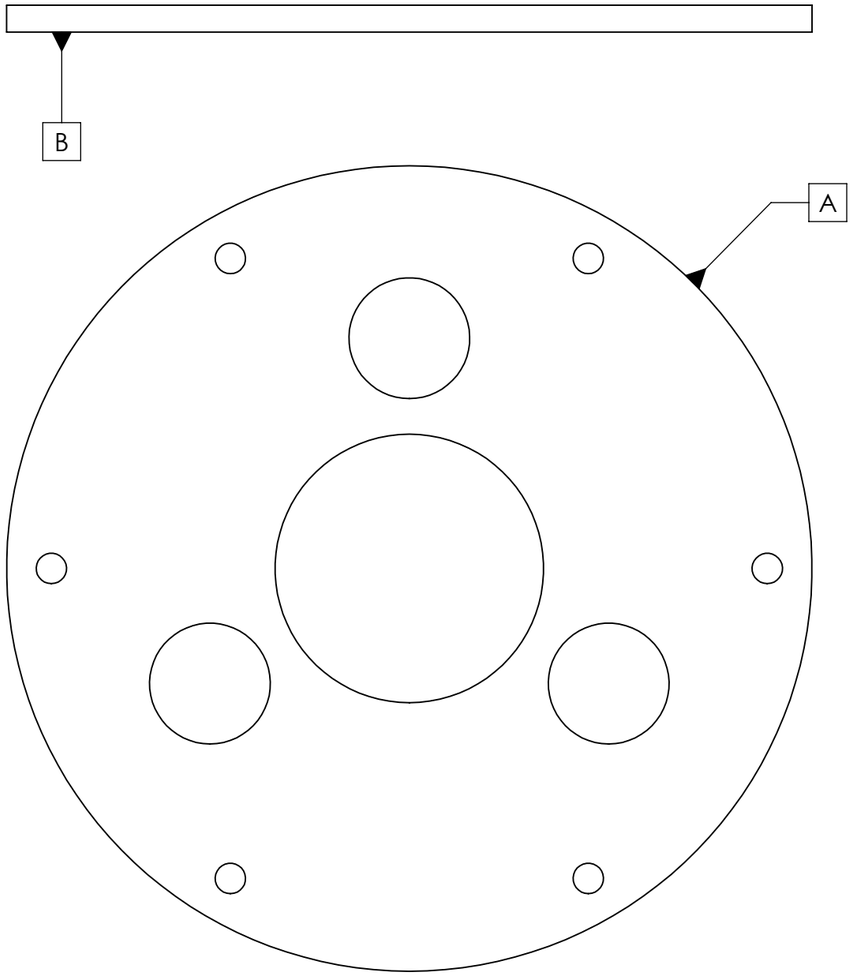
2 MATERIAL:6061-T6 ALUMINUM

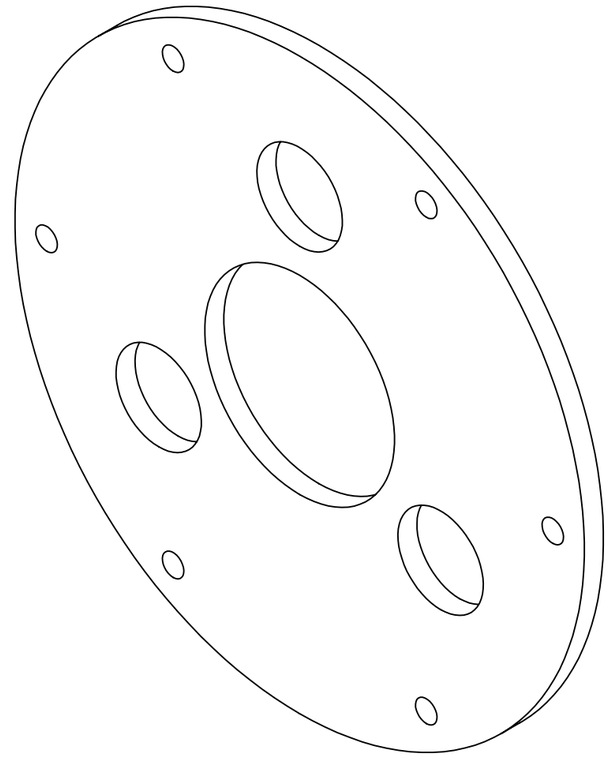
1. DIMENSIONAL LIMITS APPLY AFTER 3 .

NOTES:

NEUtron DOSimetry & Exploration CubeSat Project McMaster University		
TITLE: RIBBON CABLE GATE B		
SIZE B	DWG. NO. H23-PLD-EST-009	REV B
SCALE 4:1	DO NOT SCALE DRAWING	SHEET 2 OF 2

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A1	Initial Release.	2023-04-27	
2-B2	B	Final PSIP Documentation. Replaced countersunk holes with clearance holes	2023-05-07	





△3 FINISH: DEBURR

△2 MATERIAL: 6061-T6 ALUMINUM

1. DIMENSIONAL LIMITS APPLY AFTER △3 .

NOTES: ACTUAL OD WILL BE MANUFACTURED TO ~88.90mm CORRESPONDING TO STANDARD 3.5" ROUND STOCK

METRIC

THIRD ANGLE PROJECTION

DRILL HOLE SIZE	TOLERANCE
0.35 THRU 3.20	+0.10 / -0.03
3.21 THRU 6.40	+0.13 / -0.03
6.41 THRU 12.70	+0.15 / -0.05
12.71 THRU 19.00	+0.20 / -0.05
19.01 THRU 25.40	+0.25 / -0.08

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES ARE:
X.X ±0.25 ANGLES: ± 0°- 30'
X.XX ±0.13 CHAMFERS: ±5°

MATERIAL △2

FINISH △3

DATE 2023-04-27

DRAWN P. CHIN

CHECKED A.TOLLIS

DESIGN

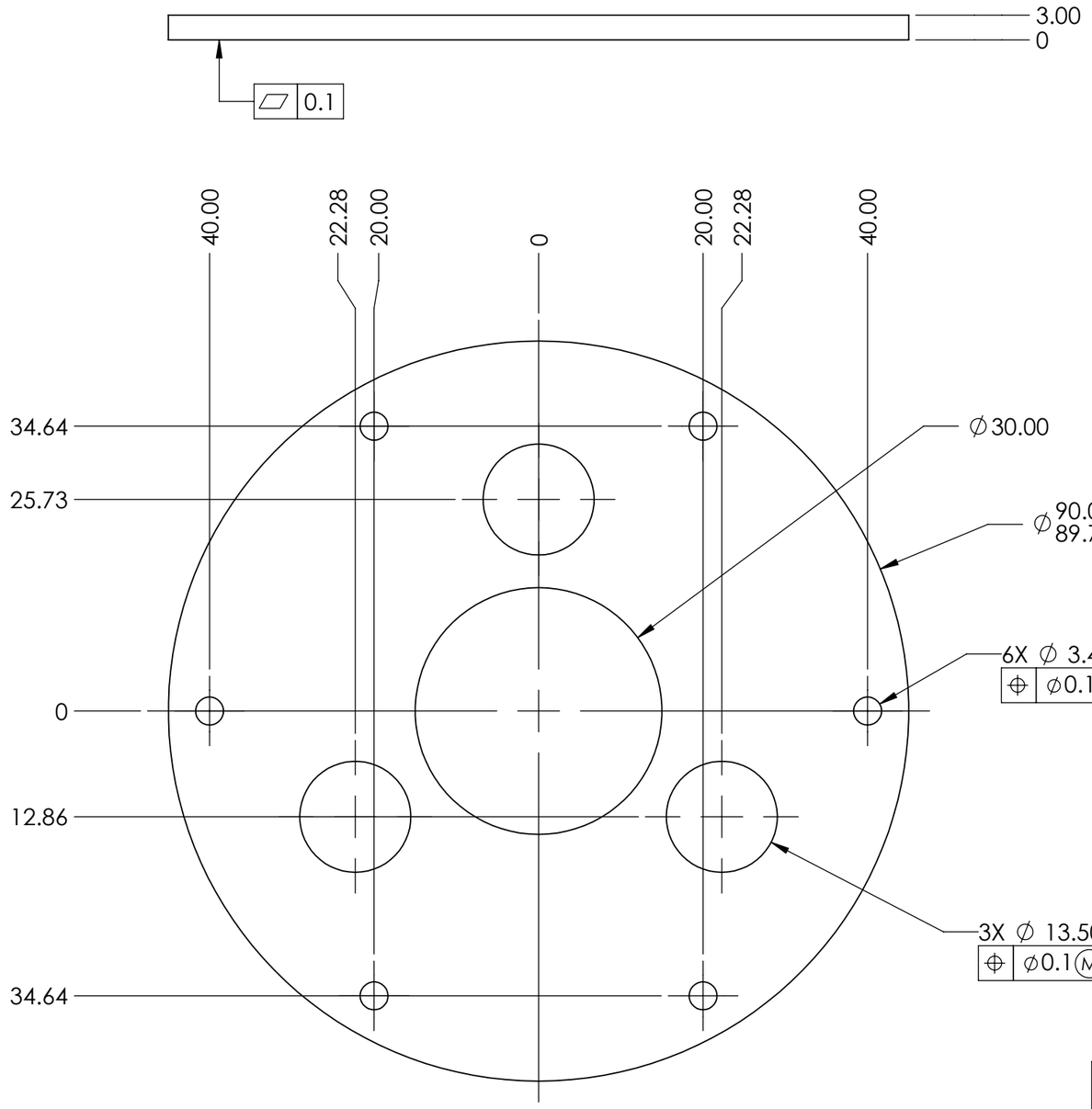
APPROVED

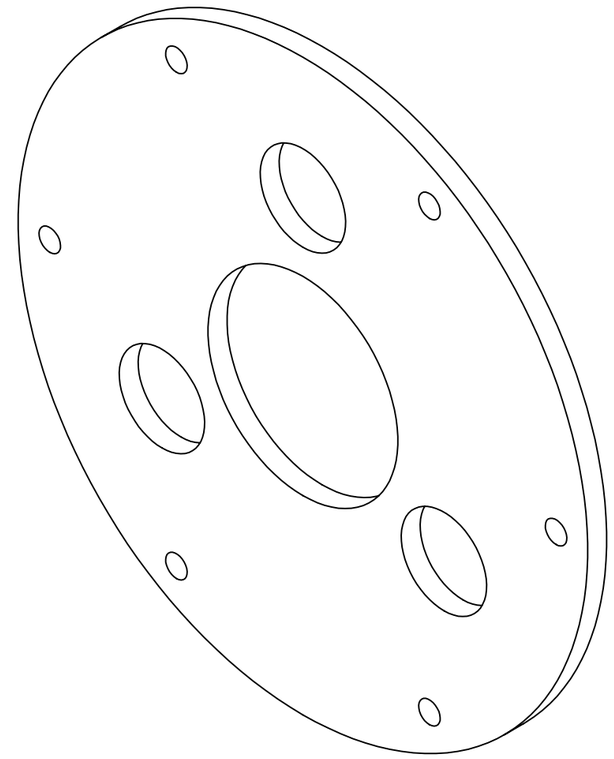
NEUtron DOSimetry & Exploration CubeSat Project
McMaster University

TITLE: COLLIMATOR LID

SIZE **B** | DWG. NO. H23-PLD-EST-011 | REV B

SCALE 3:2 | DO NOT SCALE DRAWING | SHEET 1 OF 2





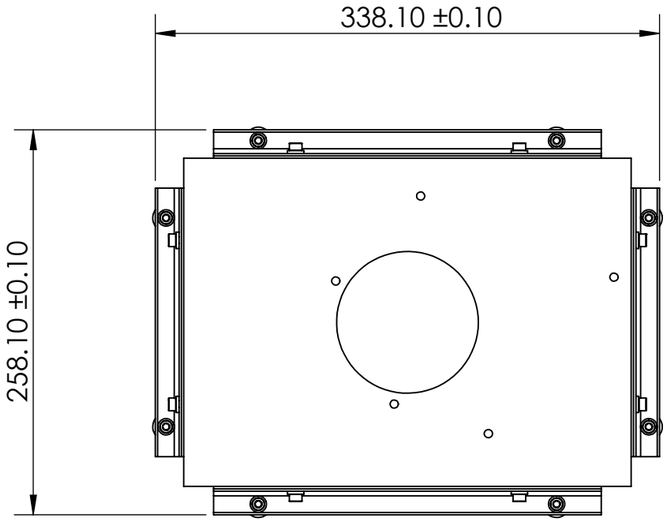
3 FINISH: DEBURR

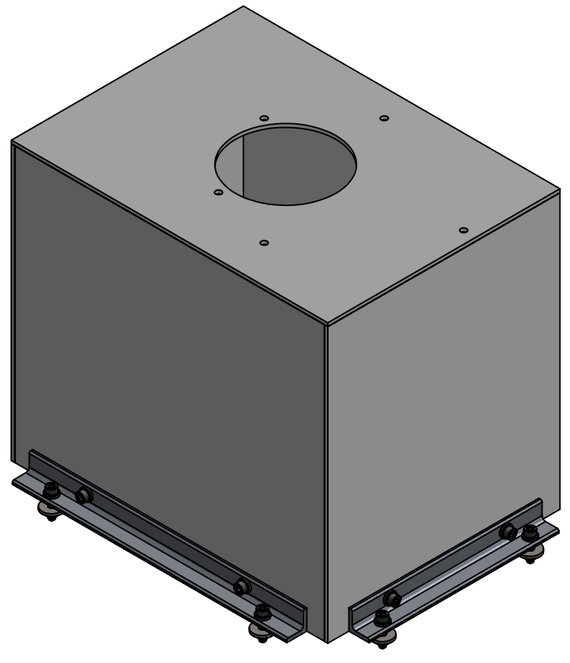
2 MATERIAL: 6061-T6 ALUMINUM

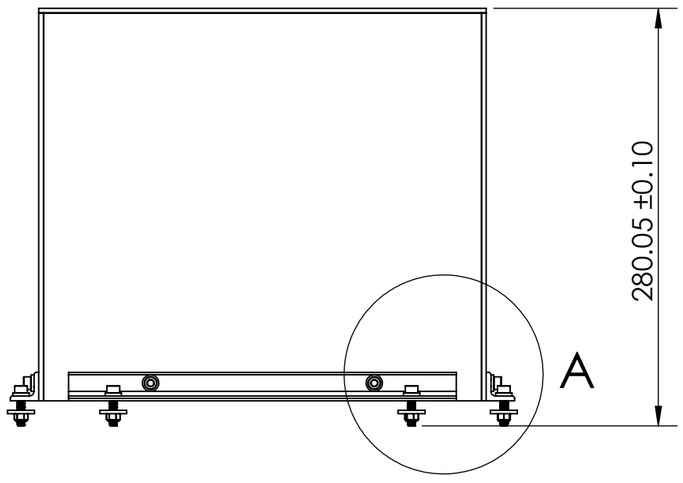
1. DIMENSIONAL LIMITS APPLY AFTER 3 .

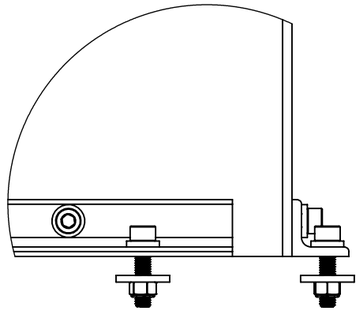
NOTES: ACTUAL OD WILL BE MANUFACTURED TO ~88.90mm CORRESPONDING TO STANDARD 3.5" ROUND STOCK

NEUtron DOSimetry & Exploration CubeSat Project McMaster University		
TITLE: COLLIMATOR LID		
SIZE B	DWG. NO. H23-PLD-EST-011	REV B
SCALE 3:2	DO NOT SCALE DRAWING	SHEET 2 OF 2







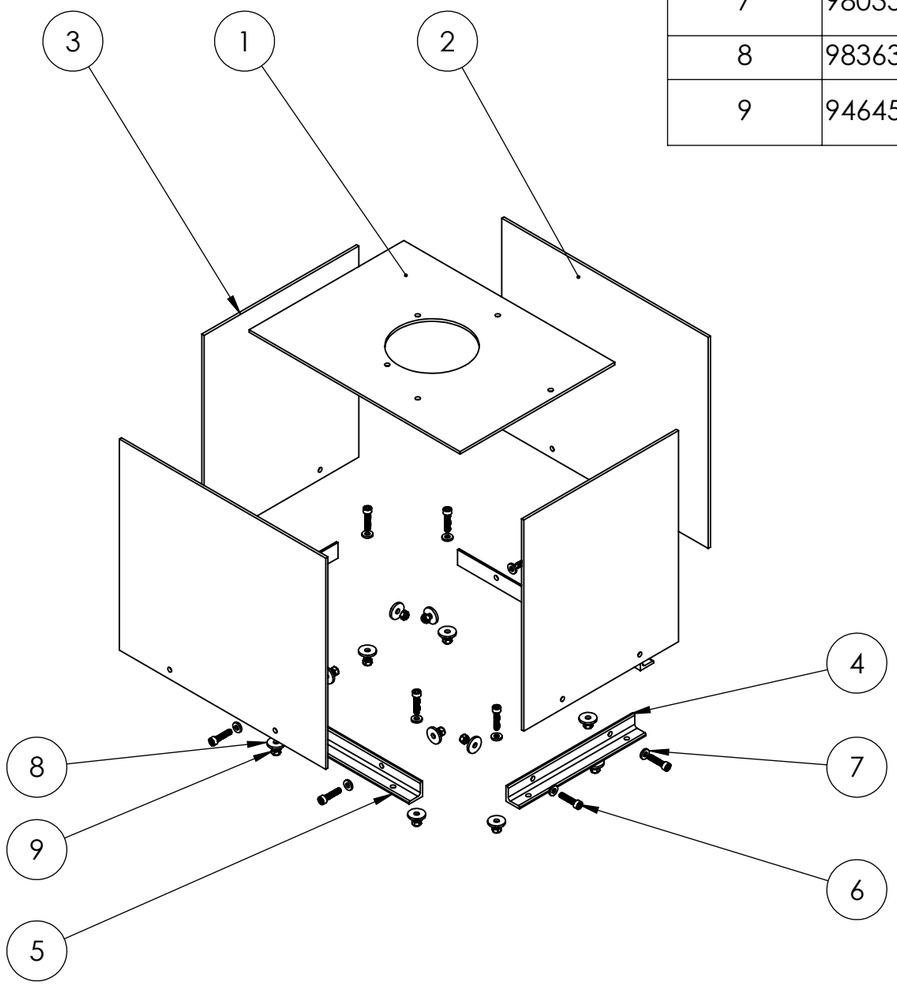


DETAIL A

SCALE 1 : 2

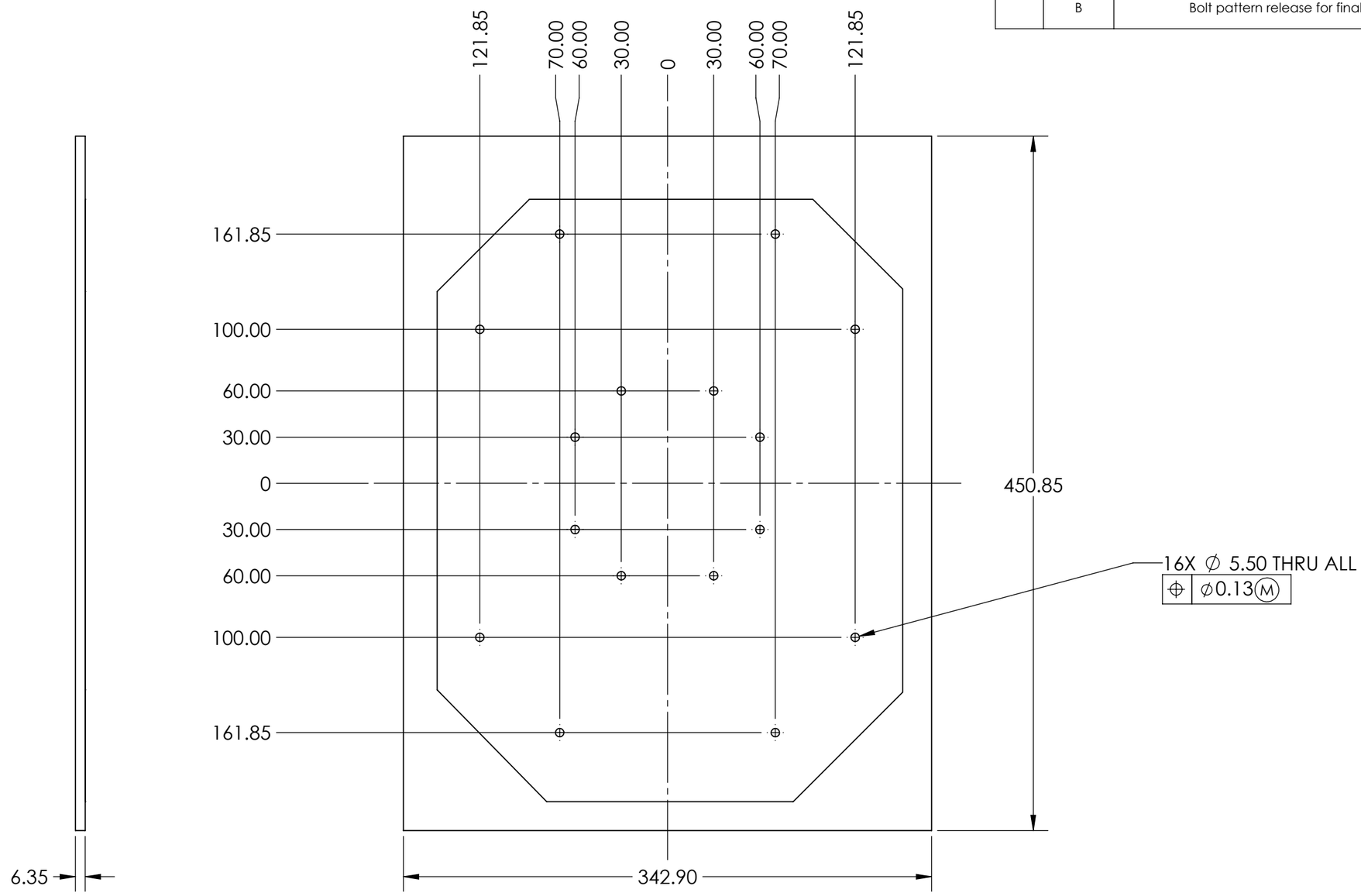
NEUtron DOSimetry & Exploration CubeSat Project McMaster University		
TITLE: Case exterior for HASP 2023		
SIZE B	DWG. NO. H23-PRE-MEC-003-SA	REV B
SCALE 1:5	DO NOT SCALE DRAWING	SHEET 1 OF 2

