HASP Payload Specification and Integration Plan

Payload Title: Energy Monitoring Instrument

Payload Class: (Small) Large (circle one)

Payload ID: 4

Institution: The Pennsylvania State University

Contact Name: Dr. Sven Bilén, Brian Schratz

Contact Phone: 814-863-1526, 814-441-0820

Contact E-mail: sbilen@engr.psu.edu, schratz@psu.edu

Submit Date: 31 May 2008

I. Mechanical Specifications:

A. Measured weight of the payload (not including payload plate)
The final fabricated mass of HEMI is not yet determined as the structure is still in the fabrication phase. The current theoretical mass for HEMI is 2967.2 grams, determined from Solid Works 3D CAD models, known masses of available components, and careful estimates of non-available components.

B. Provide a mechanical drawing detailing the major components of your payload and specifically how your payload is attached to the payload mounting plate
Mechanical drawings are provided along with this documentation in Adobe PDF format, under the name Vessel Drawings.

C. If you are flying anything that is potentially hazardous to HASP or the ground crew before or after launch, please supply all documentation provided with the hazardous components (i.e. pressurized containers, radioactive material, projectiles, rockets…)
We are flying a sealed container, which was approved by Hugo Franco at CSBF after extensive communication with the HASP-HEMI structural lead Corey Friedenberger. Attached are Solidworks Cosmos models, showing the factor of safety calculated for the top and bottom parts of the container and correspondence between Hugo and Corey. We will test the container according to Hugo Franco's recommendations and provide documentation of the tests before flight.

D. Other relevant mechanical information
The HEMI payload is mechanically static with no moving components and nothing that will cause variable mass. To maximize safety and minimize the risk of malfunction due to unintentional human contact, all electrical components, with the exception of sealed PMT modules and electrical cables, are entirely enclosed within the electronics housing inside the vessel.

II. Power Specifications:

A. Measured current draw at 30 VDC: 200 mA (nominal value)

B. If HASP is providing power to your payload, provide a power system wiring diagram starting from pins on the student payload interface plate EDAC 516 connector through your power conversion to the voltages required by your subsystems.

The power system wiring diagrams are attached.

Function	EDAC Pins	Wire Color	Connector to HEMI	HEMI Function	Connector Type
+30 VDC	A	White with red stripe	J1-1	5V DC/DC Input	DB-9S
+30 VDC	B	White with red stripe	J1-1	5V DC/DC Input	DB-9S
+30 VDC	C	White with red stripe	J1-2	Independent Monitor Input	DB-9S
+30 VDC	D	White with red stripe	J1-6	15V DC/DC Input	DB-9S
Power Ground	W	White with black stripe	J1-3	5V DC/DC Return	DB-9S
Power Ground	T	White with black stripe	J1-3	5V DC/DC Return	DB-9S
Power Ground	U	White with black stripe	J1-7	Independent Monitor Input	DB-9S
Power Ground	X	White with black stripe	J1-8	15V DC/DC Return	DB-9S
Analog 1	K	Blue	J1-4	Temp1+	DB-9S
Analog 2	M	Red	J1-5	Pres1+	DB-9S
Signal Return	L	Black	J1-9	Temp1-	DB-9S
Signal Return	R	Black	J1-9	Pres1-	DB-9S
Discrete 1	F	Brown	No Connect	Not Used	N/A
Discrete 2	N	Green	No Connect	Not Used	N/A
Discrete 3	H	No Connect	No Connect	Not Used	N/A
Discrete 4	P	No Connect	No Connect	Not Used	N/A

Note: The two 5V DC/DC Inputs will be spliced together, as well as their respective returns. The Pres1 and Temp1 signal returns will be spliced together as well.

C. Other relevant power information

III. Downlink Telemetry Specifications:

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

Data is sent once every second.

B. Approximate serial downlink rate (in bits per second):
2,400 bps (under the 4,800 baud rate which we were previously approved for in the HASP 2008 Student Payload Summary) We can reduce this if necessary.

C. Specify your serial data record including record length and information contained in each record byte:
224 bytes (1792 bits)

Table 1 Telemetry Downlink Format (each cell represents one 8-bit byte)

