HASP Payload Specification and Integration Plan

Payload Title: High Altitude X-Ray Detector Testbed (HAXDT)

Payload Class: [✓ Small] Large (circle one)

Payload ID: 3

Institution: University of Minnesota – Twin Cities

Contact Name: Patrick Doyle

Contact Phone: 314-276-1944

Contact E-mail: doyle174@umn.edu

Submit Date: June 22, 2012

I. Mechanical Specifications:

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

The mass of all components and the structure is 1.2 kg.

B. Provide a mechanical drawing detailing the major components of your payload and specifically how your payload is attached to the payload mounting plate

See Appendix for dimensioned mechanical drawings and pictures of major hardware components. Included are the following:

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…)

No hazardous material being flown.

D. Other relevant mechanical information

The structure walls and detector housing are attached using a size 4-40 socket head cap screw, while the structure is attached to the HASP mounting plate with a ¼-inch bolt secured by a locknut. Rubber grommets sit between the mounting plate and structure, while washers sit between the nuts and mounting plate.

II. Power Specifications:

A. Measured current draw at 30 VDC

The payload draws 235 mA at 30 VDC.

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.

Figure 1 below shows pins A-D from the EDAC 516 connector, which provide the 30 VDC supply to our power protection and regulation circuit as schematically shown in Figure 2. The power is then grounded through pins T, U, W, and X on the EDAC connector. Although a further DC voltage conversion is performed via the daughter board for its peripheral systems, this is not dependent on the power system’s first stage as shown in Figure 2.

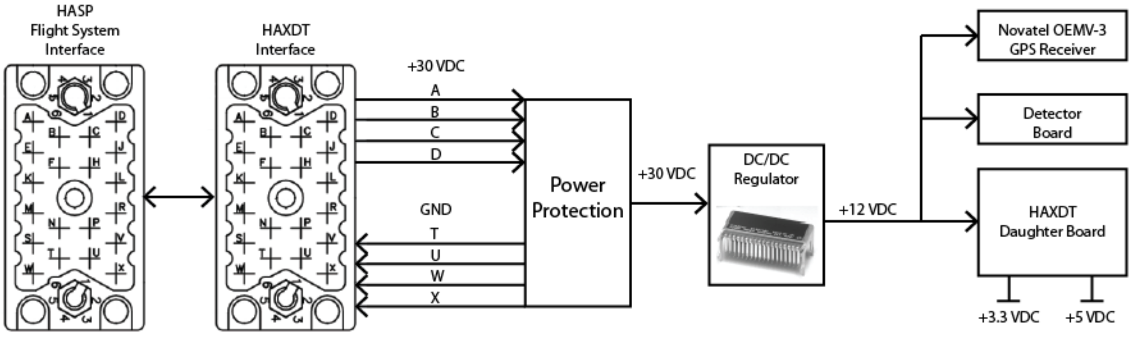

Figure 1. HASP EDAC516 connector interface with the payload power system.

The payload is isolated from reverse polarity of input voltage and limits the current draw of the circuit to 495mA to prevent in-rush current spikes. A green LED indicates stable 12.8V source for GPS system, flight computer and x-ray detector.