ITEM NO.	PART NUMBER	DESCRIPTION	Material	Mass (g)	Method	QTY.
1	H23-PRE-MEC-004-PF	Exterior housing case Z top	PVC Rigid	242.67	Analysis	1
2	H23-PRE-MEC-003-PF	Exterior housing case Y side	PVC Rigid	314.93	Analysis	2
3	H23-PRE-MEC-002-PF	Exterior housing case X side	PVC Rigid	235.90	Analysis	2
4	8982K281	Multipurpose 6061 Aluminum 90 Degree Angle	6061 Aluminum	53.60	Analysis	2
5	8982K281	Multipurpose 6061 Aluminum 90 Degree Angle	6061 Aluminum	77.79	Analysis	2
6	91290A248	Alloy Steel Socket Head Screw	Alloy Steel	4.43	Analysis	16
7	98035A103	Black-Oxide Steel Oversized Washer	Steel	1.096	Analysis	16
8	98363A111	Steel Oversized Washer	Steel	4.09	Analysis	16
9	94645A102	High-Strength Steel Nylon-Insert Locknut	Steel	1.42	Analysis	16



NEUtron DOSimetry & Exploration CubeSat Project McMaster University		
TITLE: Case exterior for HASP 2023 Exploded View		
SIZE B	DWG. NO. H23-PRE-MEC-003-SA	REV B
SCALE 1:4	DO NOT SCALE DRAWING	SHEET 2 OF 2

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	B	Bolt pattern release for final PSIP	2023-06-27	



3 FINISH: NONE

2 MATERIAL: PVC RIGID

1. DIMENSIONAL LIMITS APPLY AFTER 3 .

NOTES:

METRIC

THIRD ANGLE PROJECTION

DRILL HOLE SIZE	TOLERANCE
0.35 THRU 3.20	+0.10 / -0.03
3.21 THRU 6.40	+0.13 / -0.03
6.41 THRU 12.70	+0.15 / -0.05
12.71 THRU 19.00	+0.20 / -0.05
19.01 THRU 25.40	+0.25 / -0.08

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES ARE:
X.X ±0.25 ANGLES: ± 0°- 30'
X.XX ±0.13 CHAMFERS: ±5°

MATERIAL 2

FINISH 3

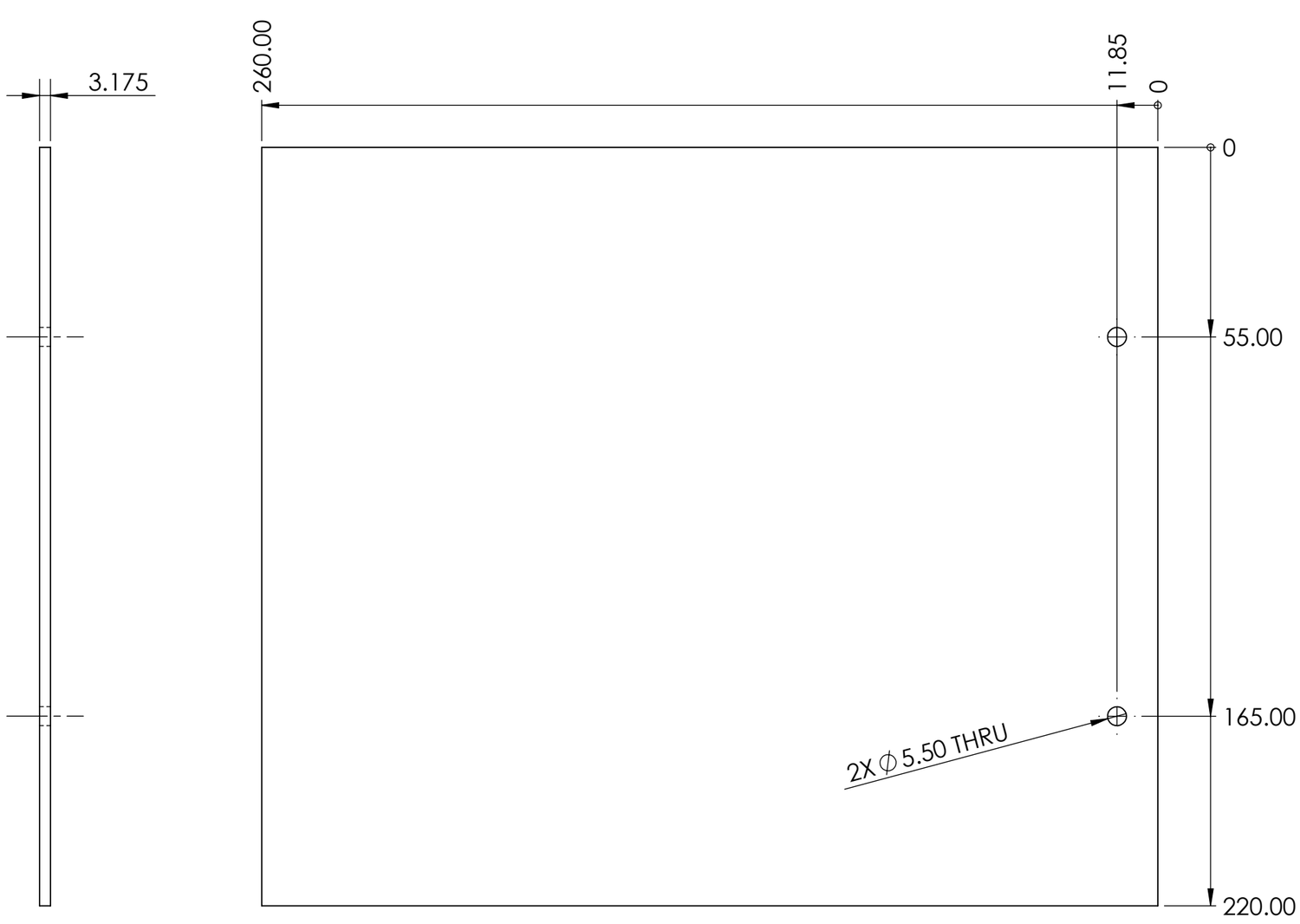
DATE	2023-06-27
DRAWN	A. TOLLIS
CHECKED	P. CHIN
DESIGN	P. CHIN
APPROVED	

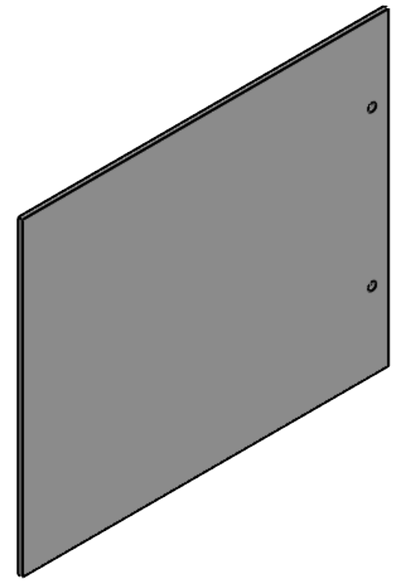
NEUtron DOSimetry & Exploration CubeSat Project
McMaster University

TITLE: HASP BASE PLATE (LARGE)

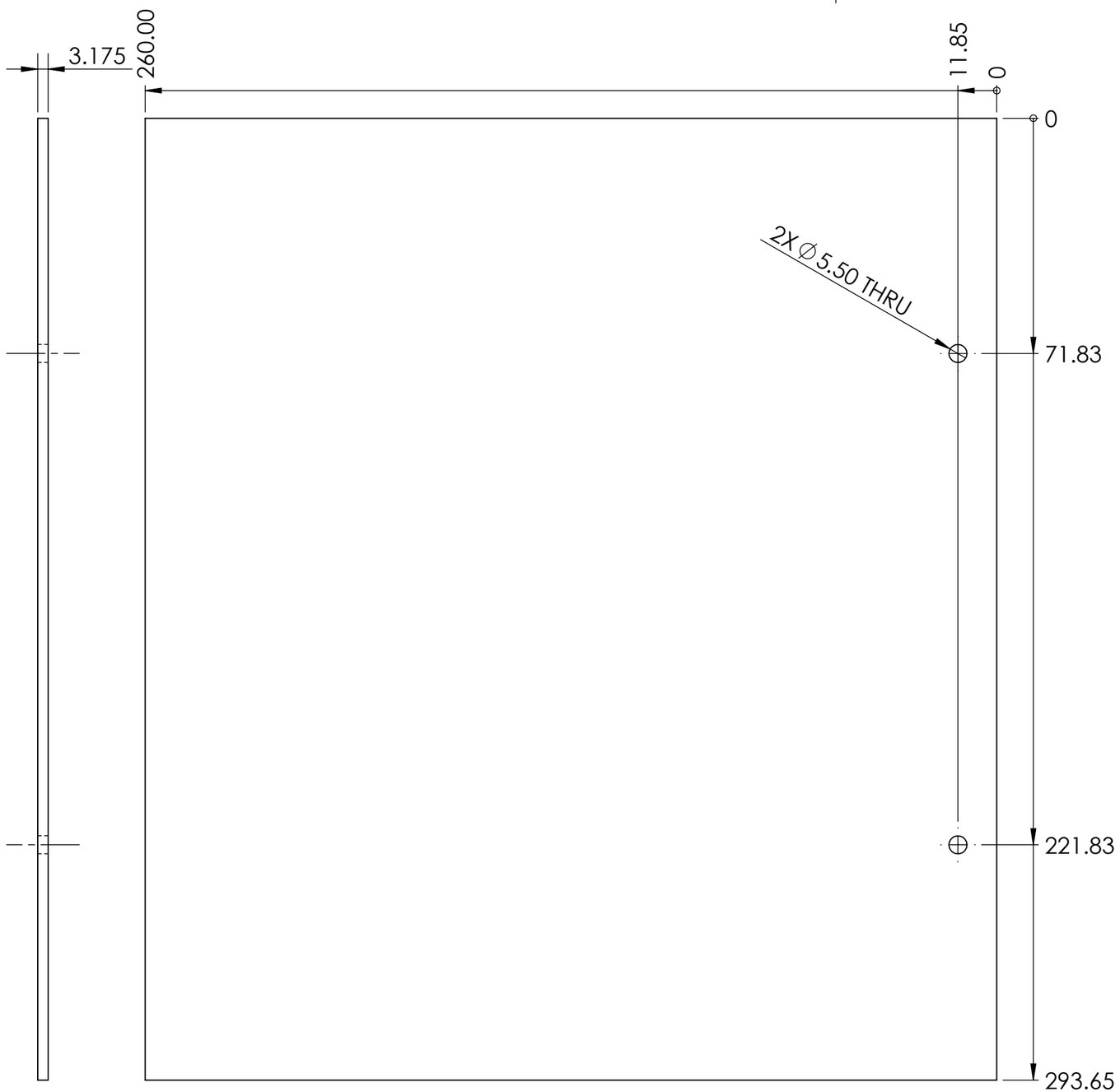
SIZE **B** | DWG. NO. H23-PRE-MEC-001-PF | REV B

SCALE 1:3 | DO NOT SCALE DRAWING | SHEET 1 OF 1

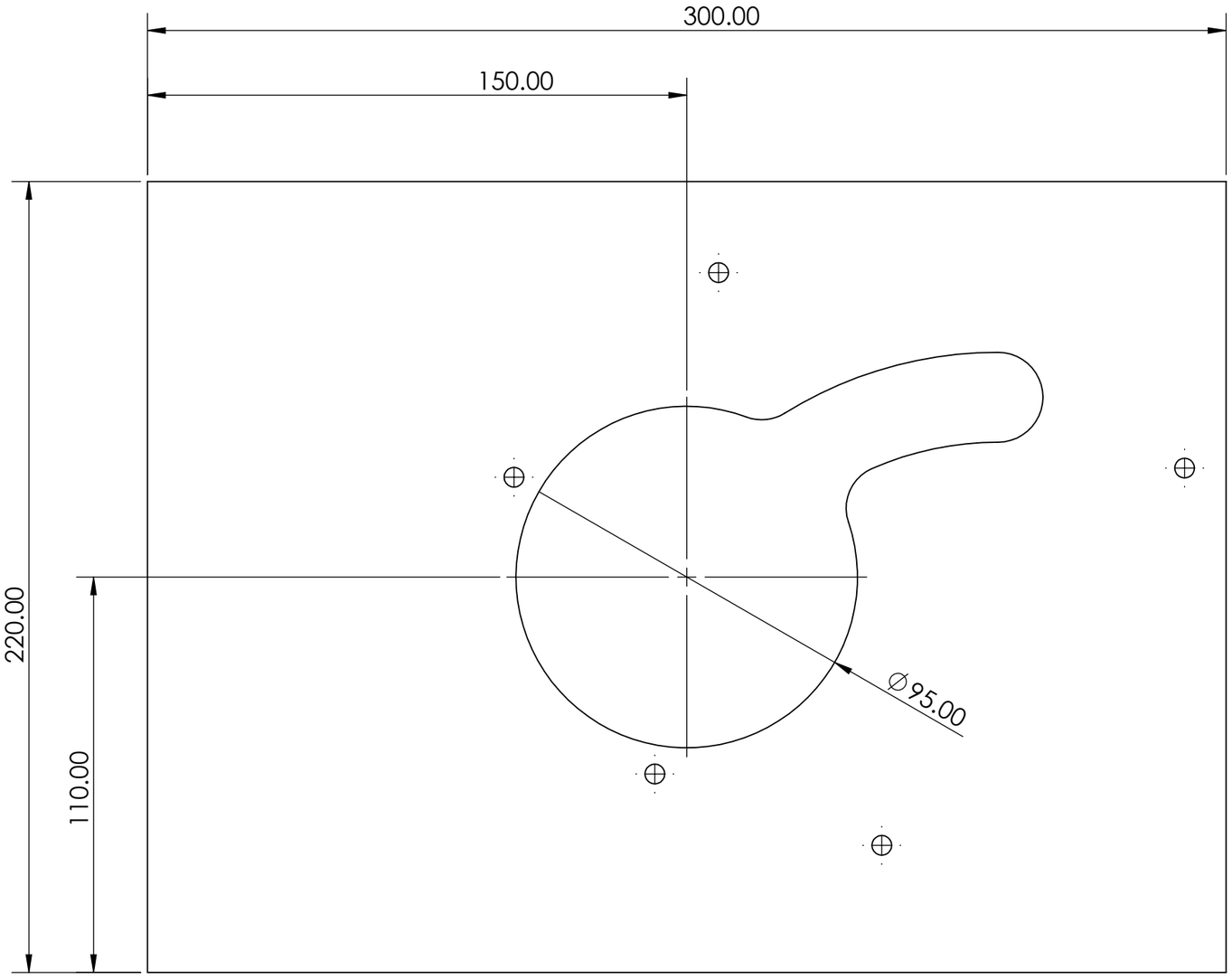


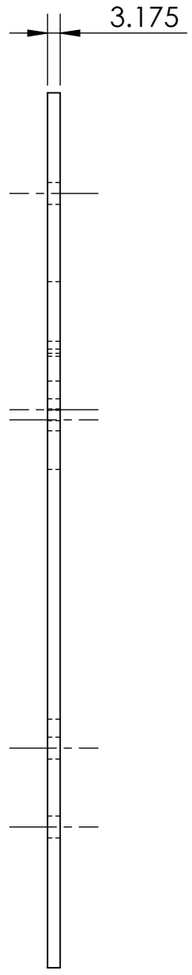


NEUtron DOSimetry & Exploration CubeSat Project McMaster University		
TITLE: Exterior housing case X side		
SIZE **B**	DWG. NO. H23-PRE-MECH-002-PF	REV B
SCALE 1:5	DO NOT SCALE DRAWING	SHEET 1 OF 1

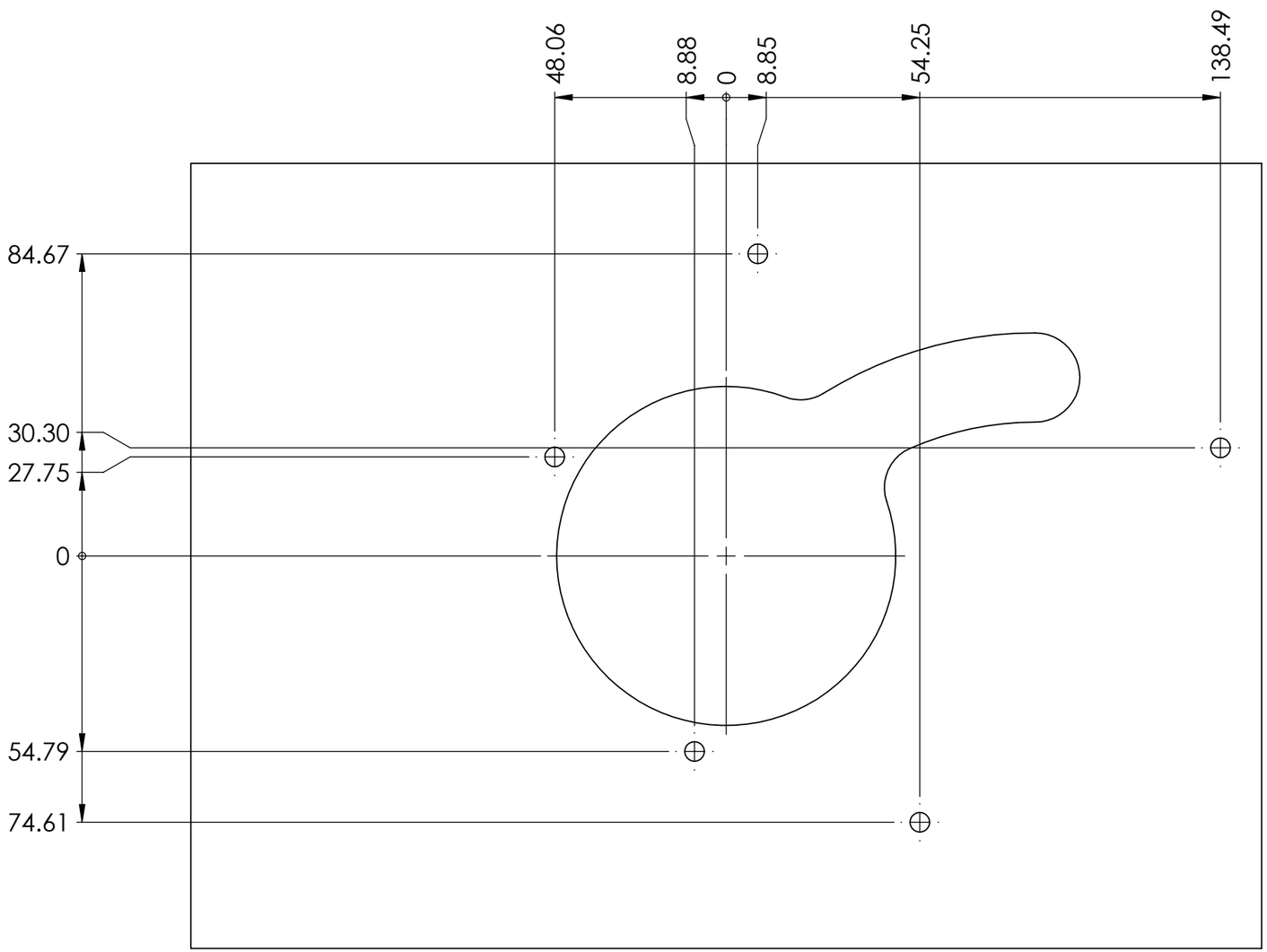


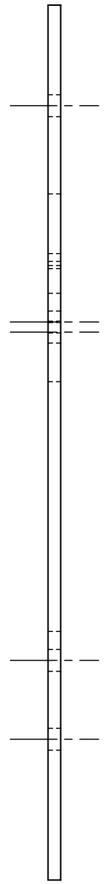
NEUtron DOSimetry & Exploration CubeSat Project McMaster University		
TITLE: Exterior housing case Y side		
SIZE **B**	DWG. NO. H23-PRE-MECH-003-PF	REV B
SCALE 1:5	DO NOT SCALE DRAWING	SHEET 1 OF 1



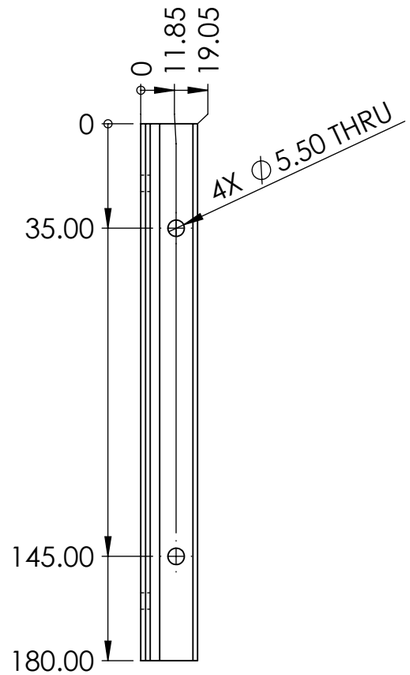


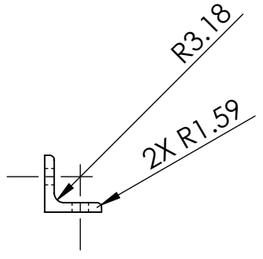
NEUtron DOSimetry & Exploration CubeSat Project McMaster University		
TITLE: Exterior housing case Z top		
SIZE B	DWG. NO. H23-PRE-MECH-004-PF	REV B
SCALE 1:2	DO NOT SCALE DRAWING	SHEET 1 OF 2