SFID	SCI1	SCI33	SCI65	SCI97	TEMP 1	SYNC
SFID	SCI2	SCI34	SCI66	SCI98	TEMP 2	SYNC
SFID	SCI3	SCI35	SCI67	SCI99	TEMP 3	SYNC
SFID	SCI4	SCI36	SCI68	SCI100	TEMP 4	SYNC
SFID	SCI5	SCI37	SCI69	SCI101	TEMP 5	SYNC
SFID	SCI6	SCI38	SCI70	SCI102	TEMP 6	SYNC
SFID	SCI7	SCI39	SCI71	SCI103	PRES1	SYNC
SFID	SCI8	SCI40	SCI72	SCI104	CURR 1	SYNC
SFID	SCI9	SCI41	SCI73	SCI105	CURR 2	SYNC
SFID	SCI10	SCI42	SCI74	SCI106	CURR 3	SYNC
SFID	SCI11	SCI43	SCI75	SCI107	CURR 4	SYNC
SFID	SCI12	SCI44	SCI76	SCI108	CURR 5	SYNC
SFID	SCI13	SCI45	SCI77	SCI109	VOLT 1	SYNC
SFID	SCI14	SCI46	SCI78	SCI110	VOLT 2	SYNC
SFID	SCI15	SCI47	SCI79	SCI111	VOLT 3	SYNC
SFID	SCI16	SCI48	SCI80	SCI112	VOLT 4	SYNC
SFID	SCI17	SCI49	SCI81	SCI113	VOLT 5	SYNC
SFID	SCI18	SCI50	SCI82	SCI114	Control V	SYNC
SFID	SCI19	SCI51	SCI83	SCI115	SPARE	SYNC
SFID	SCI20	SCI52	SCI84	SCI116	SPARE	SYNC
SFID	SCI21	SCI53	SCI85	SCI117	SPARE	SYNC
SFID	SCI22	SCI54	SCI86	SCI118	SPARE	SYNC
SFID	SCI23	SCI55	SCI87	SCI119	SPARE	SYNC
SFID	SCI24	SCI56	SCI88	SCI120	SPARE	SYNC
SFID	SCI25	SCI57	SCI89	SCI121	SPARE	SYNC
SFID	SCI26	SCI58	SCI90	SCI122	SPARE	SYNC
SFID	SCI27	SCI59	SCI91	SCI123	SPARE	SYNC
SFID	SCI28	SCI60	SCI92	SCI124	SPARE	SYNC
SFID	SCI29	SCI61	SCI93	SCI125	SPARE	SYNC
SFID	SCI30	SCI62	SCI94	SCI126	SPARE	SYNC

SFID	SCI31	SCI63	SCI95	SCI127	SPARE	SYNC
SFID	SCI32	SCI64	SCI96	SCI128	SPARE	SYNC

Note: Temp1 and Pres1 are included in our serial data for redundancy.

D. Number of analog channels being used:
2

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

F. Number of discrete lines being used:
0

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

H. Are there any on-board transmitters? If so, list the frequencies being used and the transmitted power.
No

I. Other relevant downlink telemetry information.
No

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*)
Estimated on 1-2 per hour, depends on the science data received to adjust instrument gains.

D. Provide a table of all of the commands that you will be uplinking to your payload. Specific codes have not been assigned (all command words will be 8 bits in addition to the recommended 8 bits of checksum and ID).

Science Commands

Control Voltage (V)	Hex Command	Threshold Voltage (V)	Hex Command
0.00	00	0.00	0A
0.05	01	0.10	0B
0.10	02	0.20	0C

0.15	03	0.30	0D
0.20	04	0.40	0E
0.25	05	0.50	0F
0.30	06	0.60	1A
0.35	07	0.70	1B
0.40	08	0.80	1C
0.45	09	0.90	1D
0.50	10	1.00	1E
0.55	11	1.10	1F
0.60	12	1.20	2A
0.65	13	1.30	2B
0.70	14	1.40	2C
0.75	15	1.50	2D
0.80	16	1.60	2E
0.85	17	1.70	2F
0.90	18	1.80	3A
0.95	19	1.90	3B
1.00	20	2.00	3C
		2.10	3D
		2.20	3E
		2.30	3F
		2.40	4A
		2.50	4B
		2.60	4C
		2.70	4D
		2.80	4E
		2.90	4F
		3.00	5A
		3.10	5B
		3.20	5C
		3.30	5D
		3.40	5E
		3.50	5F
		3.60	6A
		3.70	6B
		3.80	6C
		3.90	6D
		4.00	6E

E. Are there any on-board receivers? If so, list the frequencies being used.
No

F. Other relevant uplink commanding information.
No

V. Integration and Logistics

A. Date and Time of your arrival for integration:
Evening, August 3

B. Approximate amount of time required for integration:
Excluding environmental testing time, and assuming that the host up/down link interface is already up and running, six hours should suffice.

C. Name of the integration team leader:
Brian Schratz

D. Email address of the integration team leader:
schratz@psu.edu

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

Brian Schratz, schratz@psu.edu

Kyle Holmes, kmh5139@psu.edu

Kyung Chae, kmc5165@psu.edu

Corey Friedenberger, cwf5034@psu.edu

F. Define a successful integration of your payload:

Instrument passes mechanical fit check and electrical interfaces (power draw, EMI, pinouts), successful uplink and downlink through HASP interface, successful operation during environment test.

G. List all expected integration steps:

Mechanical check, power check, communications check (down, then up), successful operations of housekeeping sensors and science instrument, thermal-vac test.