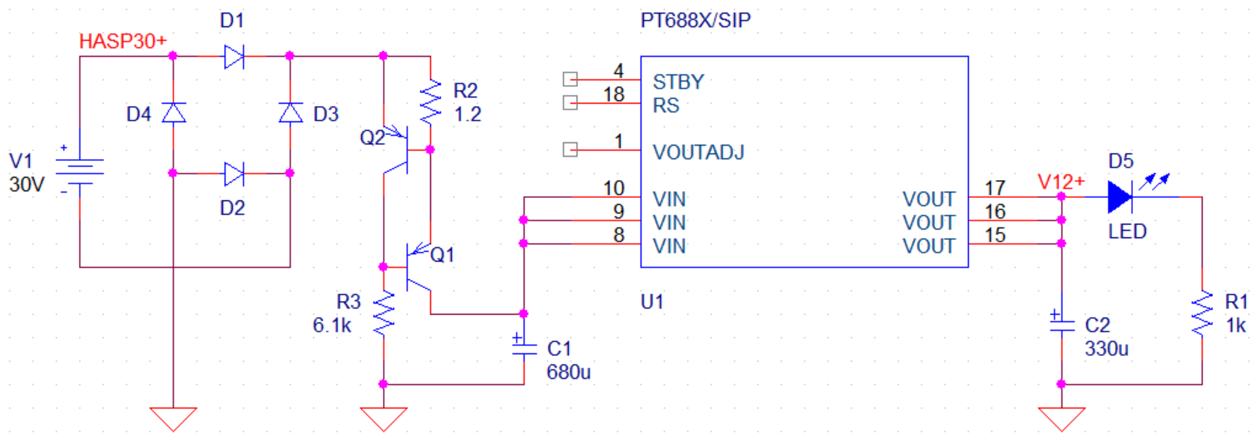

Figure 2. Power regulation and protection circuit.

C. Other relevant power information

No battery is required.

III. Downlink Telemetry Specifications:

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

B. Approximate serial downlink rate (in bits per second)

The serial link is connected at 1200 baud using 8 data bits, no parity, and 1 stop bit as described in the HASP Student Payload Interface Manual. The serial downlink traffic from HAXDT will be 440 bps (the 44 byte packet outlined in Table 1 below plus serial framing bits) sent over the 1200 baud connection. This implies we will initiate data transfer once per second, or at a frequency of 1 Hz.

C. Specify your serial data record including record length and information contained in each record byte.

Byte	Title	Description
1-2	Header	Indicates beginning of data record
3-10	GPSec	Milliseconds since beginning of GPS week
11-18	X_Pos	Earth-centered Earth-fixed, x coordinate
19-26	Y_Pos	Earth-centered Earth-fixed, y coordinate
27-34	Z_Pos	Earth-centered Earth-fixed, z coordinate
35-42	Ambient_Temp	Temperature of internal chamber of payload
43-44	Footer	Indicates end of complete data record

Table 1. Downlink Data Record

D. Number of analog channels being used: 1

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

One analog channel will be used to monitor processor core temperature by affixing an analog temperature sensor to the processor.

F. Number of discrete lines being used: 1

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

The default discrete line is used to turn on and off the payload power. This line will also be used to turn the power off and back on if the payload appears to be malfunctioning during flight.

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

None.

I. Other relevant downlink telemetry information.

None.

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*)

D. Provide a table of all of the commands that you will be uplinking to your payload

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

The payload includes a GPS receiver and antenna. The frequency of the GPS signal is 1.57542 GHz and a bandwidth of ±2 MHz. We will also be detecting pulsars from deep space that have a frequency in the range of 10^{17} Hz and energies exceeding 20 keV.

F. Other relevant uplink commanding information.

None

V. Integration and Logistics

A. Date and Time of your arrival for integration:

July 29, 2012, Afternoon / Evening (exact time TBD)

B. Approximate amount of time required for integration:

4 hours total. Although it is expected that completing the integration steps outlined below will take 3 hours, 1 extra hour has been included to provide time for any unforeseen troubleshooting.

C. Name of the integration team leader: Patrick Doyle

D. Email address of the integration team leader: doyle174@umn.edu

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

Patrick Doyle	doyle174@umn.edu
Mark Abotossaway	aboto001@umn.edu

F. Define a successful integration of your payload:

All payload systems power on, the flight computer successfully stores and transmits data in a simulated flight environment, and the payload resets and continues to collect data under the same simulated conditions.

G. List all expected integration steps:

- i. Attach payload to HASP gondola
- ii. Connect EDAC 516 and RS 232 interfaces to payload
- iii. Remove one panel on payload structure to visually monitor interior components
- iv. HASP gondola provides power to payload
- v. Check that all available LED indicators are on and indicating successful operation
- vi. Allow payload to continuously collect and transmit data for 30 minutes
- vii. Intentionally reset (turn power off and on) the system and allow it to collect data for an additional 15 minutes.
- viii. Power down and review transmission logs and on board storage
- ix. Troubleshoot any issues and repeat steps iv – viii if necessary
- x. Place payload and HASP gondola in thermal vacuum chamber and repeat steps iv – viii above with all payload panels installed to simulate exposure to the extreme environments encountered during HASP flight operations
- xi. Review data and payload systems operation and repeat tests if any flaws are found and time allows

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

- i. Payload successfully interfaces with HASP gondola
- ii. Payload powers on
- iii. Power can be turned on and off to reset system
- iv. Payload successfully stores data
- v. Payload successfully transmits status packets

    vi. Payload operates (remains on, stores, transmits data, and resets) in simulated environment

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…):

None anticipated.