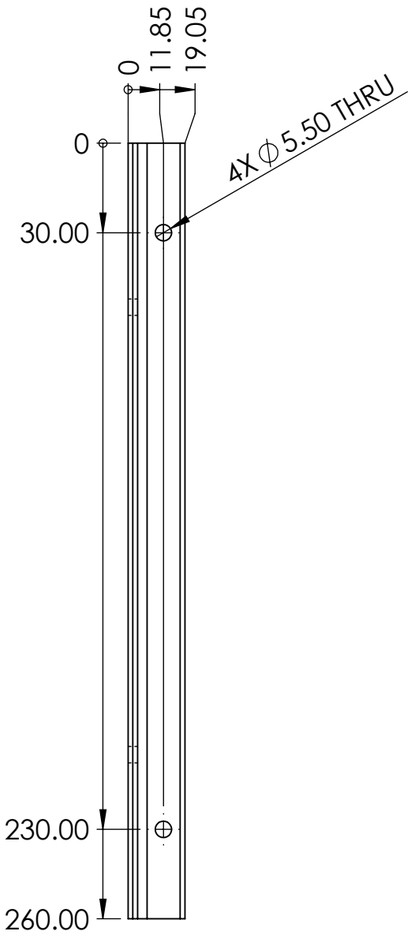


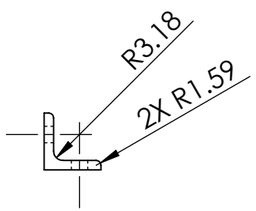
NEUtron DOSimetry & Exploration CubeSat Project McMaster University		
TITLE: Exterior housing case Z top		
SIZE **B**	DWG. NO. H23-PRE-MECH-004-PF	REV B
SCALE 1:2	DO NOT SCALE DRAWING	SHEET 2 OF 2

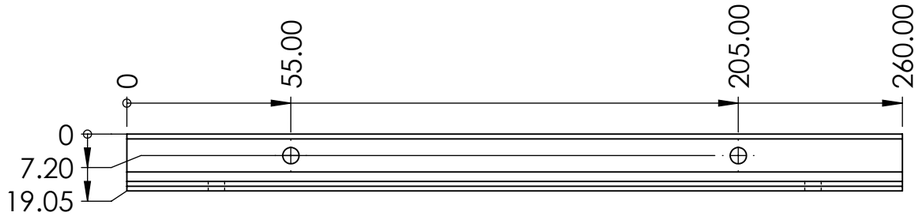




NEUtron DOSimetry & Exploration CubeSat Project McMaster University		
TITLE: X Angle		
SIZE **B**	DWG. NO. H23-PRE-MEC-005-PF	REV B
SCALE 1:2	DO NOT SCALE DRAWING	SHEET 1 OF 1

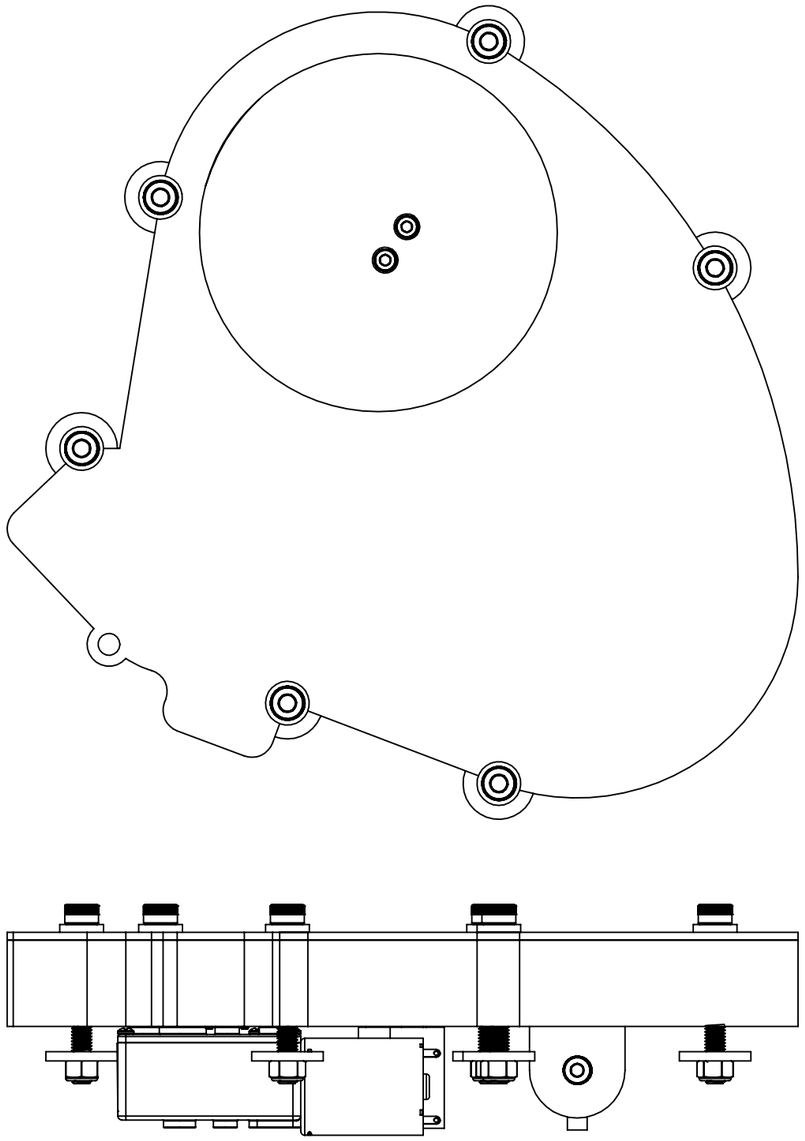


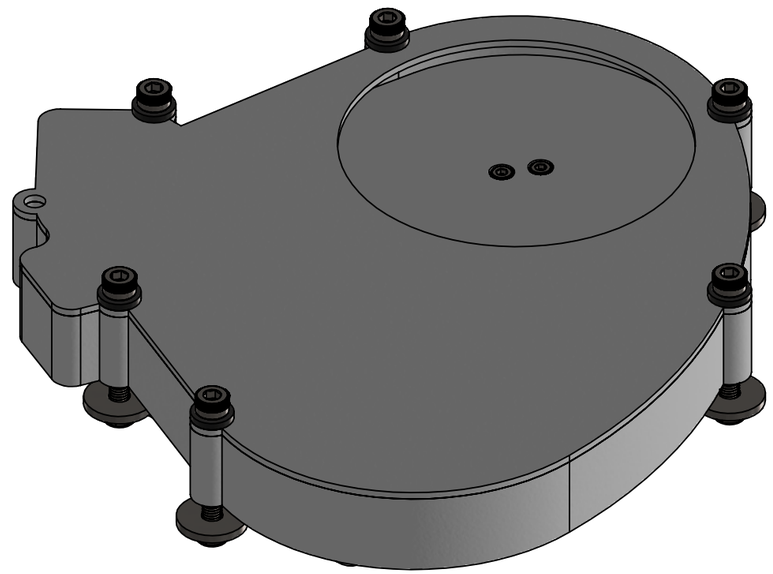




NEUtron DOSimetry & Exploration CubeSat Project McMaster University		
TITLE: Y Angle		
SIZE B	DWG. NO. H23-PRE-MEC-006-PF	REV B
SCALE 1:2	DO NOT SCALE DRAWING	SHEET 1 OF 1

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A	Initial PSIP release (legacy created in OnShape)	2023-04-11	
2-D4	B	PSIP2 release. Updated BOM	2023-05-31	





3 FINISH: N/A

2 MATERIAL: N/A

1. DIMENSIONAL LIMITS APPLY AFTER 3 .

NOTES:

METRIC

THIRD ANGLE PROJECTION

DRILL HOLE SIZE	TOLERANCE
0.35 THRU 3.20	+0.10 / -0.03
3.21 THRU 6.40	+0.13 / -0.03
6.41 THRU 12.70	+0.15 / -0.05
12.71 THRU 19.00	+0.20 / -0.05
19.01 THRU 25.40	+0.25 / -0.08

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES ARE:
X.X ±0.25 ANGLES: ± 0°- 30'
X.XX ±0.13 CHAMFERS: ±5°

MATERIAL 2

FINISH 3

DATE 2023-05-31

DRAWN P. CHIN

CHECKED

DESIGN P. CHIN

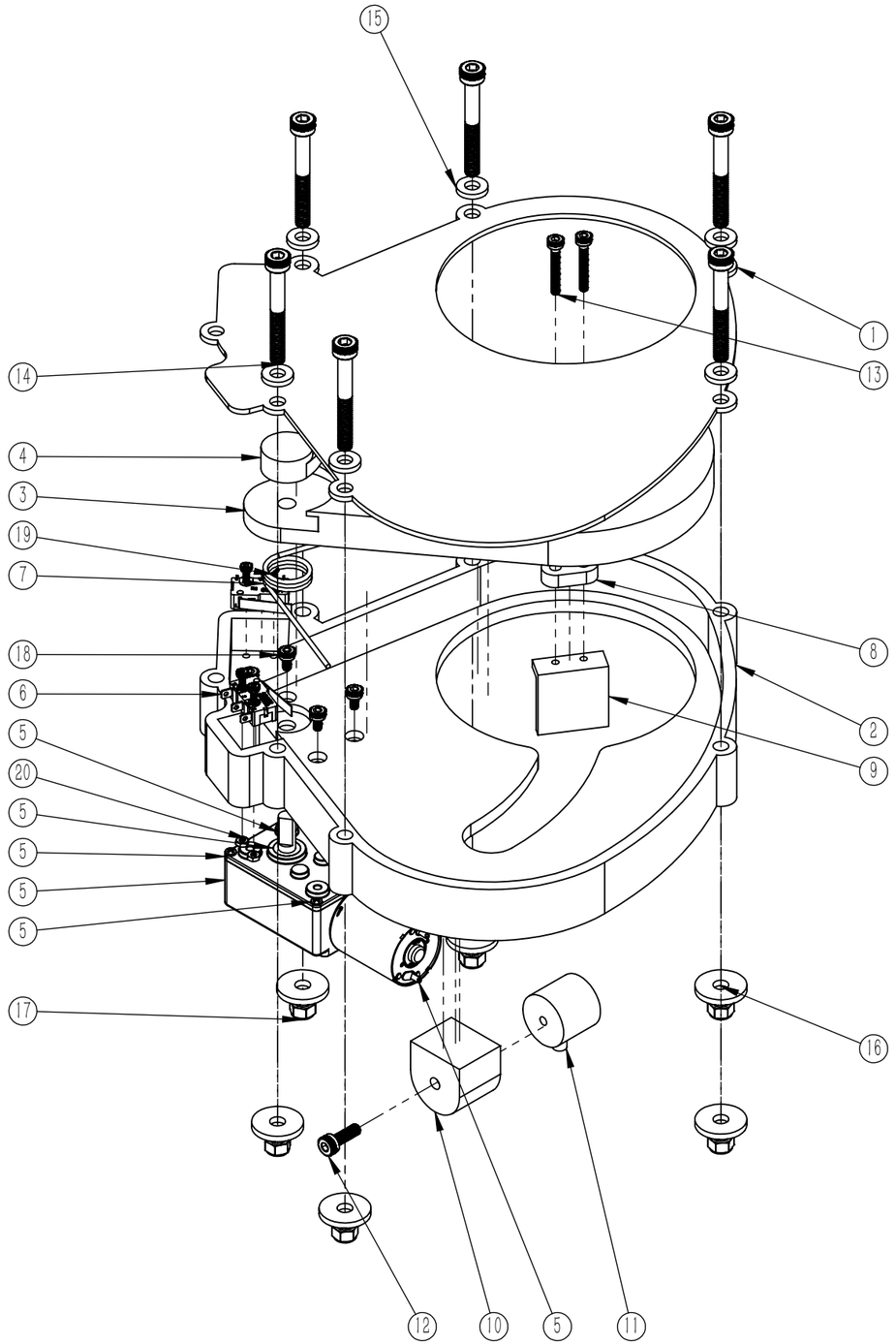
APPROVED

NEUtron DOSimetry & Exploration CubeSat Project
McMaster University

TITLE: Collimator shutter module subassembly

SIZE B | DWG. NO. H23-PRE-MEC-002-SA | REV B

SCALE 2:3 | DO NOT SCALE DRAWING | SHEET 1 OF 2



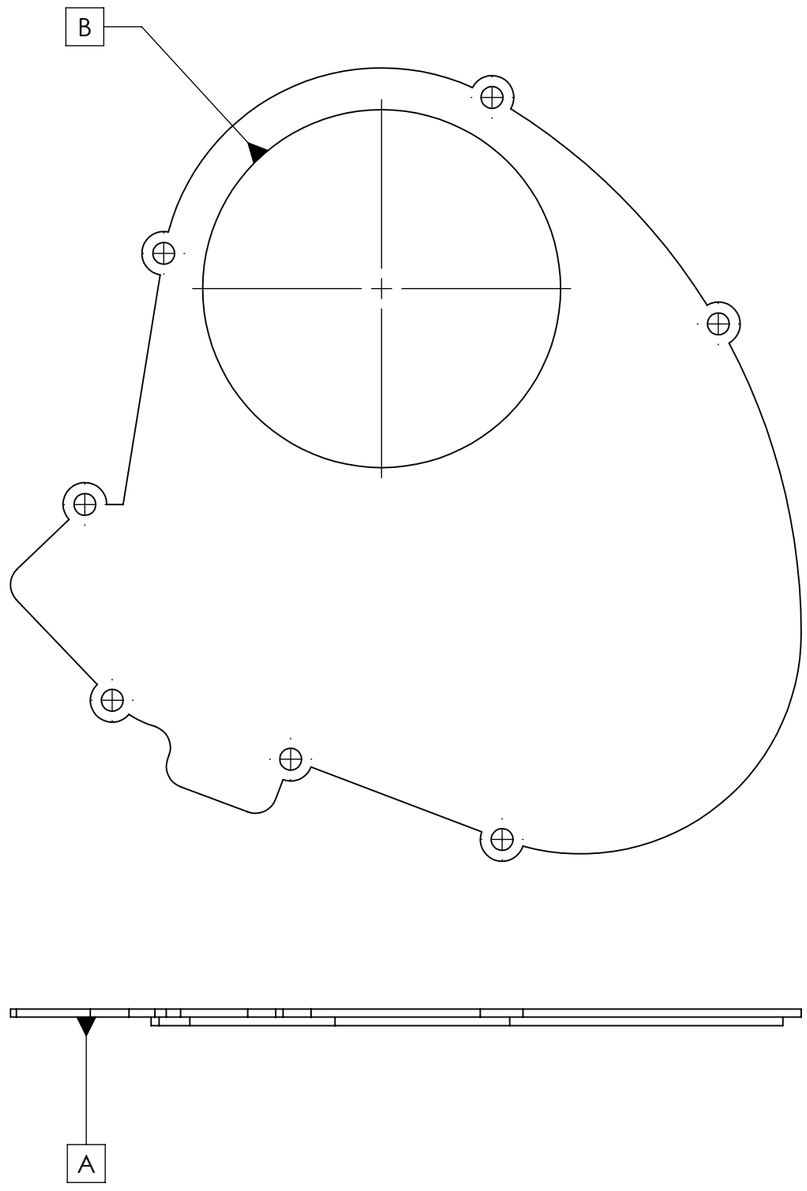
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	Weight	Material
1	H23-PRE-MEC-X01-PF	CSM - case top	1	44.91	ABS
2	H23-PRE-MEC-X02-PF	CSM - case bottom	1	152.94	ABS
3	H23-PRE-MEC-X03-PF	CSM - rotating lid	1	152.79	ABS
4	H23-PRE-MEC-X04-PF	CSM - Spring clutch arm	1	2.70	ABS
5	Amazon-gearmotor	12VDC electric motor with reduction gearbox	1	140	Design
6	zm10e10c01_SW_G	Honeywell - basic / snap action microswitch	2	2	design
7	9271K586	Torsion Spring (5.5 in-lbs)	1	4.032	Music-Wire Steel
8	H23-PRE-MEC-X05-PF	CSM - Spacer plate for magnetic armature	1	0.79	ABS
9	H23-PRE-MEC-X06-PF	CSM - Magnetic armature	1	19.17	Alloy Steel
10	H23-PRE-MEC-X07-PF	Housing for magnetic latch	1	4.28	ABS
11	M52180 - 12VDC Electromagnet	12VDC Electromagnetic latch	1	15	Design
12	90128A214	Zinc-Plated Alloy Steel Socket Head Screw	1	1.9598	Alloy Steel
13	90128A204	Zinc-Plated Alloy Steel Socket Head Screw	2	1.3589	Alloy Steel
14	90128A257	Zinc-Plated Alloy Steel Socket Head Screw	6	7.2450	Alloy Steel
15	98035A103	Black-Oxide Steel Oversized Washer	6	1.096	Steel
16	98363A111	Steel Oversized Washer	6	4.09	Steel
17	94645A102	High-Strength Steel Nylon-Insert Locknut	6	1.42	Steel
18	90128A187	Zinc-Plated Alloy Steel Socket Head Screw	4	0.6893	Alloy Steel
19	90128A182	Zinc-Plated Alloy Steel Socket Head Screw	4	0.3785	Alloy Steel
20	90591A265	Zinc-Plated Steel Hex Nut	4	0.00	Steel

NEUtron DOSimetry & Exploration CubeSat Project
McMaster University

TITLE: Collimator shutter module subassembly

SIZE	DWG. NO.	REV
B	H23-PRE-MEC-002-SA	B
SCALE 1:2	DO NOT SCALE DRAWING	SHEET 2 OF 2

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A	Initial PSIP release	2023-04-28	
	B	Final PSIP. Transfered from OnShape	2023-05-17	



3 FINISH: NONE

2 MATERIAL: ABS

1. DIMENSIONAL LIMITS APPLY AFTER 3 .

NOTES:

METRIC

THIRD ANGLE PROJECTION	
DRILL HOLE SIZE	TOLERANCE
0.35 THRU 3.20	+0.10 / -0.03
3.21 THRU 6.40	+0.13 / -0.03
6.41 THRU 12.70	+0.15 / -0.05
12.71 THRU 19.00	+0.20 / -0.05
19.01 THRU 25.40	+0.25 / -0.08

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES ARE:
X.X ±0.25 ANGLES: ± 0°- 30'
X.XX ±0.13 CHAMFERS: ±5°

MATERIAL 2

FINISH 3

DATE 2023-05-17
DRAWN P. CHIN
CHECKED
DESIGN P. CHIN
APPROVED

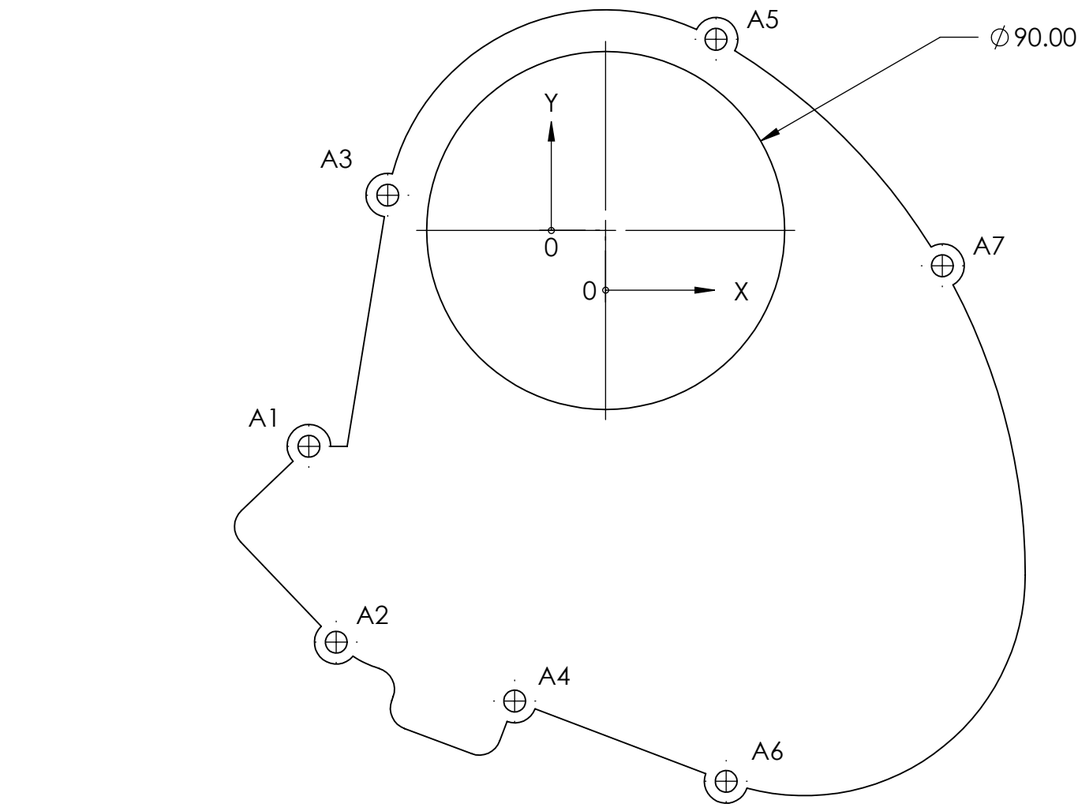
NEUtron DOSimetry & Exploration CubeSat Project
McMaster University