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

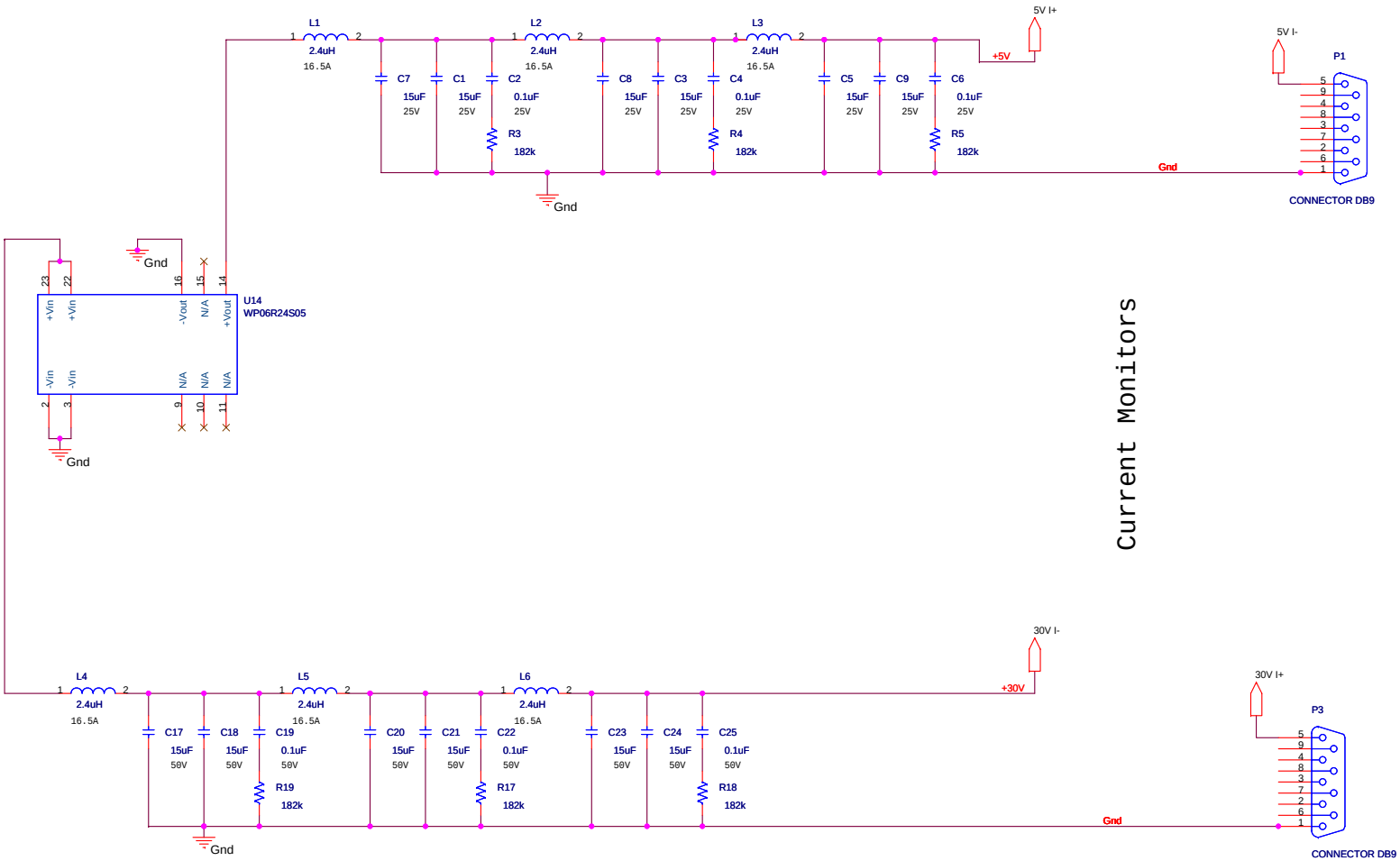
Nominal current draw, successful sequence testing with other payloads, uplink command echoed in downlink command, payload remains within nominal ranges during thermal vac checkout.

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…):

Please provide recommendations on accommodations and eateries available during integration.

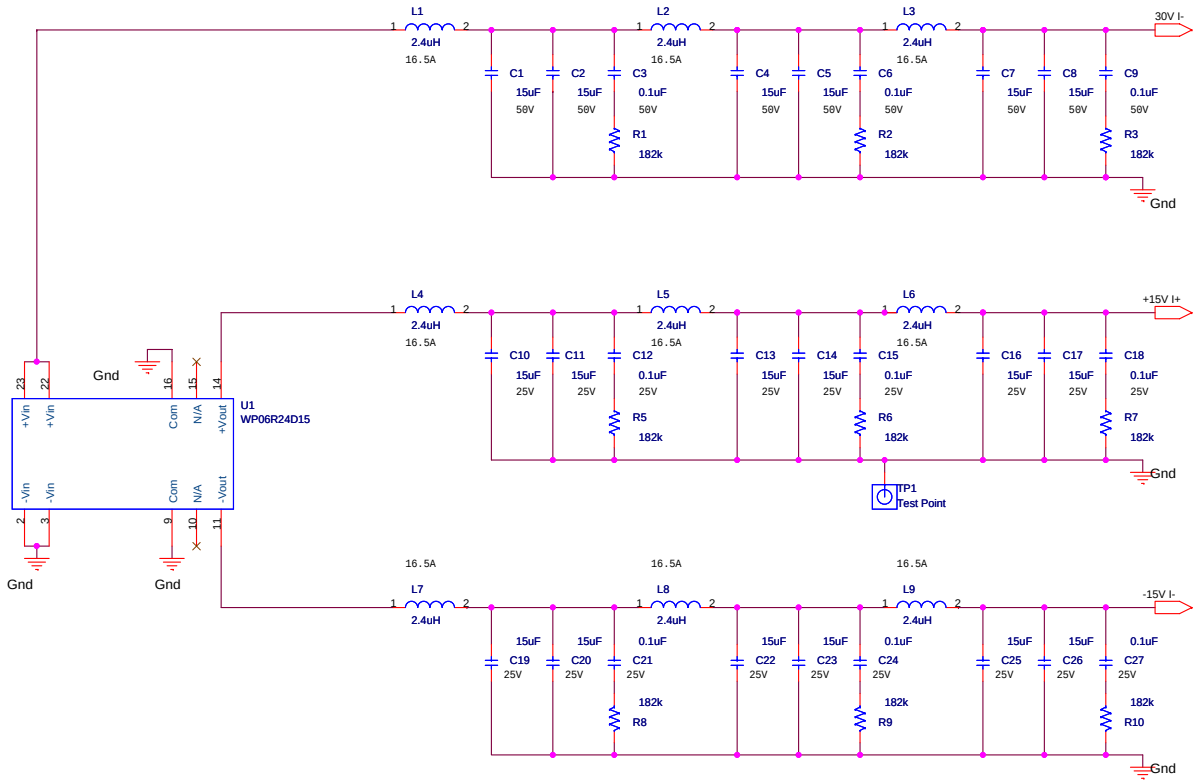
J. List any LSU supplied equipment that may be needed for a successful integration:

Adjustable power supply (or supplies) that can provide output voltages: 3V, 0 to ±15V, and 30V. Oscilloscope (preferably mixed signal that can serve as logic analyzer).



Current Monitors

Preparer: David McLaughlin	*Signature:*	HASP Power System Student Space Programs Laboratory The Pennsylvania State University 332 EE East, Universtiy Park, PA 16802			
Responsible Engr. Authority: N/A	*Signature:*				
Responsible Engr. Authority: N/A	*Signature:*	*Title:* 5V DC/DC and Filters			
Systems Engineer: Brian Schratz	*Signature:*	*Document Number:* 5004-04-0003	*Revision:* 001	*Date:* July 11, 2008	*Page:* 1 of 1



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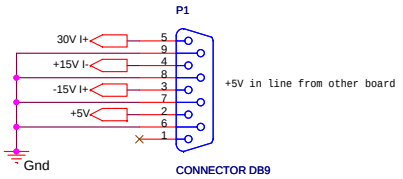
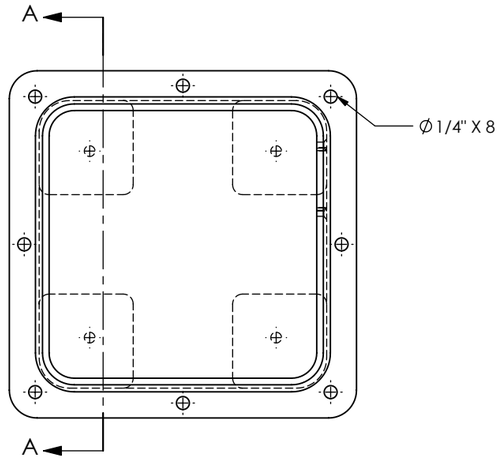
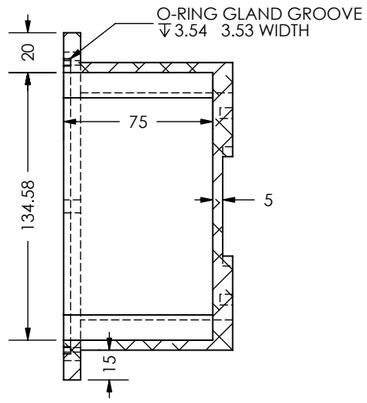


Preparer: David McLaughlin	*Signature:*	HASP Power System Student Space Programs Laboratory The Pennsylvania State University 332 EE East, Universtiy Park, PA 16802	
Responsible Engr. Authority: Brian Schratz	*Signature:*		
Responsible Engr. Authority: N/A	*Signature:*	*Title:* 15V DC/DC Converter and Filters	
Systems Engineer: Brian Schratz	*Signature:*	*Document Number:* 5004-04-0003	*Revision:* 001
		Date: July 11, 2008	*Page:* 1 of 2





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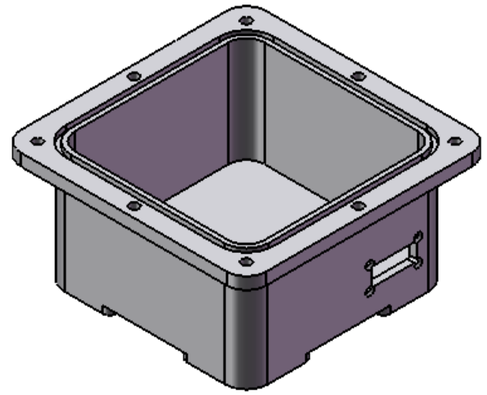