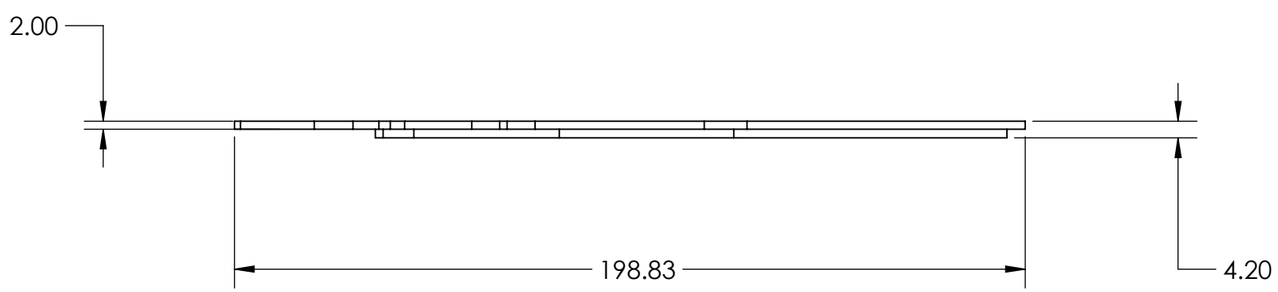
TITLE: CSM - case top

SIZE **B** | DWG. NO. H23-PRE-MEC-007-PF | REV B

SCALE 2:3 | DO NOT SCALE DRAWING | SHEET 1 OF 2

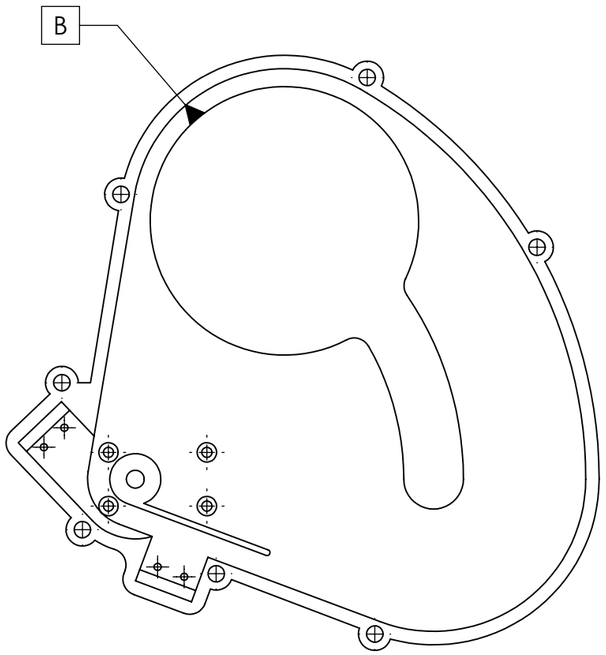
TAG	X LOC	Y LOC	SIZE
A1	-74.61	-54.25	∅ 5.50 THRU ALL
A2	-67.74	-103.50	∅ 5.50 THRU ALL
A3	-54.79	8.88	∅ 5.50 THRU ALL
A4	-22.88	-118.30	∅ 5.50 THRU ALL
A5	27.75	48.06	∅ 5.50 THRU ALL
A6	30.30	-138.49	∅ 5.50 THRU ALL
A7	84.67	-8.85	∅ 5.50 THRU ALL

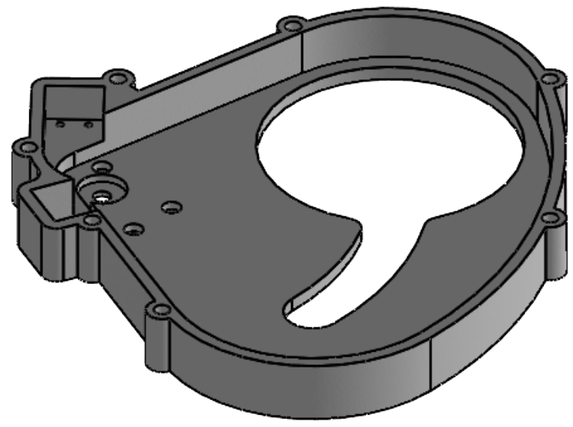




NEUtron DOSimetry & Exploration CubeSat Project McMaster University		
TITLE: CSM - case top		
SIZE **B**	DWG. NO. H23-PRE-MEC-007-PF	REV B
SCALE 2:3	DO NOT SCALE DRAWING	SHEET 2 OF 2

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A	Initial PSIP release	2023-04-28	
	B	Final PSIP. Transfered from OnShape	2023-05-17	





3 FINISH: NONE

2 MATERIAL: ABS

1. DIMENSIONAL LIMITS APPLY AFTER 3 .

NOTES:

METRIC

THIRD ANGLE PROJECTION	
DRILL HOLE SIZE	TOLERANCE
0.35 THRU 3.20	+0.10 / -0.03
3.21 THRU 6.40	+0.13 / -0.03
6.41 THRU 12.70	+0.15 / -0.05
12.71 THRU 19.00	+0.20 / -0.05
19.01 THRU 25.40	+0.25 / -0.08

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES ARE:
X.X ±0.25 ANGLES: ± 0°- 30'
X.XX ±0.13 CHAMFERS: ±5°

MATERIAL 2

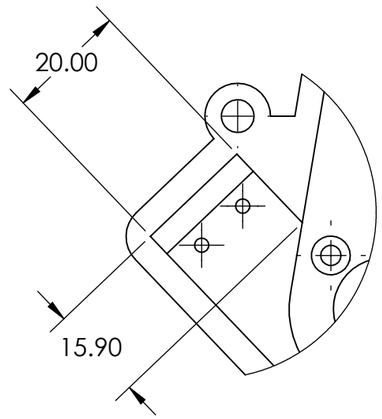
FINISH 3

DATE	2023-05-17
DRAWN	P. CHIN
CHECKED	
DESIGN	P. CHIN
APPROVED	

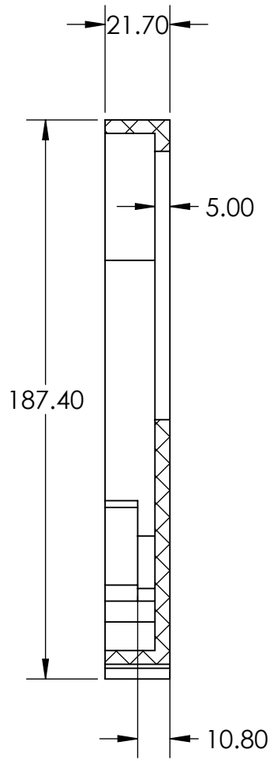
NEUtron DOSimetry & Exploration CubeSat Project
McMaster University

TITLE: CSM - case bottom

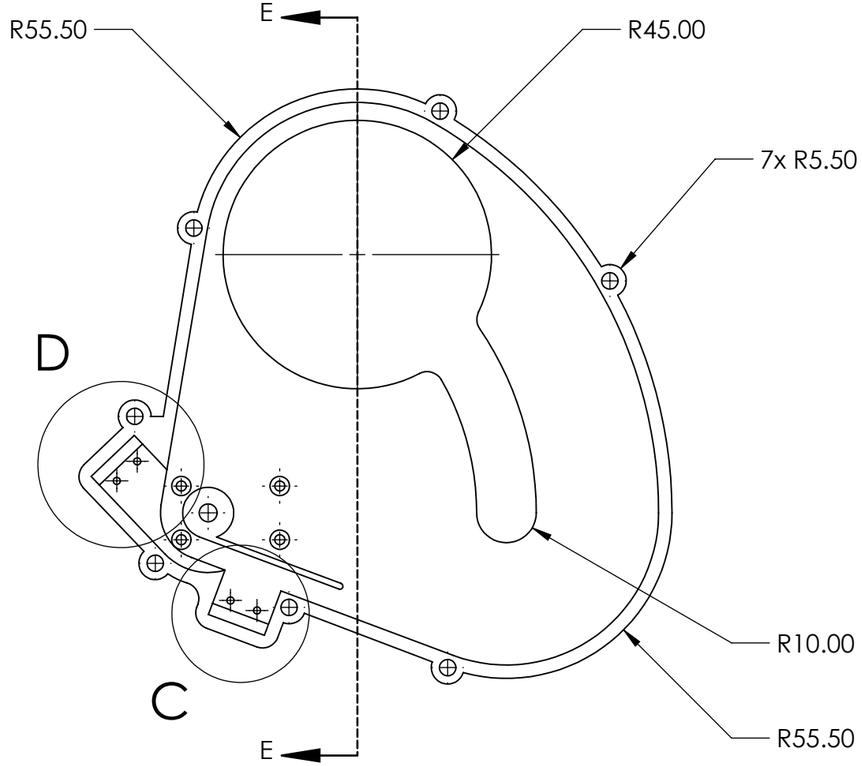
SIZE	DWG. NO.	REV
B	H23-PRE-MEC-008-PF	B
SCALE 1:2	DO NOT SCALE DRAWING	SHEET 1 OF 3

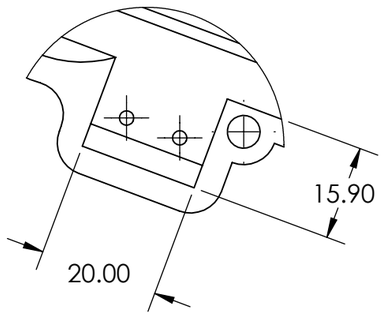


DETAIL D
SCALE 1 : 1

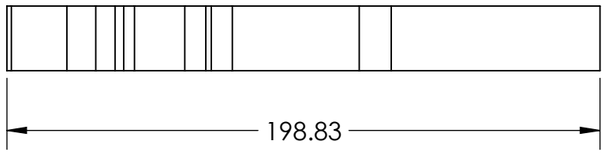


SECTION E-E

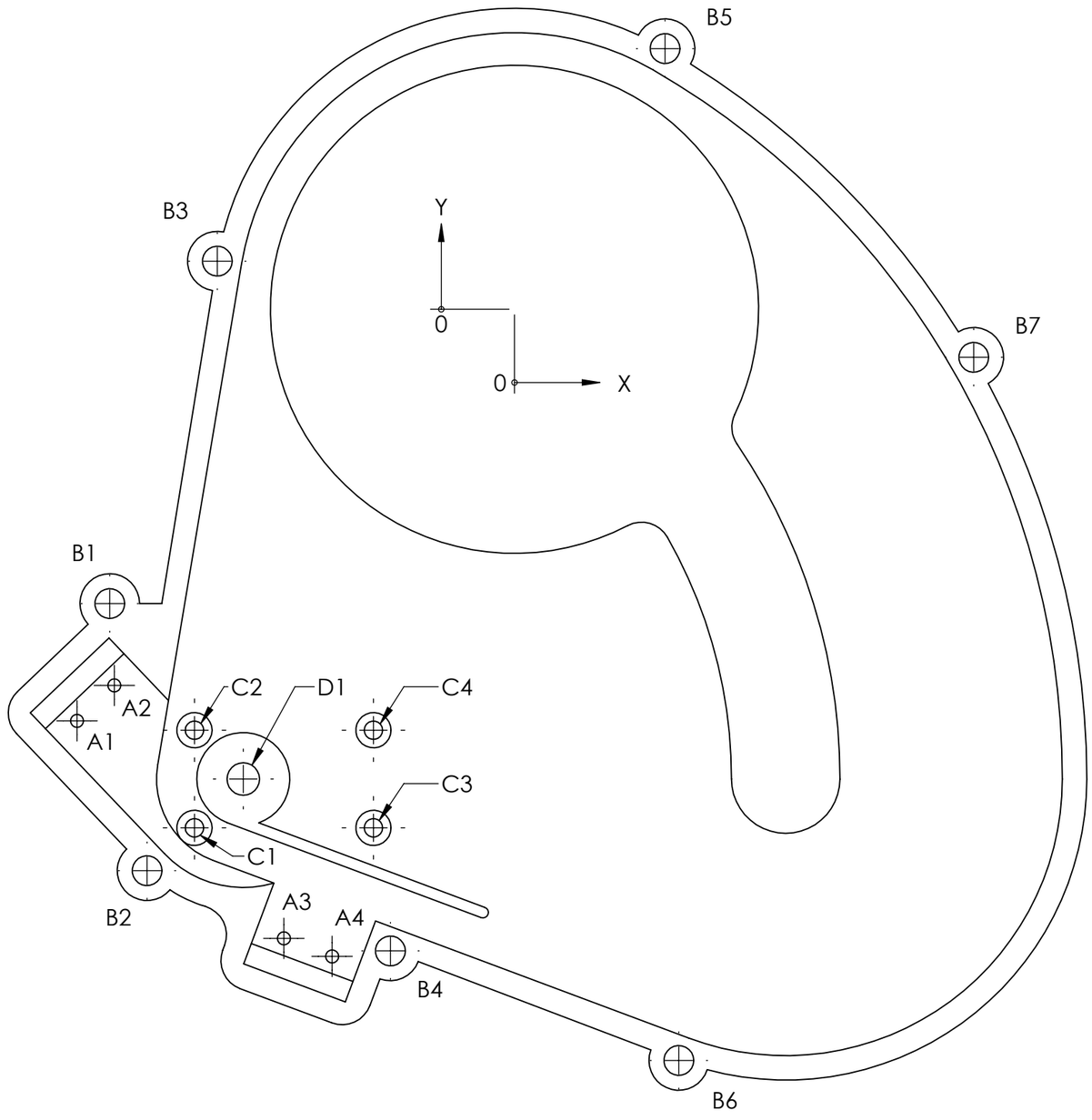




DETAIL C
SCALE 1 : 1



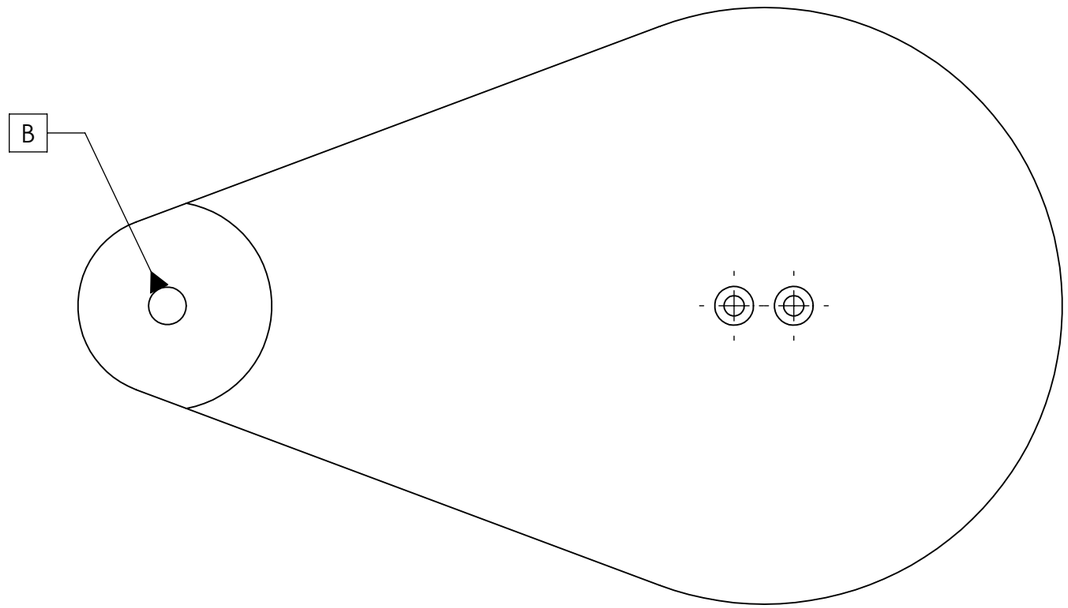
NEUtron DOSimetry & Exploration CubeSat Project McMaster University		
TITLE: CSM - case bottom		
SIZE B	DWG. NO. H23-PRE-MEC-008-PF	REV B
SCALE 1:2	DO NOT SCALE DRAWING	SHEET 2 OF 3

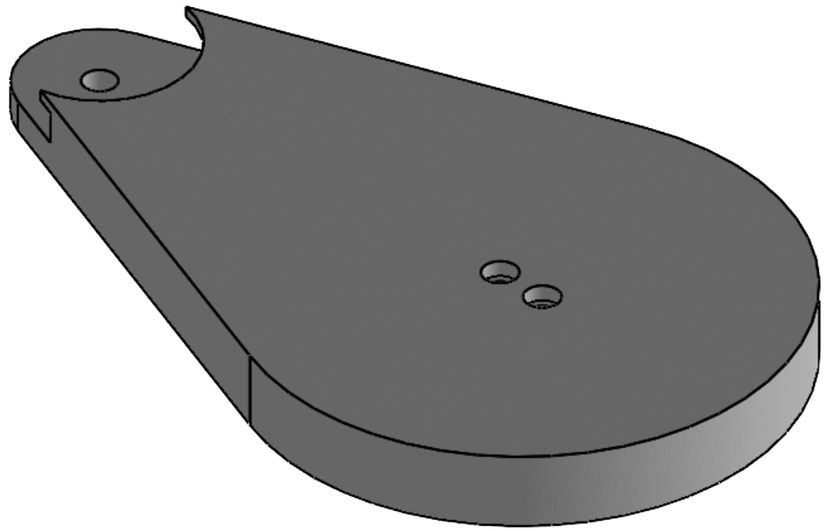


TAG	X LOC	Y LOC	SIZE
A1	-80.65	-75.89	∅ 2.40 THRU ALL
A2	-73.77	-69.34	∅ 2.40 THRU ALL
A3	-42.51	-115.98	∅ 2.40 THRU ALL
A4	-33.61	-119.31	∅ 2.40 THRU ALL
B1	-74.61	-54.25	∅ 5.50 THRU ALL
B2	-67.74	-103.50	∅ 5.50 THRU ALL
B3	-54.79	8.88	∅ 5.50 THRU ALL
B4	-22.88	-118.30	∅ 5.50 THRU ALL
B5	27.75	48.06	∅ 5.50 THRU ALL
B6	30.30	-138.49	∅ 5.50 THRU ALL
B7	84.67	-8.85	∅ 5.50 THRU ALL
C1	-59	-95.60	∅ 3.40 THRU ALL ⌴ ∅ 6.50 ↧ 3.00
C2	-59	-77.60	∅ 3.40 THRU ALL ⌴ ∅ 6.50 ↧ 3.00
C3	-26	-95.60	∅ 3.40 THRU ALL ⌴ ∅ 6.50 ↧ 3.00
C4	-26	-77.60	∅ 3.40 THRU ALL ⌴ ∅ 6.50 ↧ 3.00
D1	-50	-86.60	∅ 6.00 THRU ALL

NEUtron DOSimetry & Exploration CubeSat Project McMaster University		
TITLE: CSM - case bottom		
SIZE **B**	DWG. NO. H23-PRE-MEC-008-PF	REV B
SCALE 1:1	DO NOT SCALE DRAWING	SHEET 3 OF 3

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A	Initial PSIP release	2023-04-28	
	B	Final PSIP. Transfered from OnShape	2023-05-17	





3 FINISH: NONE

2 MATERIAL: ABS

1. DIMENSIONAL LIMITS APPLY AFTER 3 .

NOTES:

METRIC

THIRD ANGLE PROJECTION	
DRILL HOLE SIZE	TOLERANCE
0.35 THRU 3.20	+0.10 / -0.03
3.21 THRU 6.40	+0.13 / -0.03
6.41 THRU 12.70	+0.15 / -0.05
12.71 THRU 19.00	+0.20 / -0.05
19.01 THRU 25.40	+0.25 / -0.08

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES ARE:
X.X ±0.25 ANGLES: ± 0°- 30'
X.XX ±0.13 CHAMFERS: ±5°

MATERIAL 2

FINISH 3

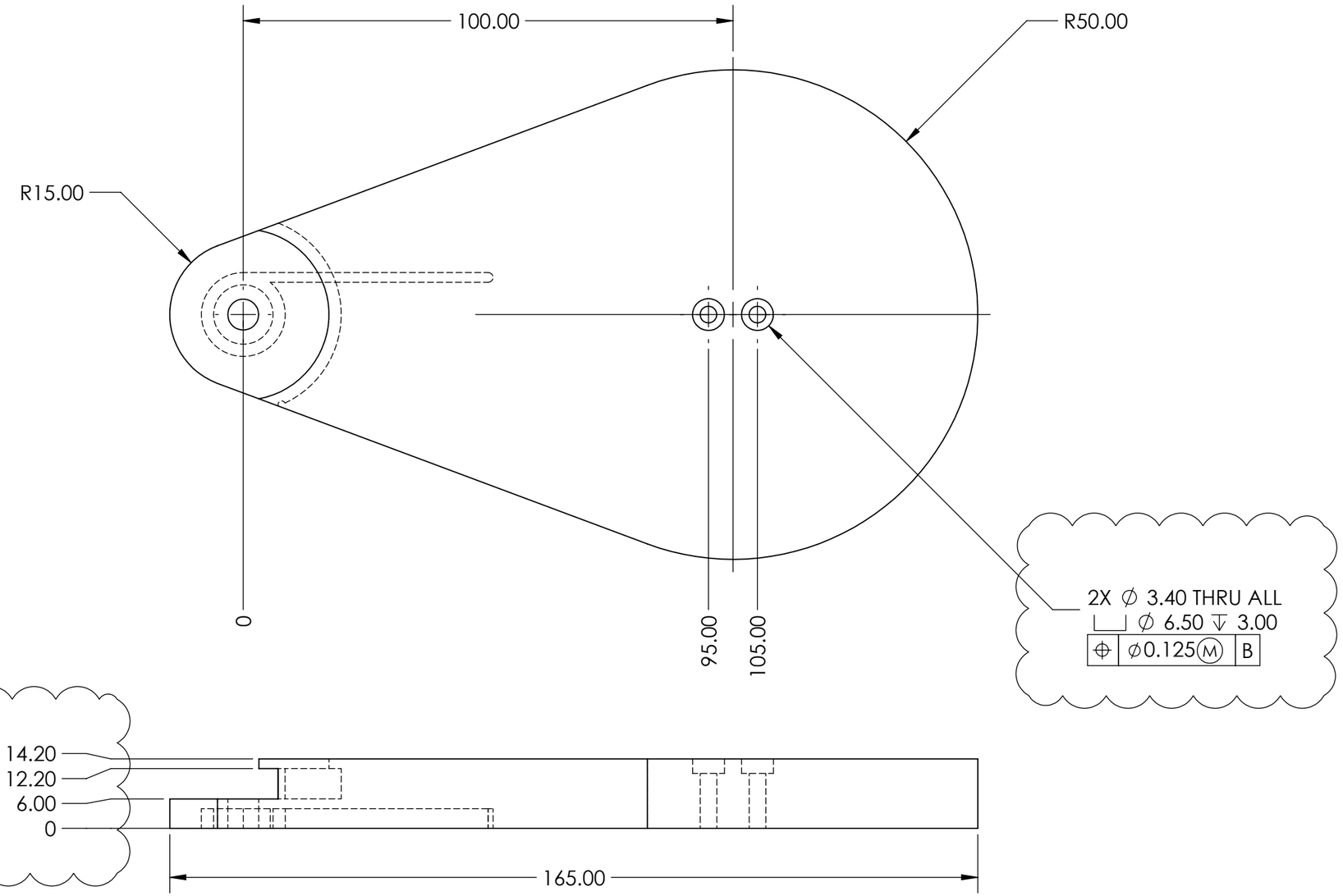
DATE 2023-05-17
DRAWN P. CHIN
CHECKED
DESIGN P. CHIN
APPROVED

NEUtron DOSimetry & Exploration CubeSat Project
McMaster University

TITLE: CSM - rotating lid

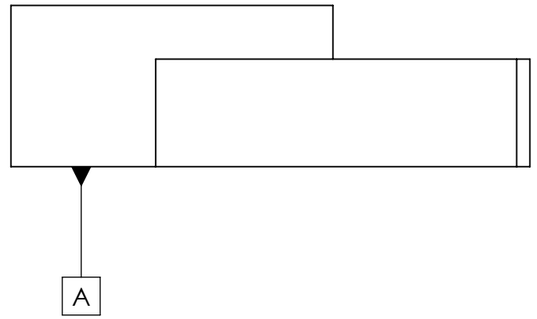
SIZE **B** | DWG. NO. H23-PRE-MEC-009-PF | REV B