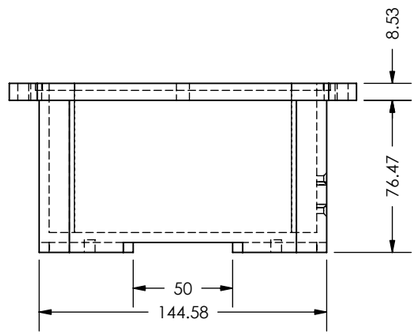

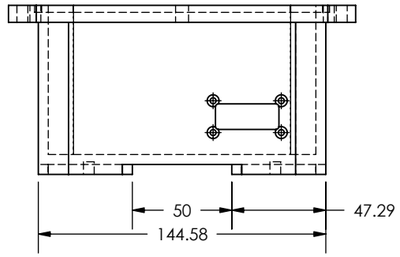

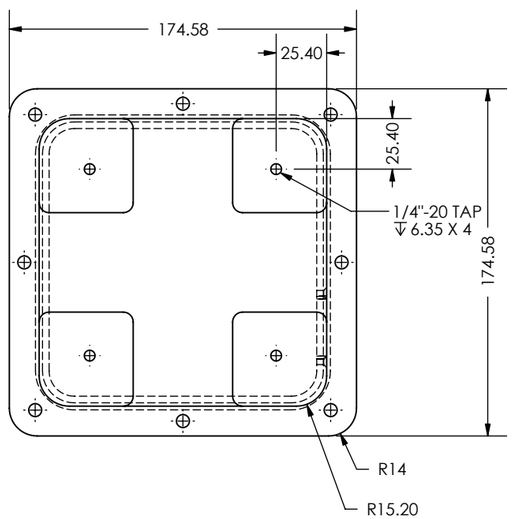

NOTE: ALL DIMENSIONS ARE IN MILLIMETERS

NEXT ASSY	USED ON	
APPLICATION		DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN MILLIMETERS
TOLERANCES:
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ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL

FINISH

	NAME	DATE
DRAWN		
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

TITLE:

VESSEL: BOTTOM SHELL

SIZE	DWG. NO.	REV
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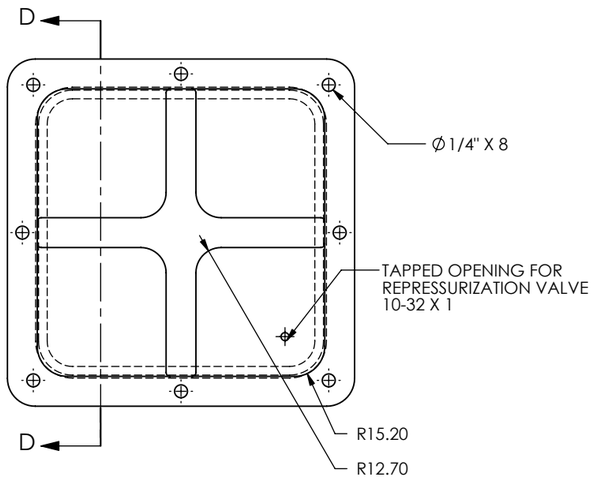

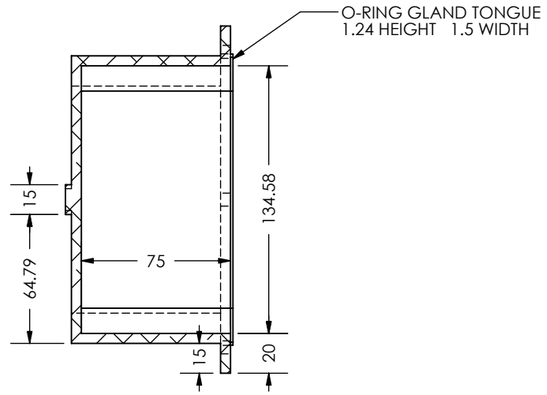

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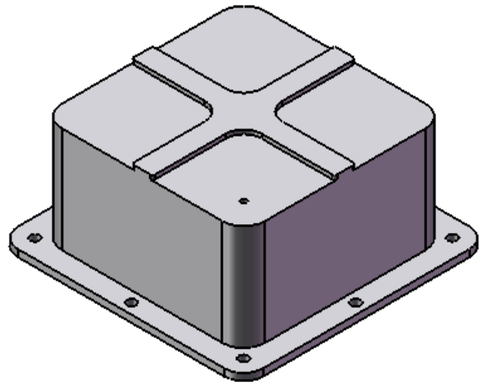

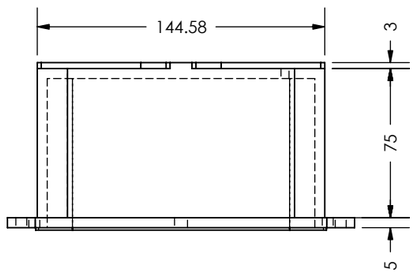

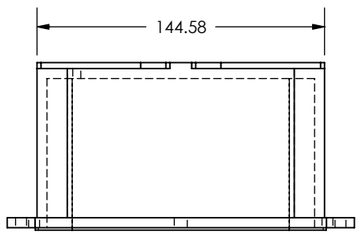

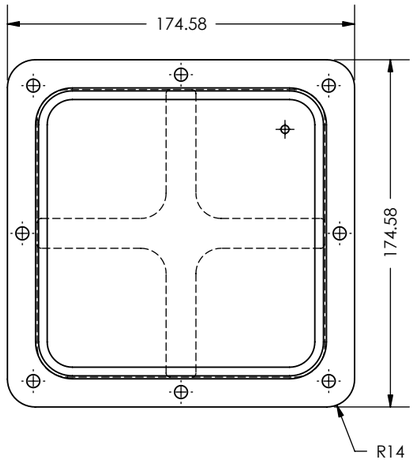

NOTE: ALL DIMENSIONS ARE IN MILLIMETERS

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UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±
INTERPRET GEOMETRIC TOLERANCING PER:
MATERIAL
FINISH
DO NOT SCALE DRAWING