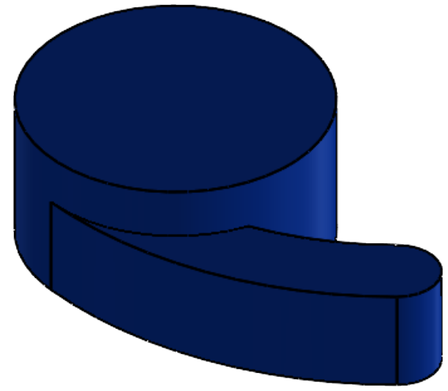
SCALE 1:1 | DO NOT SCALE DRAWING | SHEET 1 OF 2



NEUtron DOSimetry & Exploration CubeSat Project McMaster University		
TITLE: CSM - rotating lid		
SIZE **B**	DWG. NO. H23-PRE-MEC-009-PF	REV B
SCALE 1:1	DO NOT SCALE DRAWING	SHEET 2 OF 2

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A	Initial PSIP release	2023-04-11	
	B	Final PSIP. Transfered from OnShape	2023-05-17	





△3 FINISH: NONE

△2 MATERIAL: ABS

1. DIMENSIONAL LIMITS APPLY AFTER △3 .

NOTES:

METRIC

THIRD ANGLE PROJECTION	
DRILL HOLE SIZE	TOLERANCE
0.35 THRU 3.20	+0.10 / -0.03
3.21 THRU 6.40	+0.13 / -0.03
6.41 THRU 12.70	+0.15 / -0.05
12.71 THRU 19.00	+0.20 / -0.05
19.01 THRU 25.40	+0.25 / -0.08

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES ARE:
X.X ±0.25 ANGLES: ± 0°- 30'
X.XX ±0.13 CHAMFERS: ±5°

MATERIAL △2

FINISH △3

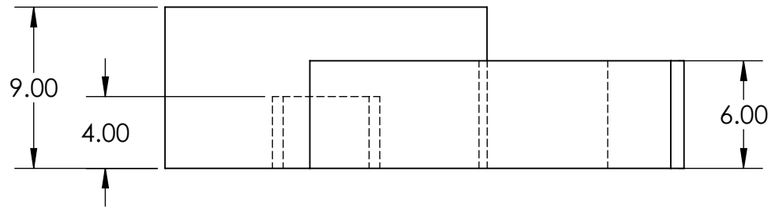
DATE 2023-05-17
DRAWN P. CHIN
CHECKED
DESIGN P. CHIN
APPROVED

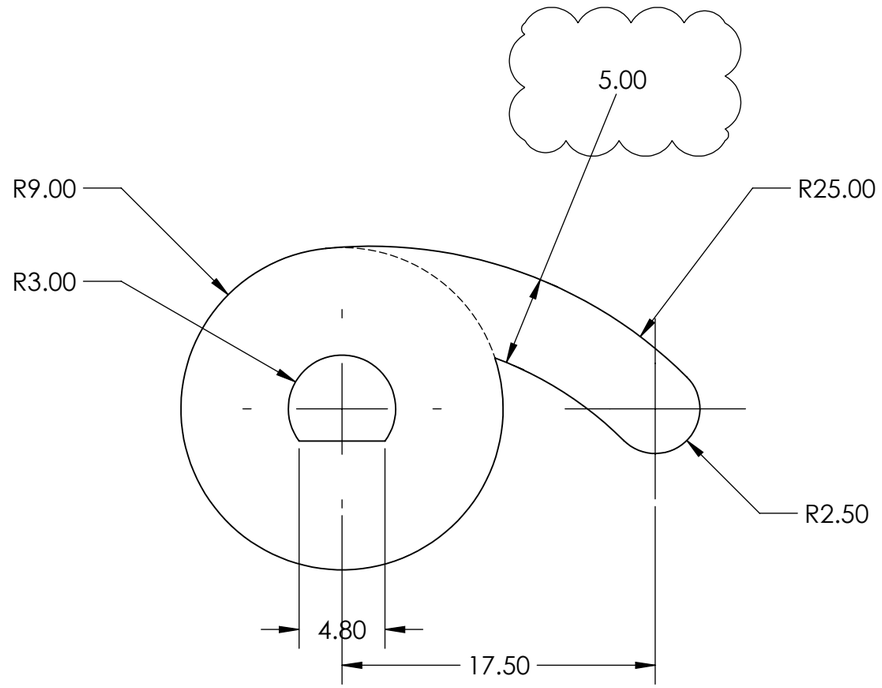
NEUtron DOSimetry & Exploration CubeSat Project
McMaster University

TITLE: CSM - Spring clutch arm

SIZE **B** | DWG. NO. H23-PRE-MEC-010-PF | REV B

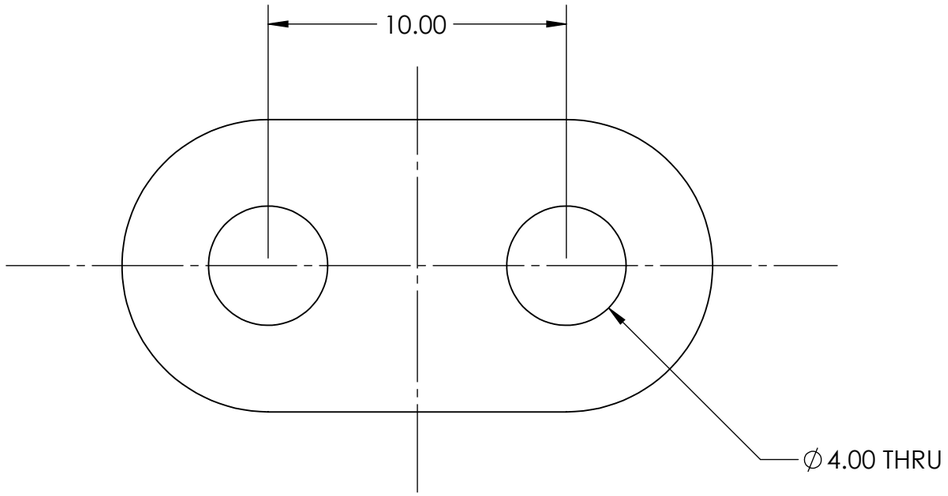
SCALE 3:1 | DO NOT SCALE DRAWING | SHEET 1 OF 2

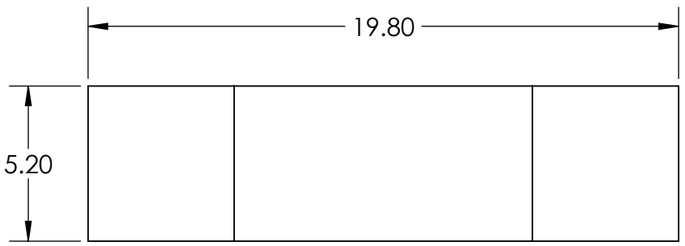


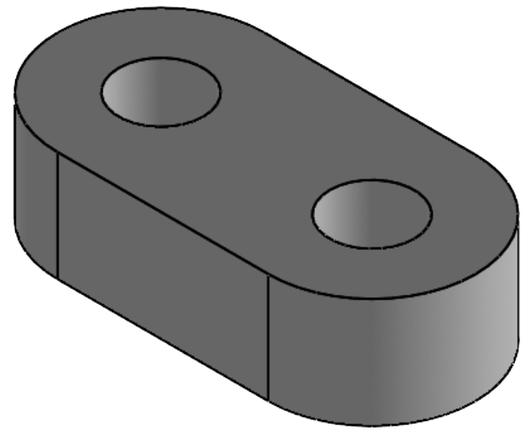


NEUtron DOSimetry & Exploration CubeSat Project McMaster University		
TITLE: CSM - Spring clutch arm		
SIZE B	DWG. NO. H23-PRE-MEC-010-PF	REV B
SCALE 3:1	DO NOT SCALE DRAWING	SHEET 2 OF 2

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED







3 FINISH: NONE

2 MATERIAL: ABS

1. DIMENSIONAL LIMITS APPLY AFTER 3 .

NOTES:

METRIC

THIRD ANGLE PROJECTION	
DRILL HOLE SIZE	TOLERANCE
0.35 THRU 3.20	+0.10 / -0.03
3.21 THRU 6.40	+0.13 / -0.03
6.41 THRU 12.70	+0.15 / -0.05
12.71 THRU 19.00	+0.20 / -0.05
19.01 THRU 25.40	+0.25 / -0.08

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES ARE:
X.X ±0.25 ANGLES: ± 0°- 30'
X.XX ±0.13 CHAMFERS: ±5°

MATERIAL 2

FINISH 3

DATE 2023-05-17

DRAWN P. CHIN

CHECKED

DESIGN P. CHIN

APPROVED

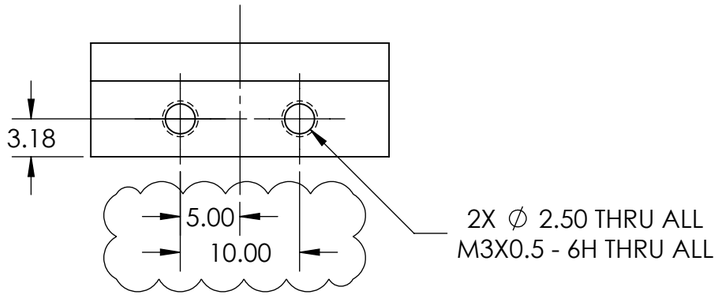
NEUtron DOSimetry & Exploration CubeSat Project
McMaster University

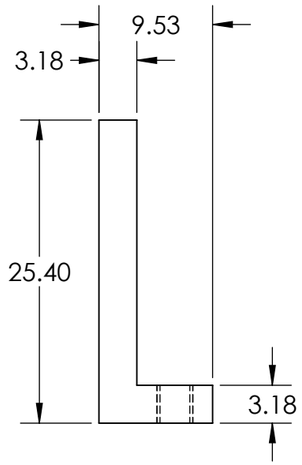
TITLE: CSM - Spacer plate for magnetic armature

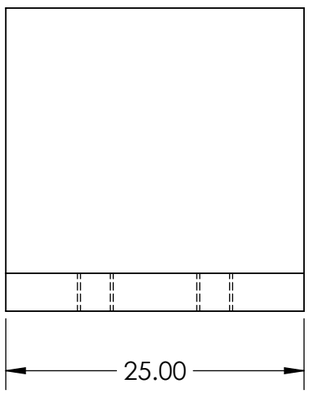
SIZE B | DWG. NO. H23-PRE-MEC-011-PF | REV -

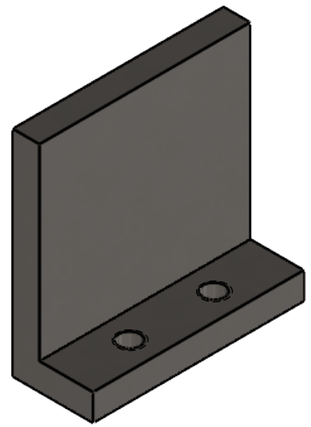
SCALE 5:1 | DO NOT SCALE DRAWING | SHEET 1 OF 1

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A	Initial PSIP release	2023-04-11	
	B	Final PSIP. Transfered from OnShape	2023-05-17	









3 FINISH: DEBURR

2 MATERIAL: ALLOY STEEL

1. DIMENSIONAL LIMITS APPLY AFTER 3 .

NOTES:

METRIC

THIRD ANGLE PROJECTION	
DRILL HOLE SIZE	TOLERANCE
0.35 THRU 3.20	+0.10 / -0.03
3.21 THRU 6.40	+0.13 / -0.03
6.41 THRU 12.70	+0.15 / -0.05
12.71 THRU 19.00	+0.20 / -0.05
19.01 THRU 25.40	+0.25 / -0.08

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES ARE:
X.X ±0.25 ANGLES: ± 0°- 30'
X.XX ±0.13 CHAMFERS: ±5°

MATERIAL 2

FINISH 3

DATE 2023-05-17

DRAWN P. CHIN

CHECKED

DESIGN P. CHIN

APPROVED

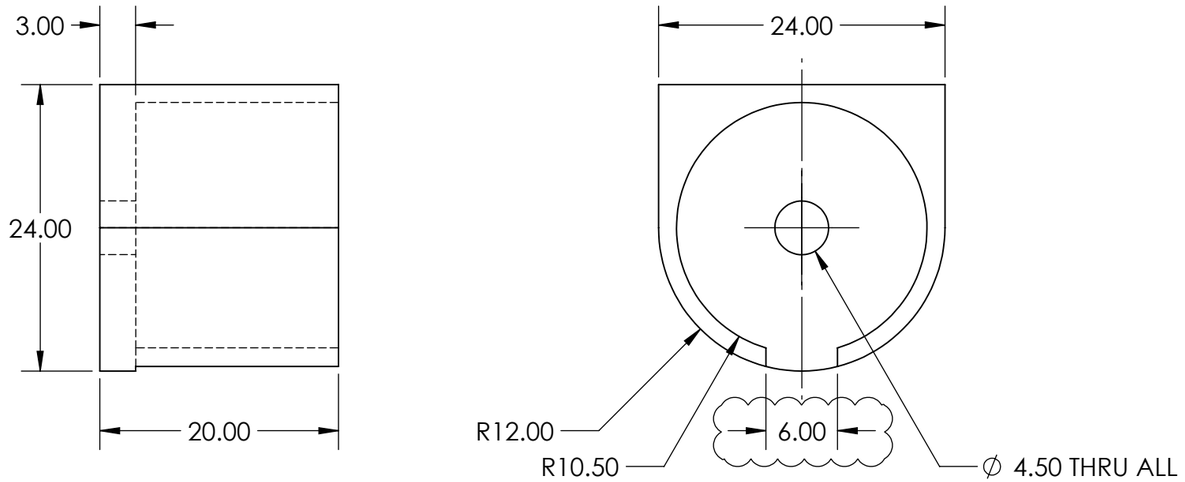
NEUtron DOSimetry & Exploration CubeSat Project
McMaster University

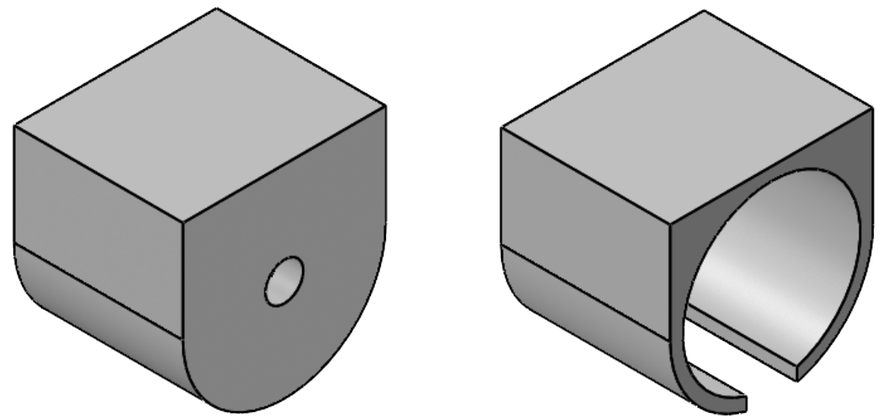
TITLE: CSM - Magnetic armature

SIZE **B** | DWG. NO. H23-PRE-MEC-012-PF | REV B

SCALE 2:1 | DO NOT SCALE DRAWING | SHEET 1 OF 1

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A	Initial PSIP release	2023-04-28	
	B	Final PSIP. Transfered from OnShape	2023-05-17	





3 FINISH: NONE

2 MATERIAL: ABS

1. DIMENSIONAL LIMITS APPLY AFTER 3 .

NOTES:

METRIC

THIRD ANGLE PROJECTION	
DRILL HOLE SIZE	TOLERANCE
0.35 THRU 3.20	+0.10 / -0.03
3.21 THRU 6.40	+0.13 / -0.03
6.41 THRU 12.70	+0.15 / -0.05
12.71 THRU 19.00	+0.20 / -0.05
19.01 THRU 25.40	+0.25 / -0.08

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES ARE:
X.X ±0.25 ANGLES: ± 0°- 30'
X.XX ±0.13 CHAMFERS: ±5°

MATERIAL 2

FINISH 3

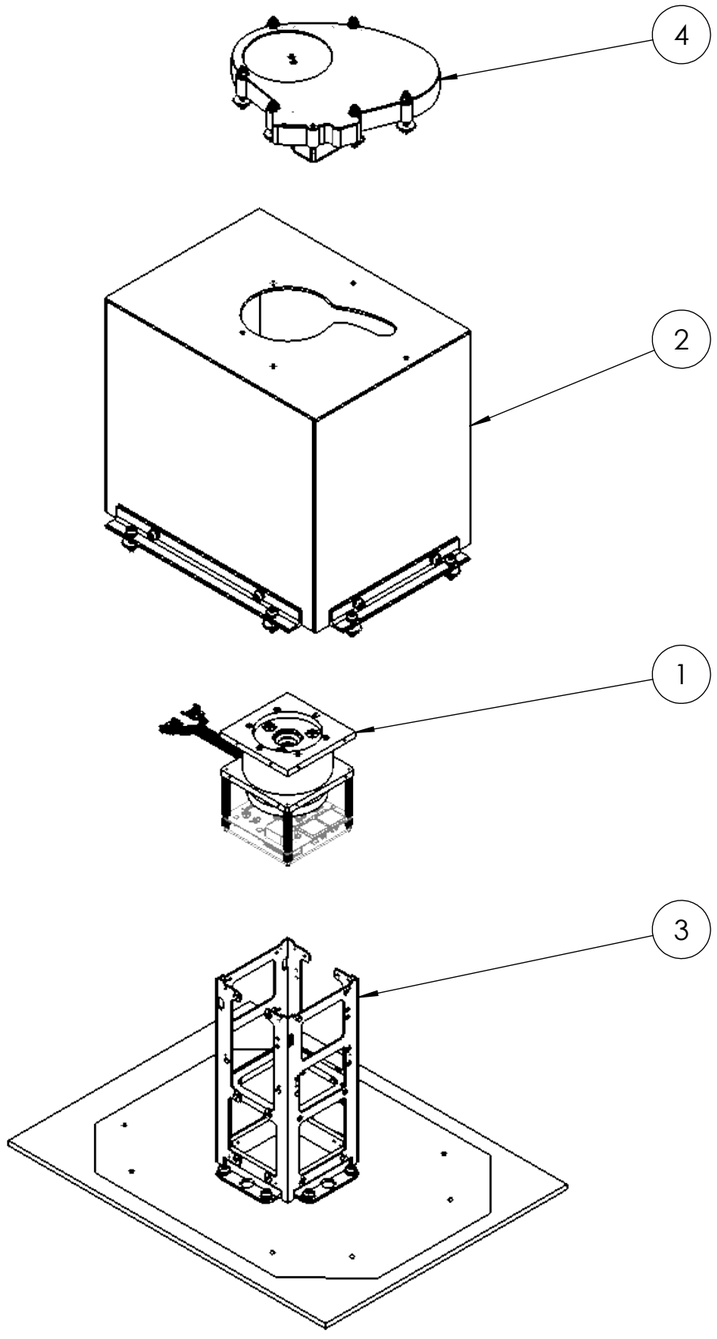
DATE 2023-05-17
DRAWN P. CHIN
CHECKED
DESIGN P. CHIN
APPROVED

NEUtron DOSimetry & Exploration CubeSat Project
McMaster University

TITLE: Housing for magnetic latch

SIZE **B** | DWG. NO. H23-PRE-MEC-013-PF | REV B

SCALE 2:1 | DO NOT SCALE DRAWING | SHEET 1 OF 1



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	H23-PRE-PLD-010-ASM	HASP 2023 MIST Payload	1
2	H23-PRE-MEC-003-SA	Case exterior for HASP 2023	1
3	H23-PRE-MEC-001-SA	HASP 2023 Structure	1
4	H23-PRE-MEC-002-SA	Collimator shutter module subassembly	1

METRIC

THIRD ANGLE PROJECTION

DRILL HOLE SIZE	TOLERANCE
0.35 THRU 3.20	+0.10 / -0.03
3.21 THRU 6.40	+0.13 / -0.03
6.41 THRU 12.70	+0.15 / -0.05
12.71 THRU 19.00	+0.20 / -0.05
19.01 THRU 25.40	+0.25 / -0.08

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES ARE:
X.X ±0.25 ANGLES: ± 0°- 30'
X.XX ±0.13 CHAMFERS: ±5°

MATERIAL 2

FINISH 3

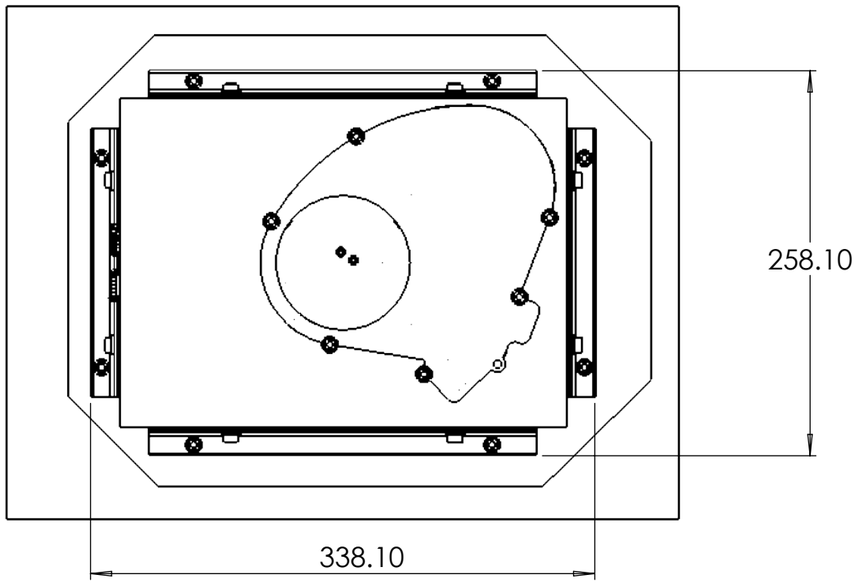
DATE 2023-06-28
DRAWN A. TOLLIS
CHECKED P. CHIN
DESIGN
APPROVED

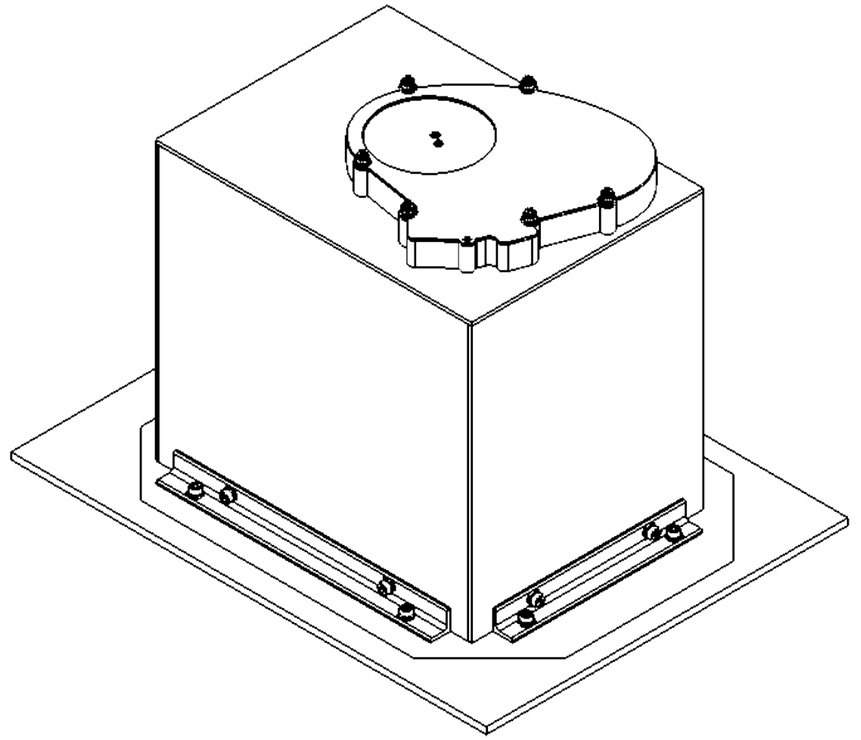
NEUtron DOSimetry & Exploration CubeSat Project
McMaster University

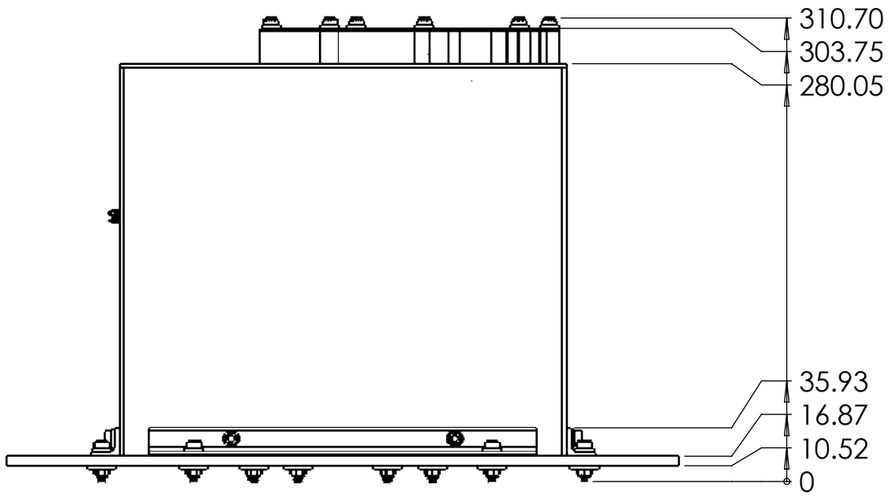
TITLE: Top level assembly HASP 2023

SIZE **B** | DWG. NO. H23-PRE-MEC-00100-AD | REV B

SCALE 1:6 | DO NOT SCALE DRAWING | SHEET 1 OF 2







NEUtron DOSimetry & Exploration CubeSat Project McMaster University		
TITLE: Top level assembly HASP 2023		
SIZE B	DWG. NO. H23-PRE-MEC-00100-AD	REV B
SCALE 1:10	DO NOT SCALE DRAWING	SHEET 2 OF 2

C. Other relevant mechanical information

N/A

II. Power Specifications:

A. Measured current draw at 30 VDC: 180mA

Item	Current (A)	Voltage (V)	Power (W)	Uncertainty
EST Instrument	2	5	2.0	0.5
Power Distribution Module	0.02	30	0.6[i]	0.1
Collimator Shutter Module	0.21	12	2.52[ii]	0.3
TOTAL			5.1	0.9

B. If HASP is providing power to your payload, provide a detailed power system wiring diagram starting from pins on the student payload interface plate EDAC 516 connector to all major components of your payload. All voltage lines must be labeled, and any power converters must be documented.

The grounding diagram and high voltage safety documentation can be found in Appendix B. Figure 1 shows the wiring diagram for our payload.

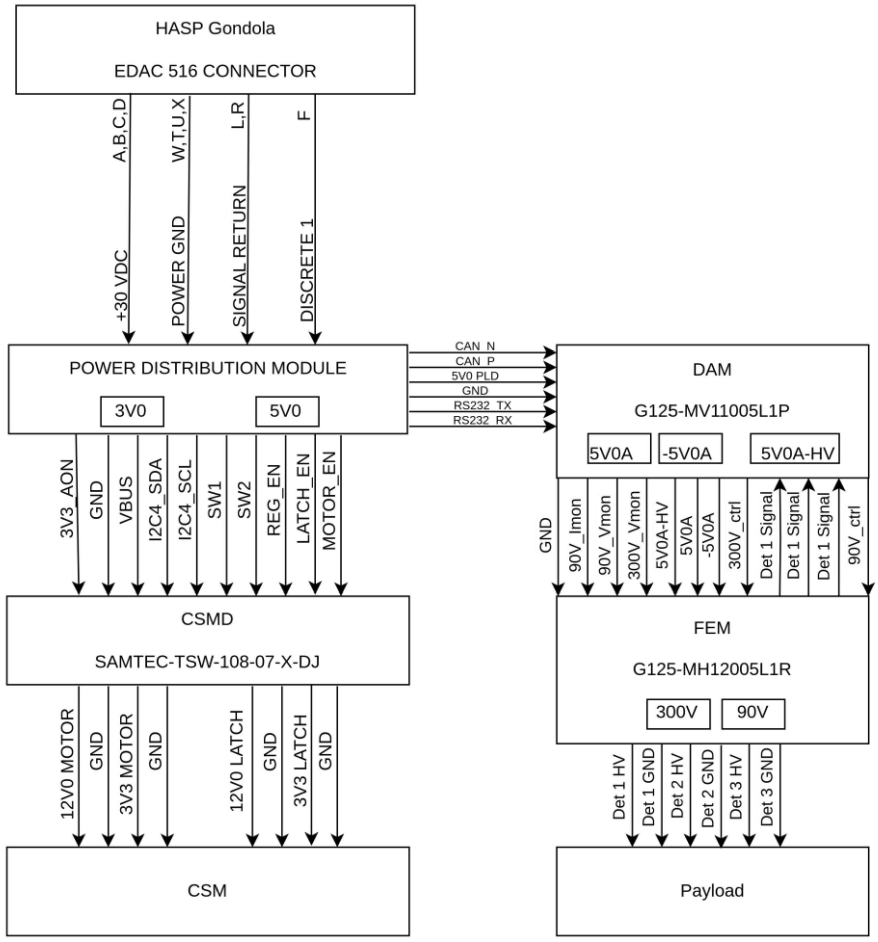


Figure 1: Wiring diagram of the EST payload

C. Other relevant power information

i. Power and current draw are based on a conversion efficiency of 10% plus overhead from a microcontroller (STM32)

ii. The collimator shutter module will operate at the listed values at all times except while opening the shutter. Opening the shutter takes under 5 seconds and draws a maximum of 24W (12V@2A). This increases the total power draw to 26.6W while opening the shutter.

The Collimator Module will draw 24W (12V@2A) for ~2 seconds when opening the shutter. We expect to only open the shutter once during flight.

III. Downlink Telemetry Specifications:

A. Serial data downlink format: Stream **Packetized** (circle one)

B. Approximate serial downlink rate (in bits per second): 1,550 kBit/s

C. Specify your serial data record including record length and information contained in each record byte. You must complete the table and include a sample data record.

Byte	Bits	Description
8	64	PAYLOAD!
1	8	Packet (Detector) ID
1	8	Number of Counts
4	32	Time (32 MSB)
4	32	Event #1 Time (LSB)
2	16	Event #1 Energy
⋮	⋮	
4	32	Event #N Time (LSB), N<=100
2	16	Event #N Energy, N<=100
1	8	XOR Parity Check
615 (Total)	4,920 (Total)	Single Detector Science Package, every 10 seconds

Byte	Bits	Description
8	64	PAYLOAD!
1	8	Packet (Housekeeping) ID
8	64	Time
2	16	DAM ADC #1 Channel #0
⋮	⋮	
2	16	DAM ADC #3 Channel #7
4	32	DAM Temperature
4	32	DAM Pressure
2	16	PDM ADC #1 Channel #0
⋮	⋮	
2	16	PDM ADC #1 Channel #3
4	32	PDM Temperature #1
⋮	⋮	
4	32	PDM Temperature #4
4	32	PDM Pressure
4	32	PDM Humidity
1	8	XOR

106 (Total)	848 (Total)	Payload Housekeeping Package, every 10 seconds

D. Number of analog channels being used:

0 (None)

E. If analog channels are being used, what are they being used for?

N/A

F. Number of discrete lines being used:

1 (One, Pin F)

G. If discrete lines are being used what are they being used for?

Control Signal for Shutter Control Module

H. Are there any on-board transmitters? If so, list the frequencies being used and the transmitted power.

No on-board transmitters

I. Other relevant downlink telemetry information.

No other relevant information

IV. Uplink Commanding Specifications:

A. Command uplink capability required: **Yes** No (circle one)

B. If so, will commands be uplinked in regular intervals: Yes **No** (circle one)

C. How many commands do you expect to uplink during the flight (can be an absolute number or a rate, i.e. *n commands per hour*):

We expect to uplink 6 commands in the first hour, and 4 commands per hour after the first hour. All commands are sent in pairs. These commands will turn on and off the high voltage power supply and allow instrument scientists to change data acquisition parameters if needed.

D. Provide a table of all uplink commands for your payload

Configuration Packet Structure

Packet Section	Field Name	Data Type	Length	Command Description
Command	Register ID / Byte-enable	Xuint8	1	Stores both the register ID and byte-enable bits for the value.

				Bits 0-5 (0x3F) Store the register ID as a number from 0-63. Bits 6-7 (0xC0) Store the byte-enable bits (00, 01, 10, 11) Corresponding to which of the four bytes within the 32 bit register the Register Value will be updating.
	Register Value	Xuint8	1	One of the four possible bytes within the 32 bit register to set.

Example Command Packet

Packet Section	Field Name	Value	Command Description
Command	Register ID / Byte-enable	0x60	Used to set the first byte of register number 32 (01)(100000) (byte-enable (register number to set)
	Register Value	0x9C	Sets the lower byte of register number 32 to 0x9C (decimal 156)

E. Are there any on-board receivers? If so, list the frequencies being used.

No on-board receivers

F. Other relevant uplink commanding information.

It should be noted that due to the nature of our command interface, there is no discrete number of commands that can be given to the payload. All registers can have their values changed, and these register values determine the functionality of the payload. A detailed list of all registers and their purpose is given in Table #.

V. Integration and Logistics

A. Date and Time of your arrival for integration:

We plan to arrive the weekend before integration (July 22-23)

B. Approximate amount of time required for integration:

Our integration is estimated to take 2 hours

C. Name of the integration team leader: Benjamin Dyer

D. Email address of the integration team leader: dyerbm@mcmaster.ca

E. List **ALL** integration participants (first and last names) who may be present for integration with their email addresses:

Name	E-Mail Address	Phone Number
Benjamin Dyer	dyerbm@mcmaster.ca	289-828-5508
Graham Power	Powerg@mcmaster.ca	226-338-8086
Angela Tollis	Tollia2@mcmaster.ca	905-464-3932
Patrick Chin	Chinpm@mcmaster.ca	905-818-4585
Connor Chandran	chandrac@mcmaster.ca	647-980-3335
Michael Altali	Maltali1999@gmail.com	289-689-5420
Jonathan Wang	Jonathanwang49@gmail.com	902-394-0912
Elijah Menna	Mennae@mcmaster.ca	905-317-7785
Kosta Gianicos	Gianick@mcmaster.ca	905-220-4901
Larysa Duda	Dudal@mcmaster.ca	416-278-7519
Kristen Di Loreto	Diloretk@mcmaster.ca	647-688-9905
Felix Yuan	Felix.yjf@gmail.com	905-467-5678
Austin Liu	Liu461@mcmaster.ca	416-459-7559

F. Define a successful integration of your payload:

Our payload will be transported to the CSBF in an enclosure to protect the silicon detectors. The payload plate and outer housing will be transported separately from the 2U

structure and will be assembled on arrival for integration. A successful integration will include:

- successful transport of the payload to CSBF with all mechanical and electrical connections still in place
- the instrument successfully powers on correctly
- the power, current and voltage measurements stay within acceptable limits when plugged into the power supply
- the high voltages on the FEM turn on in response to uplink command
- the CSM opens using discrete commands
- the data records show successful functioning of all equipment and the instrument
- successfully transmits data through the HASP serial lines
- housekeeping telemetry packets received are within acceptable limits
- data packets are received periodically
- the instrument mechanical structure survives TVAC
- the instrument successfully operates in the TVAC

G. List all expected integration steps:

i. Remove the 2U structure from Pelican case and conduct a visual inspection to verify all components are undamaged
ii. Assemble the 2U structure with the payload plate and protective housing
iii. Official weight in of the instrument
iv. Plug the instrument into the power supply and conduct the official power draw test
v. Transmit housekeeping data packets through HASP communication lines
vi. Verify the power cycling of the instrument by turning the high voltages on the FEM on and off
vii. Verify the CSM operation by opening the shutter through a HASP discrete line
viii. Attempt to resolve any issues if they arise

H. List all checks that will determine a successful integration:

Check 1: Physical examination of the instrument

Check 2: Secure mounting of the instrument

Check 3: Data records are received and are in range of acceptance criteria

Check 4: Successful power cycling of the entire payload

Check 5: Successful opening of the CSM

Check 6: Temperature control

Check 7: Concluding physical examination of the payload instrument after TVAC

I. List any additional LSU personnel support needed for a successful integration other than directly related to the HASP integration (i.e. lifting, moving equipment, hotel information/arrangements, any special delivery needs…):

N/A

J. List any LSU supplied equipment that may be needed for a successful integration:

N/A

VI. Hazards

A. Are you flying anything that is potentially hazardous, as listed in the Call for Proposal and the HASP Student Manual, to HASP or the ground crew before or after launch: **Yes** No (Circle one)

Appendix A: NASA Hazard Tables

If you intend to fly a listed hazard on HASP, you must **fully complete** the appropriate hazard form and include the form on **both** the Preliminary PSIP and the Final PSIP. This documentation is required for NASA safety to clear your payload for flight. Be specific and as detailed as possible with the information requested.

Appendix A.1 High Voltage Hazard Documentation

HASP 2022 High Voltage System Documentation	
Manufacture Model	0.5US5-P0.1
Part Number	633-0.5US5-P0.1-ND
Location of Voltage Source	EST detector housing
Fully Enclosed (Yes/No)	Yes
Is High Voltage source Potted?	Yes
Output Voltage	0-500 V
Power (W)	0.1 W
Peak Current (A)	0.2 mA
Run Current (A)	0.2 mA

HASP 2022 High Voltage System Documentation	
Manufacture Model	MAX1932
Part Number	MAX1932ETC+T
Location of Voltage Source	EST detector housing
Fully Enclosed (Yes/No)	Yes
Is High Voltage source Potted?	Yes
Output Voltage	4.5-90 V
Power (W)	0.1 W
Peak Current (A)	2.5 mA
Run Current (A)	1 mA

Appendix B: High Voltage Safety Documentation

Placement of The FEM

The Front-End Module (FEM) is located at the bottom of the Payload, attached by four metal standoffs. The entire Payload is then located within the Payload Housing, an aluminum frame with plastic covers. Figure 2 shows the exploded view of the FEM attached to the Payload as well as the placement of the power supplies on the FEM. The FEM is grounded to the HASP gondola through the Data Acquisition Module (DAM), and the metal standoffs provides a short through the Payload again to the HASP gondola should the harness to the FEM fail to ground it.

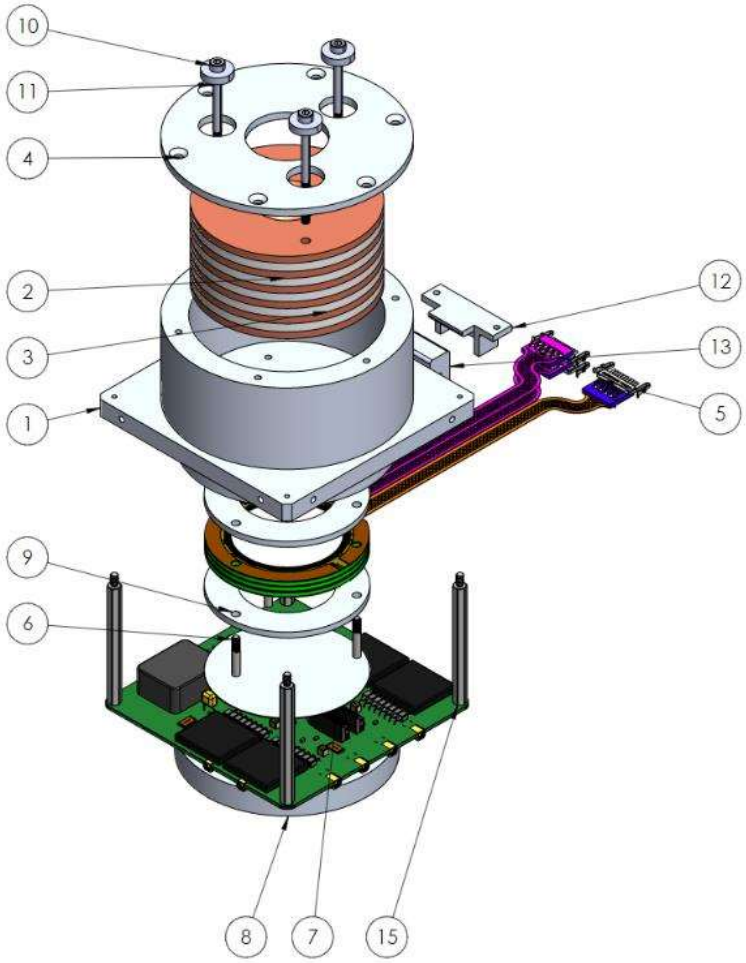


Figure 2: Exploded view of the EST instrument with FEM attached

Power Startup Sequence

When power is applied to the Payload subsystem, the Front-End Module (FEM) is not powered, preventing any risk of shock. First, the Power Distribution Module (PDM) is powered directly and completes several health checks using the onboard sensors. Namely, the voltage and current on the PDM regulators is monitored to ensure there are no shorts on the Payload. Should a short be detected, the PDM cuts power to the rest of the Payload to ensure no risk of shock or damage to any of the Payload. The FEM on/off state is controlled by the +5V analog power supply placed on the Data Acquisition Module (DAM). The analog power supply is controlled by the Spartan 6 onboard FPGA. When the FPGA receives a command via the HASP gondola to enable the +5V analog regulators, the regulators are then supplied power producing the +5V needed to run the FEM. There is no risk of shock upon powering the Payload due to the pull up configuration of the FEM.

Fail Case Scenarios

If failure is to occur, it could happen in the possible ways:

- The FEM becomes disconnected from the standoffs and shorts out with the aluminum housing
- Hardware failures cause a short on the FEM

The Payload has been grounded in such a way that if any of these fail case scenarios were to take place, the associated power would be properly grounded to the chassis of the Payload. The Payload is grounded using a star point grounding system, with a single grounding point in the PDM in case of a short circuit or hardware failure. As the Payload will not have access to a true ground, each of the chassis sections will have a resistor to prevent a current loop within the Payloads chassis. The grounding diagram, shown in Figure 3, shows this main path the current will take in each of the failure conditions.