	NAME	DATE
DRAWN		
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

SSPL

TITLE:
VESSEL: TOP SHELL

SIZE	DWG. NO.	REV
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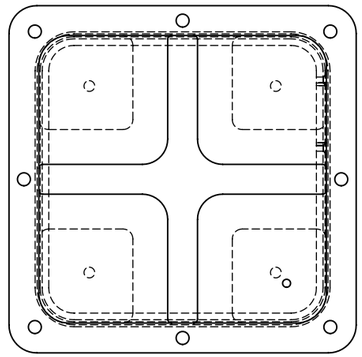

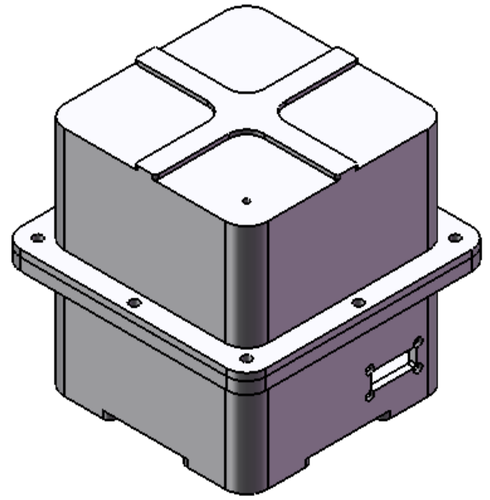

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TOLERANCES:
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TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL

FINISH

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN		
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ENG APPR.		
MFG APPR.		
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COMMENTS:

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TITLE:

VESSEL

SIZE	DWG. NO.	REV
B	HH039	2

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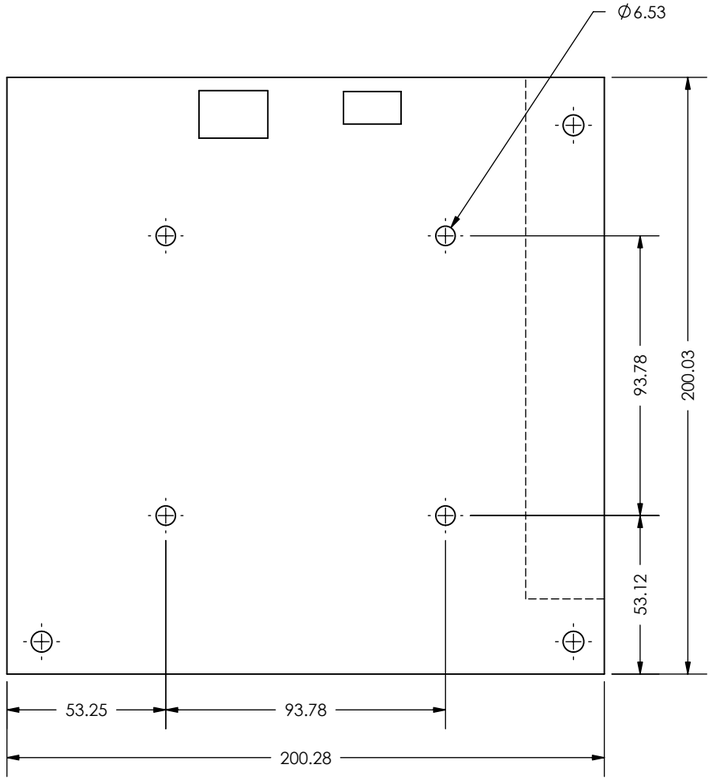

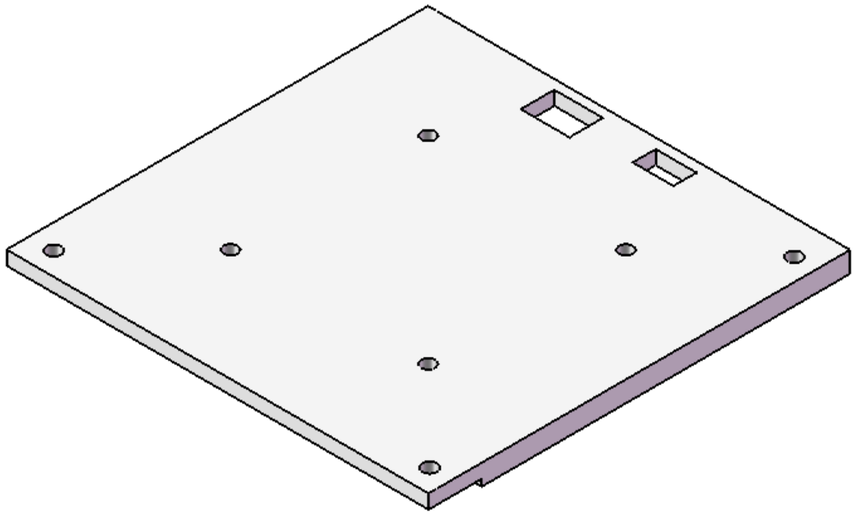

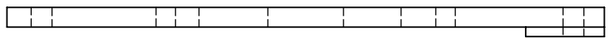

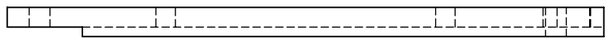

NOTE: ALL DIMENSIONS ARE IN MILLIMETERS

NOTE: ∅6.35 HOLES ARE CONNECTED TO 1/4"-20 TAP HOLES IN DRAWING HH037 USING 1/4"-20 STAINLESS STEEL HEX BOLTS

NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL

FINISH

DO NOT SCALE DRAWING

	NAME	DATE
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ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

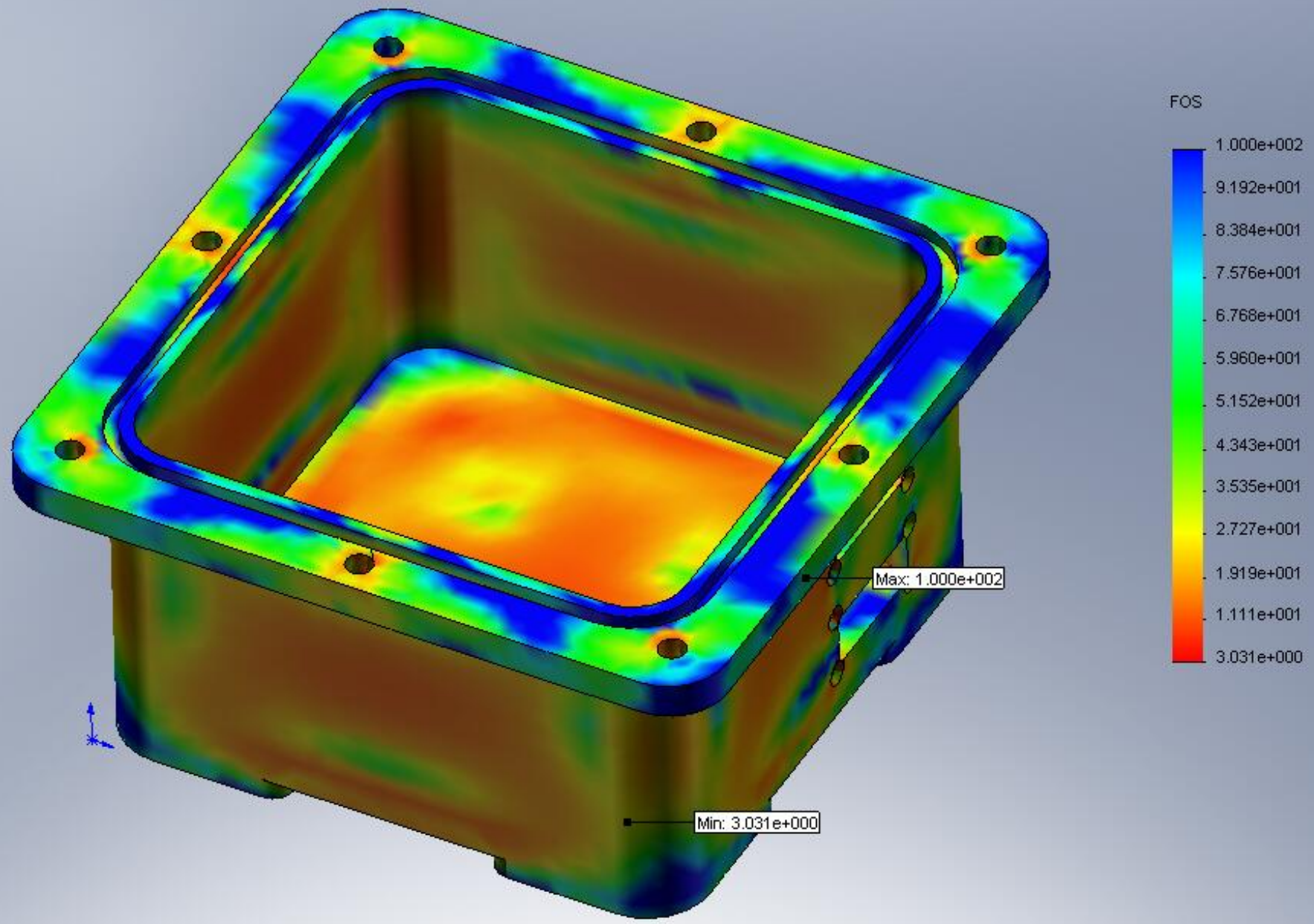
SSPL

TITLE:

HASP INTERFACE PLATE

SIZE	DWG. NO.	REV
B	HH040	2
SCALE: 1:2	WEIGHT:	SHEET 4 OF 4

Model name: Bottom Shell
Study name: Flight Conditions
Plot type: Design Check Design Check1
Criterion : Max von Mises Stress
Factor of safety distribution: Min FOS = 3