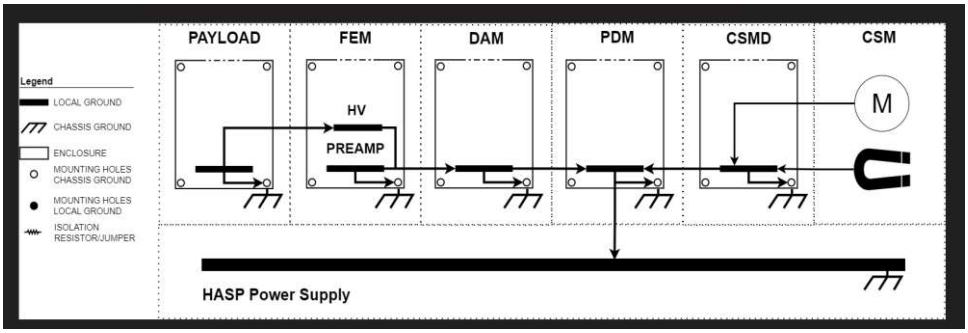


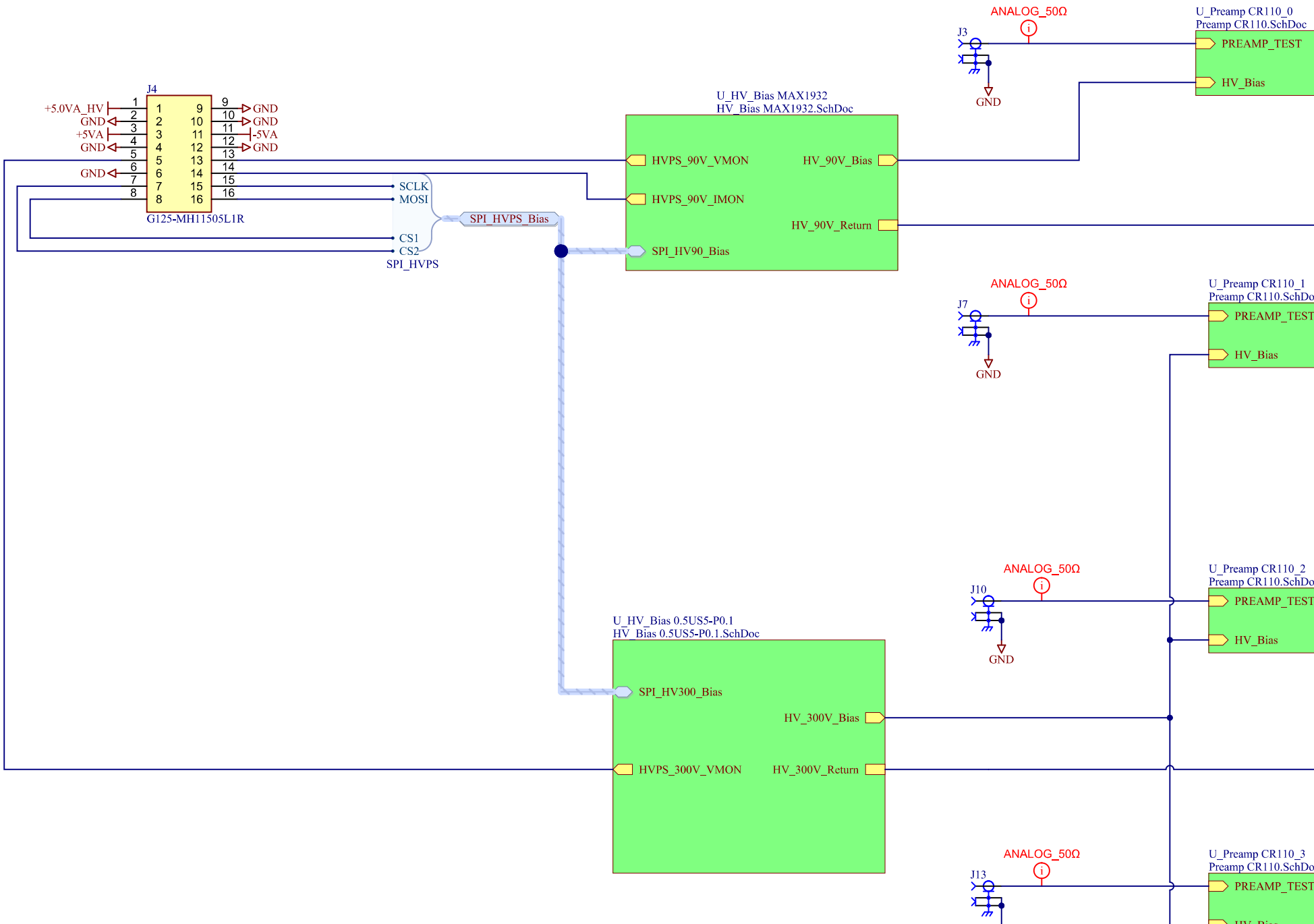
Figure 3: Grounding diagram

Below are the electrical schematics of the FEM

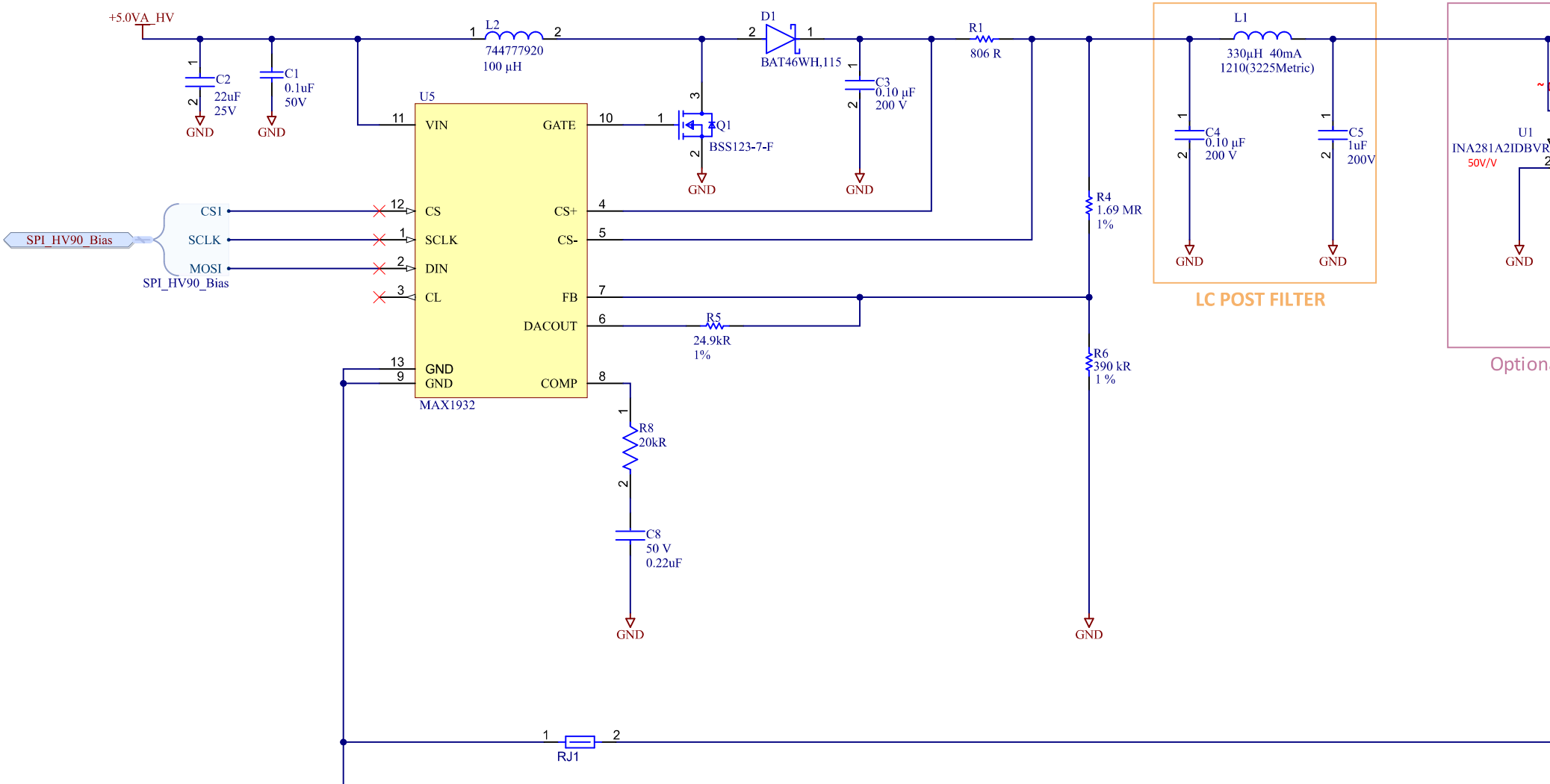
Appendix C: Mechanical Part and Mass Breakdown

For reference, a verification method of 'A' indicates an estimation based on the CAD and induces a 20% uncertainty. A verification method of 'T' indicated the part has been tested and has an uncertainty of 5%.

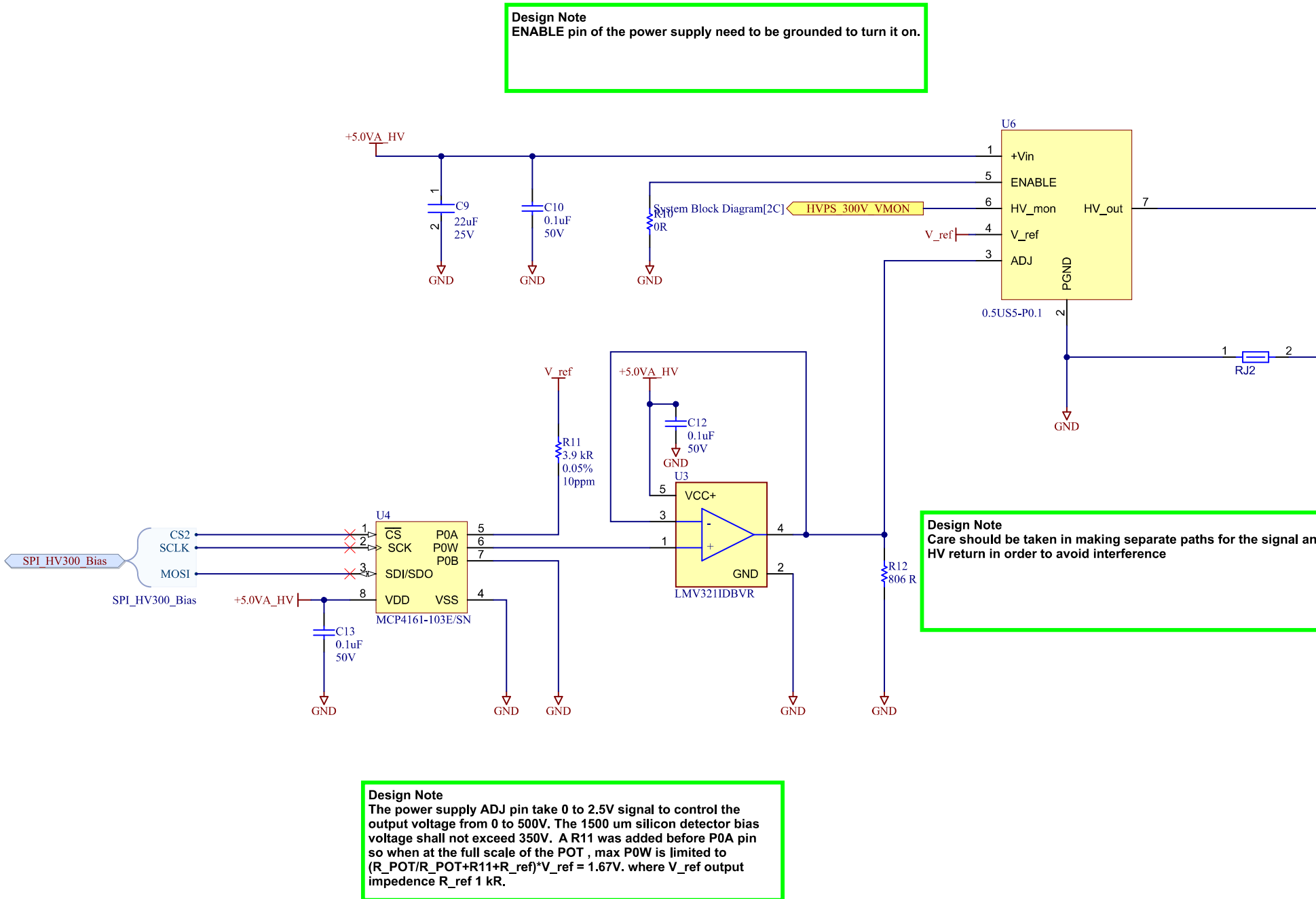
Front-End Module (FEM) - Rev A



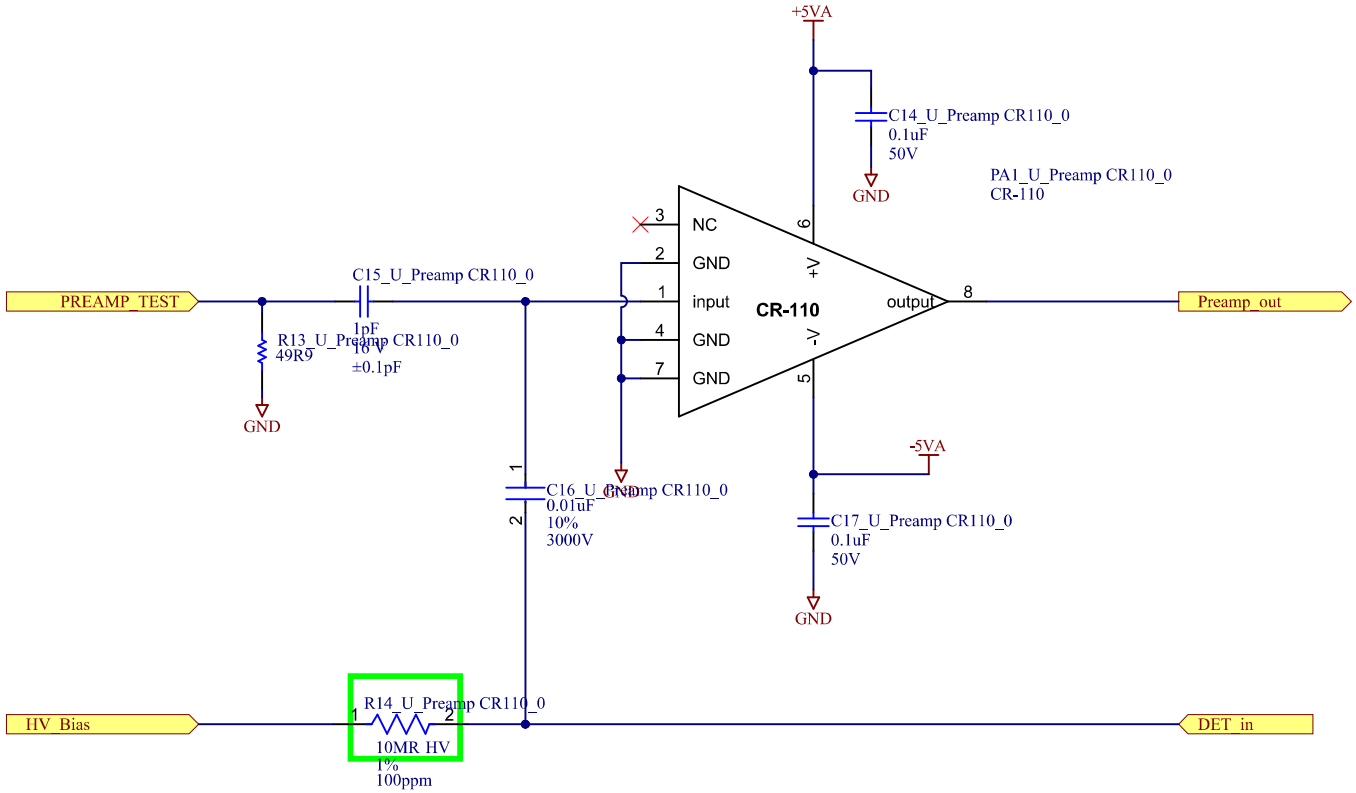
HV_90V_Bias MAX1932



HV_Bias 0.5US5-P0.1



Preamp CR110

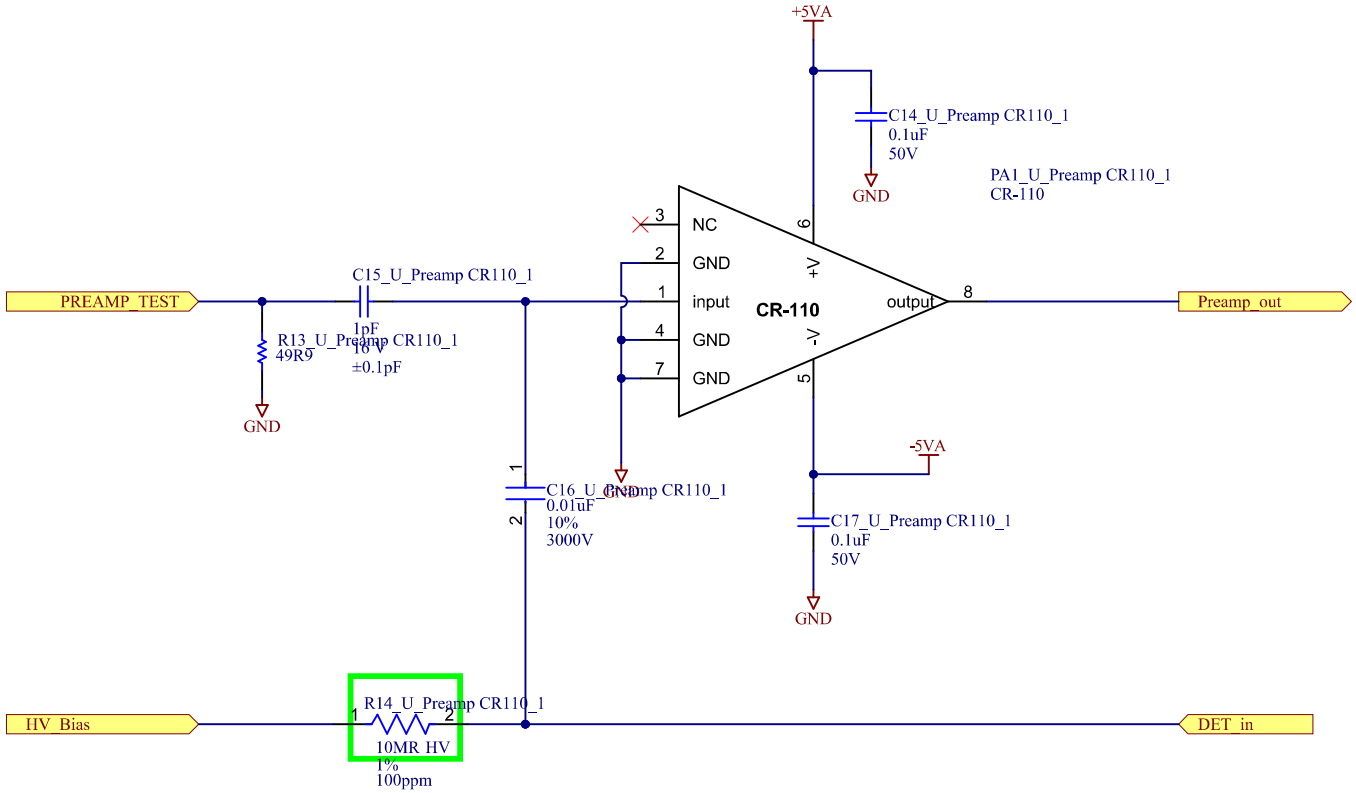


Design Note
For the AC-coupled circuits, there is a bias resistor (R14). If the voltage drop across the bias resistor is too small (less than about 100 mV), the electronic noise (thermal noise) of the bias resistor starts to become significant in the detection circuit. On the other hand, if the voltage drop across the bias resistor is too large, the voltage across the detector may be significantly less than the applied bias voltage
The resistor values are subject to change.

Variant: HASP2023

PRESET		McMaster University 1280 Main Street West Hamilton, ON, Canada	
ENGINEER X. Cheng	COMPONENT NUMBER CCP-PRE-PLD-002		REVISION A
DRAWN X. Cheng	COMPONENT NAME Front-End Module (FEM)		
CHECKED *	SCHEMATIC FILENAME Preamp CR110.SchDoc		
APPROVED *	SIZE Letter	DATE 4/24/2023	SHEET 4 OF 4

Preamp CR110

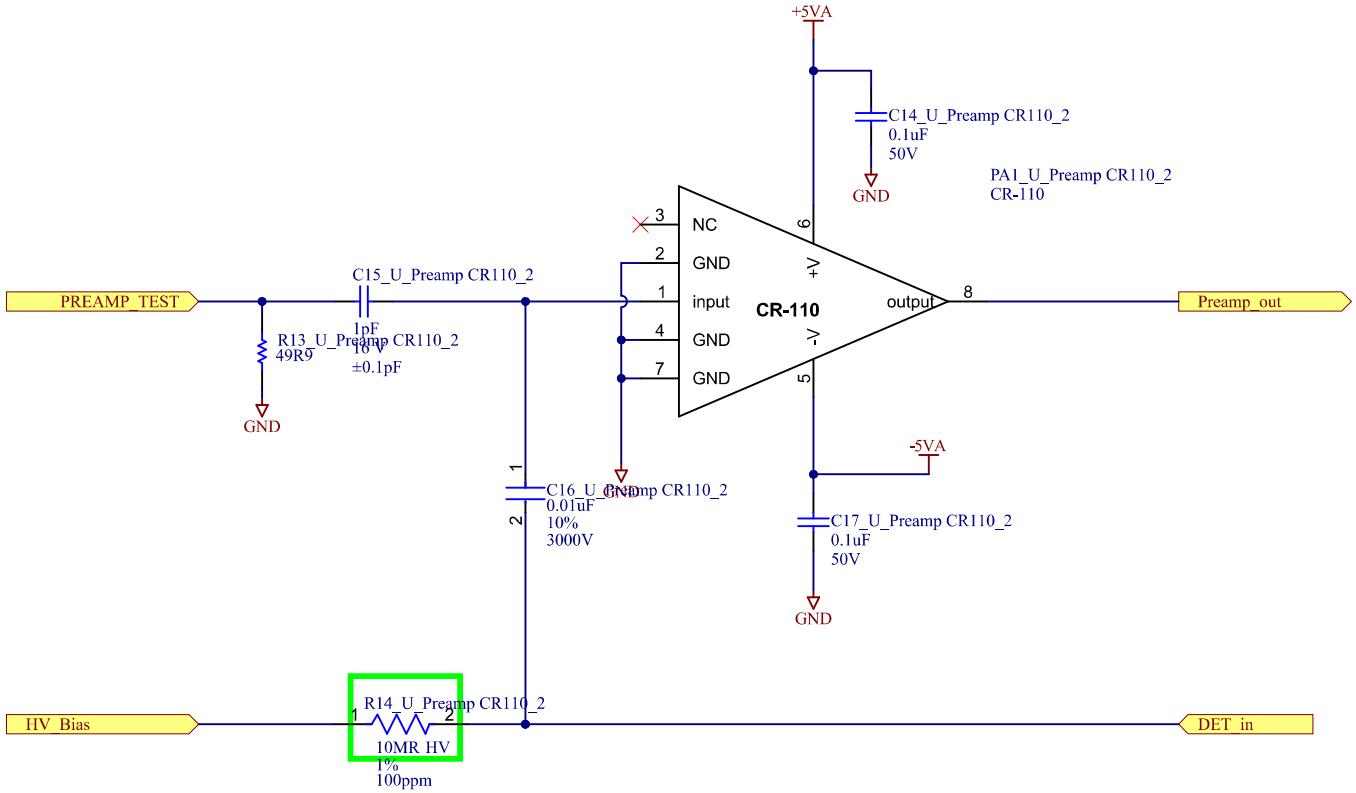


Design Note
For the AC-coupled circuits, there is a bias resistor (R14). If the voltage drop across the bias resistor is too small (less than about 100 mV), the electronic noise (thermal noise) of the bias resistor starts to become significant in the detection circuit. On the other hand, if the voltage drop across the bias resistor is too large, the voltage across the detector may be significantly less than the applied bias voltage
The resistor values are subject to change.

Variant: HASP2023

PRESET		McMaster University 1280 Main Street West Hamilton, ON, Canada	
ENGINEER X. Cheng	COMPONENT NUMBER CCP-PRE-PLD-002		REVISION A
DRAWN X. Cheng	COMPONENT NAME Front-End Module (FEM)		
CHECKED *	SCHEMATIC FILENAME Preamp CR110.SchDoc		
APPROVED *	SIZE Letter	DATE 4/24/2023	SHEET 4 OF 4

Preamp CR110

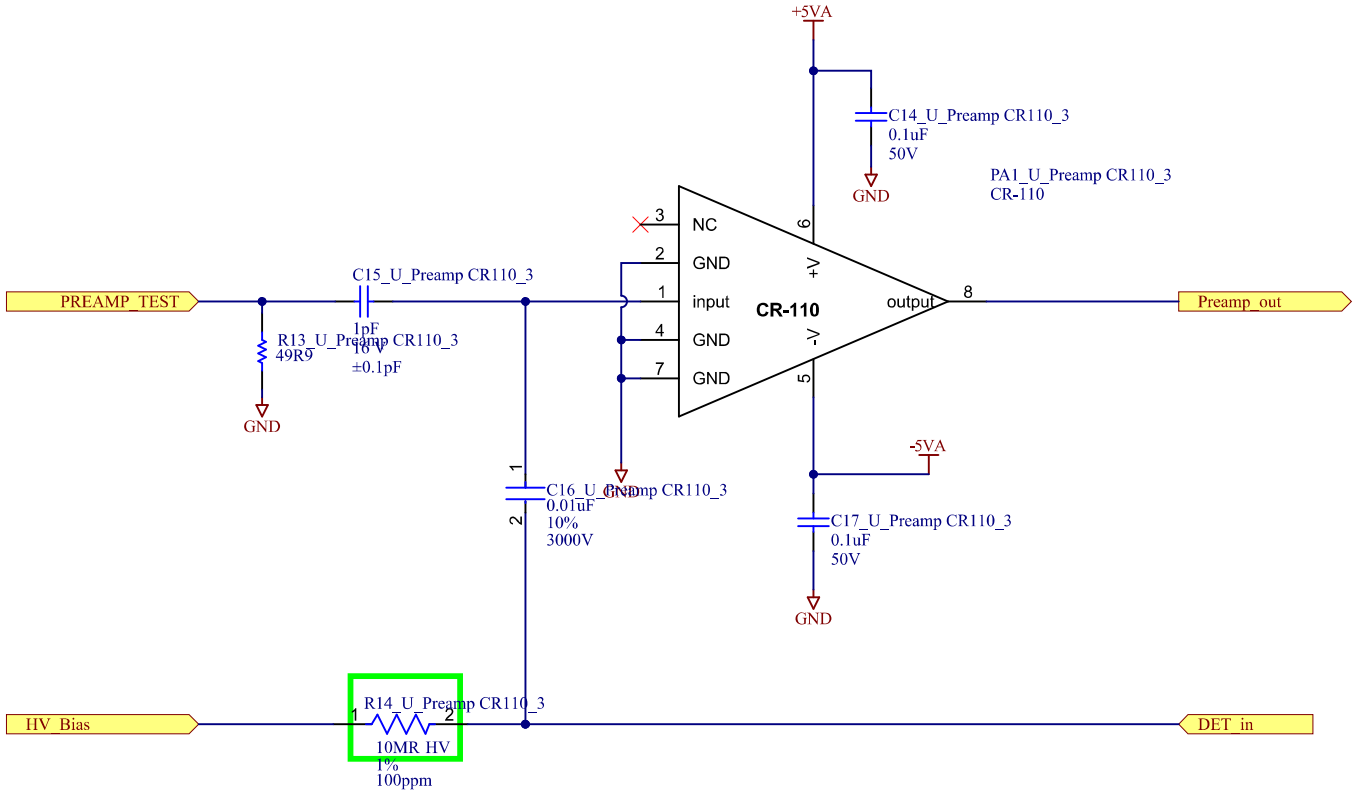


Design Note
For the AC-coupled circuits, there is a bias resistor (R14). If the voltage drop across the bias resistor is too small (less than about 100 mV), the electronic noise (thermal noise) of the bias resistor starts to become significant in the detection circuit. On the other hand, if the voltage drop across the bias resistor is too large, the voltage across the detector may be significantly less than the applied bias voltage
The resistor values are subject to change.

Variant: HASP2023

PRESET		McMaster University 1280 Main Street West Hamilton, ON, Canada	
ENGINEER X. Cheng	COMPONENT NUMBER CCP-PRE-PLD-002		REVISION A
DRAWN X. Cheng	COMPONENT NAME Front-End Module (FEM)		
CHECKED *	SCHEMATIC FILENAME Preamp CR110.SchDoc		
APPROVED *	SIZE Letter	DATE 4/24/2023	SHEET 4 OF 4

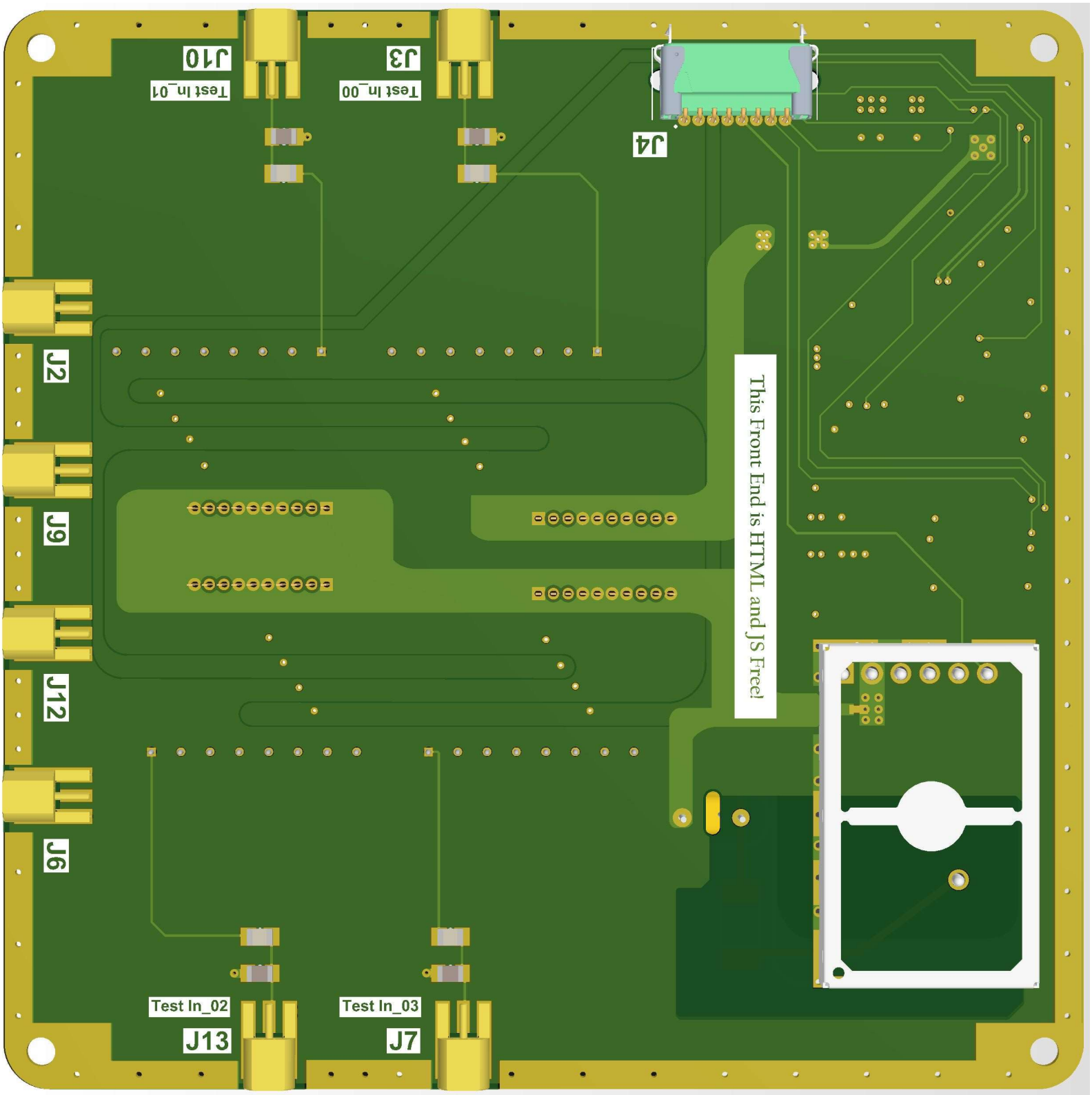
Preamp CR110

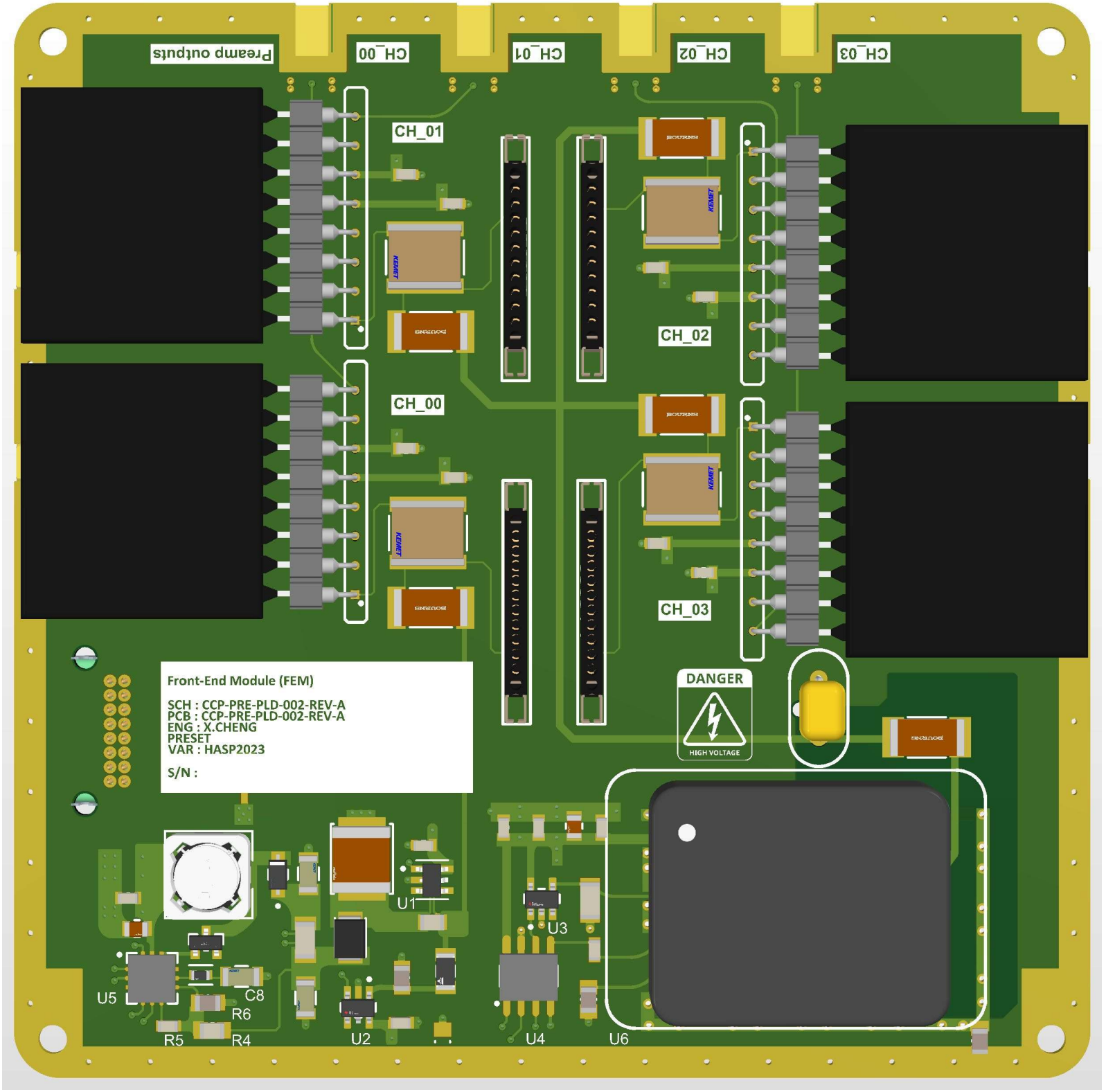


Design Note
For the AC-coupled circuits, there is a bias resistor (R14). If the voltage drop across the bias resistor is too small (less than about 100 mV), the electronic noise (thermal noise) of the bias resistor starts to become significant in the detection circuit. On the other hand, if the voltage drop across the bias resistor is too large, the voltage across the detector may be significantly less than the applied bias voltage
The resistor values are subject to change.

Variant: HASP2023

PRESET		McMaster University 1280 Main Street West Hamilton, ON, Canada	
ENGINEER X. Cheng	COMPONENT NUMBER CCP-PRE-PLD-002		REVISION A
DRAWN X. Cheng	COMPONENT NAME Front-End Module (FEM)		
CHECKED *	SCHEMATIC FILENAME Preamp CR110.SchDoc		
APPROVED *	SIZE Letter	DATE 4/24/2023	SHEET 4 OF 4


J10
Test In_01
J3
Test In_00
J4
J2
J9
J12
J6
This Front End is HTML and JS Free!
Test In_02
J13
Test In_03
J7


Preamp outputs
CH_00
CH_01
CH_02
CH_03
CH_01
CH_02
CH_00
CH_03
Front-End Module (FEM)
SCH : CCP-PRE-PLD-002-REV-A
PCB : CCP-PRE-PLD-002-REV-A
ENG : X.CHENG
PRESET
VAR : HASP2023
S/N :
DANGER
HIGH VOLTAGE
U1
U2
U3
U4
U5
U6
C8
R4
R5
R6

Appendix C: Mechanical Part and Mass Breakdown

For reference, a verification method of 'A' indicates an estimation based on the CAD and induces a 20% uncertainty. A verification method of 'T' indicated the part has been tested and has an uncertainty of 5%.

Project: H23-PRE-MEC
Document: H23-PRE-MEC-001-ML
Revision: P-

Title: Mass budget for preliminary PSIP

Revision Date: 2023-04-14
Author: P. CHIN

Checked Date:
Checked by:

Part Number	Description	Mass (g)	Verification Method		QTY	Subtotal (g)	Uncertainty (g)
H23-PLD-EST-1	Electron silicon telescope (EST)	2466.41	A	-	1	2466.4	493.3
H23-PRE-MEC-001-SA	Mecahnical structure (STR)	2558.8	A	-	1	2826.8	488.8
H23-PRE-MEC-002-SA	Collimator shutter module (CSM)	660.4	A	-	1	660.4	130.2

Estimated Total	**5953.6**	**1112.3**
Estimated Maximum	**7065.9**	

COLLIMATOR SHUTTER MODULE (CSM) SUBASSEMBLY

Part Number	Description	Mass (g)	Verification Method		QTY	Subtotal (g)	Uncertianty (g)
PRE-MEC-CSM-PRT-01	Housinge case top	83.7	A	20%	1	83.7	16.7
PRE-MEC-CSM-PRT-02	Housing case bottom	168.2	A	20%	1	168.2	33.6
31m2hvwusx-01	DC gear motor	140.0	A	20%	1	140.0	28.0
9271K586	7.5 in-lb torsion spring	5.4	A	20%	1	5.4	1.1
PRE-MEC-CSM-PRT-03	Rotating lid	171.0	A	20%	1	171.0	34.2
PRE-MEC-CSM-PRT-04	Spring clutch	3.6	A	20%	1	3.6	0.7
ZM10E10C01	Honeywell microswitch	2.0	R	10%	2	4.0	0.4
PRE-MEC-CSM-PRT-06	Magnetic housing	5.7	A	20%	1	5.7	1.1
4307-M52180/12VDC-ND	Magnetic latch	15.0	R	10%	1	15.0	1.5
N/A	Spacer for magnet armature	1.0	A	20%	2	2.0	0.4
PRE-MEC-CSM-PRT-07	Magnet armature	19.5	A	20%	1	19.5	3.9
	Motor mounting screw M3x0.50 x8mm SHCS	1.0	A	20%	4	4.0	0.8
	Microswitch mounting screw - M2x0.40 x18mm SHCS	1.4	A	20%	4	5.6	1.1
	Microswitch mounting screw nut - M2x0.40 hex nut	1.0	A	20%	4	4.0	0.8
	Case mounting screw - M3x0.50 x30mm SHCS	2.0	A	20%	8	16.0	3.2
	Case mounting screw nut - M3x0.50 hex nut	1.0	A	20%	8	8.0	1.6
	Magnet mounting screw - M4x0.70 x10mm SHCS	1.9	A	20%	1	1.9	0.4
	Armature mounting screw - M3x0.50 x18mm SHCS	1.4	A	20%	2	2.8	0.6
					Estimated Total	**660.4**	**130.2**
					Estimated Maximum	**790.6**	

MECHANICAL STRUCTURE (STR) SUBASSEMBLY

Part Number	Description	Mass (g)	Verification Method		QTY	Subtotal (g)	Uncertianty (g)
	Large sized HASP baseplate	1438.3	A	20%	1	1438.3	287.7
HASP-HOC-01	PVC housing case	83.7	A	20%	1	83.7	16.7
8982K218	Multipurpose 6061 aluminum 90 degree angle (180mm)	53.9	A	20%	1	53.9	10.8
8982K218	Multipurpose 6061 aluminum 90 degree angle (260 mm)	78.3	A	20%	1	78.3	15.7
CCP-NEU-MEC-001-01	2U cubesat rails	88.0	T	5%	2	176.0	8.8
CCP-NEU-MEC-001-02	+ Z plate	81.9	T	5%	1	81.9	4.1
CCP-HSP21-001-PF	-Z plate	178.5	T	5%	1	178.5	8.9
CCP-NEU-MEC-001-04	Mid support tray	73.8	T	5%	1	73.8	3.7
91294A128	Rail mounting - M3x0.5 x8 FHCS	0.5	A	20%	36	18.0	3.6
91294A132	Support tray and payload mounting - M3x0.5 x10mm FHCS	0.8	A	20%	38	30.4	6.1
PRE-PDM-0001	Power distribution module for HASP2023	45.2	A	20%	1	45.2	9.0
PRE-CSMD-0001	Collimator shutter module drive for HASP2023	200.0	A	20%	1	200.0	40.0
94868A178	M3 hex standoffs	2.9	A	20%	8	23.2	4.6
91291A111	M3x0.5 x6mm - PCB mounting screws	0.8	A	20%	4	3.2	0.6
91290A248	M5x0.8 (22mm) black-oxide alloy steel SHCS	4.0	A	20%	32	128.0	25.6
98035A103	Black-Oxide Steel Oversized Washer for M5 Screw Size, 5.3 mm ID, 11 mm OD	1.1	A	20%	32	35.2	7.0
9836A111	Black-Oxide Steel Oversized Washer for M5 Screw Size, 5.3 mm ID, 18 mm OD	4.2	A	20%	32	134.4	26.9
94645A102	High-Strength Steel Nylon-Insert Locknut Class 10, M5 x 0.8 mm Thread, 5 mm High	1.4	A	20%	32	44.8	9.0
					Estimated Total	**2826.8**	**488.8**
					Estimated Maximum	**3315.6**	

ELECTRON SILICON TELESCOPE (EST) SUBASSEMBLY

Part Number	Description	Mass (g)	Verification Method		QTY	Subtotal (g)	Uncertianty (g)
	Payload-Collimator housing	473.5	A	20%	1	473.5	94.7
	Collimator Baffle	88.9	A	20%	6	533.4	106.7
	Collimator Spacer	13.5	A	20%	5	67.5	13.5
	Collimator Lid	41.6	A	20%	1	41.6	8.3
A-5258	Si-detector	200.0	A	20%	3	600.0	120.0
	Standoff Pin	0.8	A	20%	3	2.5	0.5
	Peelable Aluminum Shim	2.9	A	20%	1	2.9	0.6
	Si Detector Compartment Lid	131.1	A	20%	1	131.1	26.2
	Upper Detector Spacer	11.7	A	20%	2	23.4	4.7
91292A025	18-8 stainless steel SHCS	2.8	A	20%	3	8.3	1.7
94768A101	18-8 stainless steel oversized washer	2.4	A	20%	3	7.3	1.5
	Ribbon Cable Gate A	5.4	A	20%	1	5.4	1.1
	Ribbon Cable Gate B	5.7	A	20%	1	5.7	1.1
CCP-PRE-PLD-002	DAM printed circuitboard	200.0	A	20%	1	200.0	40.0
91075A224	Male-female threaded hex standoff	91.0	A	20%	4	364.0	72.8

Estimated Total	**2466.4**	**493.3**
Estimated Maximum	**2959.7**	