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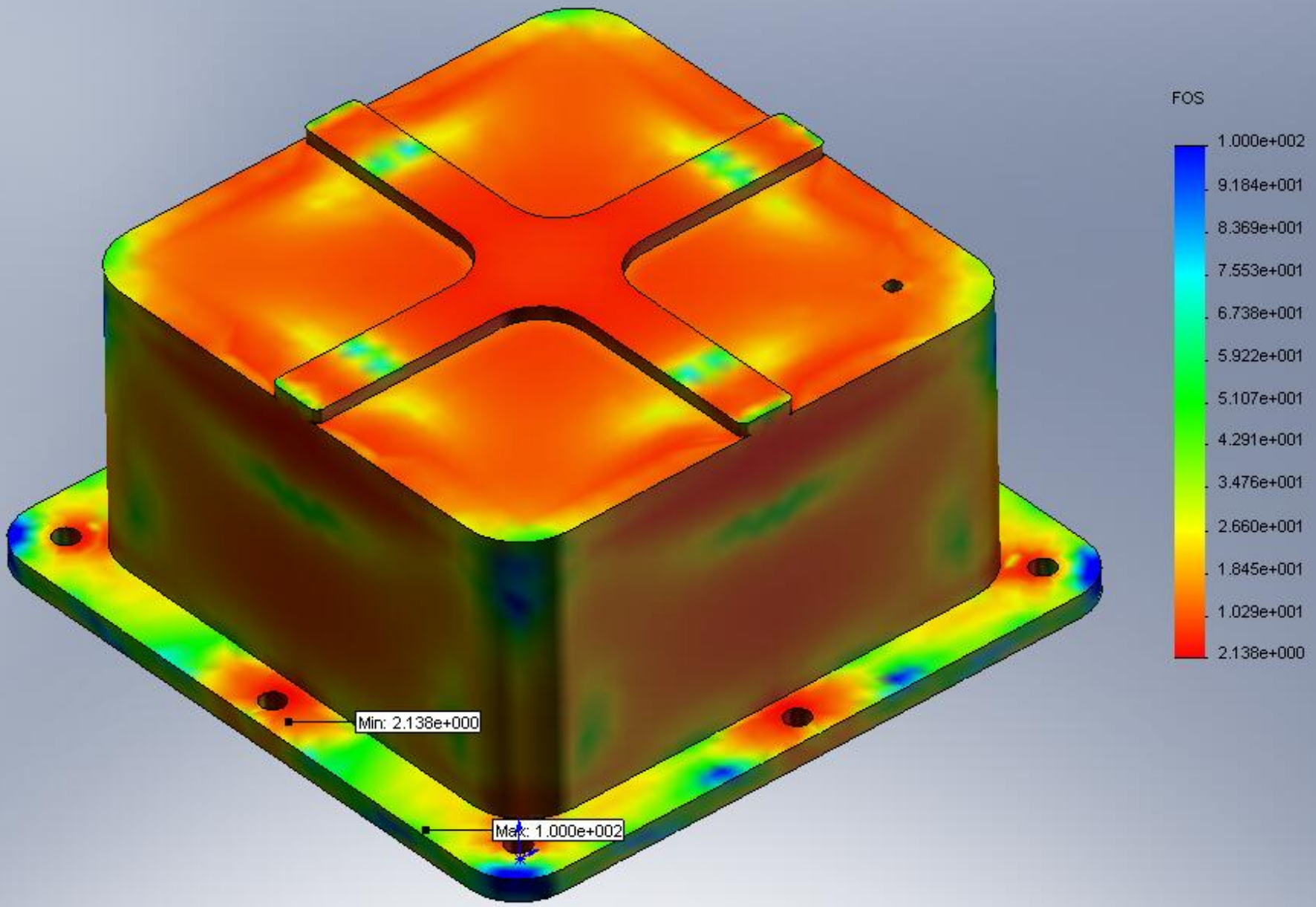
Study name: Flight Conditions
Plot type: Design Check Design Check1
Criterion : Max von Mises Stress
Factor of safety distribution: Min FOS = 2.1



Print

Message 1 of 12
Read

From

Hugo Franco <hugo.franco@csbf.nasa.gov> ⊕

To

COREY W FRIEDENBERGER <cwf5034@psu.edu> ⊕

Subject RE: HASP: Penn State Univ - Design Check
Date Wed, Jul 16, 2008 03:20 PM
Safe View On [Turn Off] What is "Safe View"?

Corey,

Internal pressure should be 1.5 atmospheres for design purposes. But, this design seems robust enough to meet the requirements, no need to redo the analysis. These results along with the vacuum test should be proof enough. Document the test and provide documents before flight.

Hugo

At 01:00 PM 7/16/2008, you wrote:

> Hello,
>
> Following your previous approval over the phone, we've been moving forward at a steady pace with fabrication of our vessel. At the current point in time, we have the top half of the vessel fabricated stronger than specification, and the bottom half of the vessel is in the process. My simulations have been updated to reflect the actual dimensions of the completed vessel components, and the current simulation results plots illustrate that the vessel is more than able to withstand the pressures involved in flight.
>
> Supplied with this email are updated simulation plots, which reflect flight conditions (1 atmosphere internal pressure and about 2 torr external pressure for our purposes).
>
> We would like to ensure that our work meets your approval at the current point in time with what we have, and that the vessel will be acceptable for flight pending passing an extended vacuum pump-down test in the near future once the structure is completed.
>
> Thanks for your time,
> Corey

On Thu, Jun 26, 2008 12:59 PM, **Hugo Franco <hugo.franco@csbf.nasa.gov>** wrote:

Tomorrow's fine for a call. Have me paged at this number 903 729 0271 if I'm not in my office.

Hugo

At 12:35 PM 6/26/2008, you wrote:

Mr. Franco,

I'm spending today rerunning finite element analysis on the individual parts and tweaking anything that arises. It will likely be later this evening until I have everything wrapped up here, so I will be calling you tomorrow if that is alright. If you are unavailable tomorrow, or only available at certain times, please let me know.

If you'd like to take a look at the bolts and flange nuts we are using to seal the vessel, they are part numbers 92200A542 and 94758A028 on http://www.mcmaster.com

The tensile strength of 80,000 psi for the bolt well exceeds expected forces on the sealing flange.

I will email you tonight with the results of the individual tests on the parts so that you have them for when we talk tomorrow.

Thanks,
Corey Friedenberger

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