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

It is anticipated that thermal and vacuum chamber testing will be provided.

Appendix: Dimensioned Mechanical Drawings and Pictures of Major Components

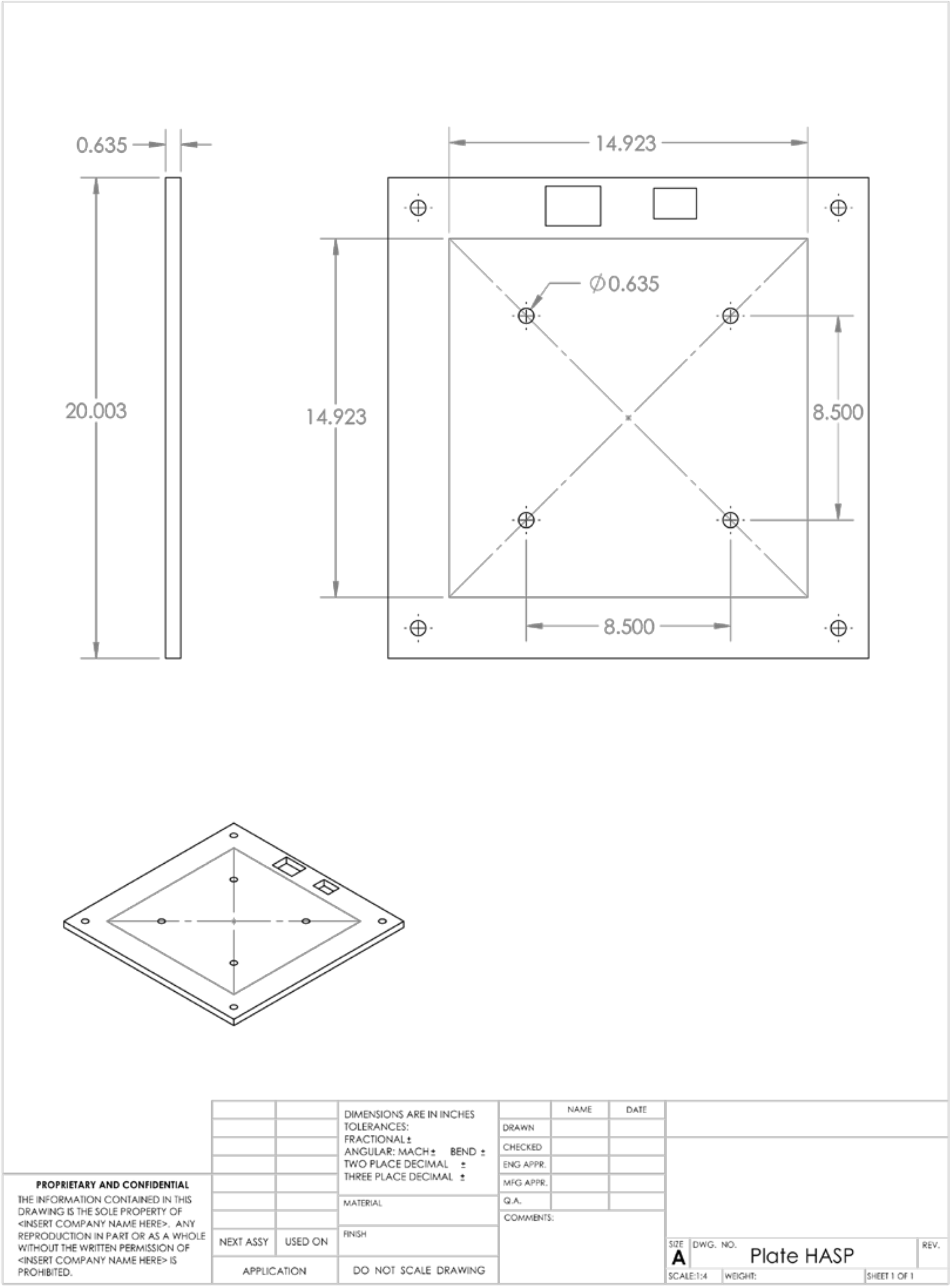

Figure A1. Mechanical drawing showing alterations to HASP mounting plate with dimensions in centimeters.

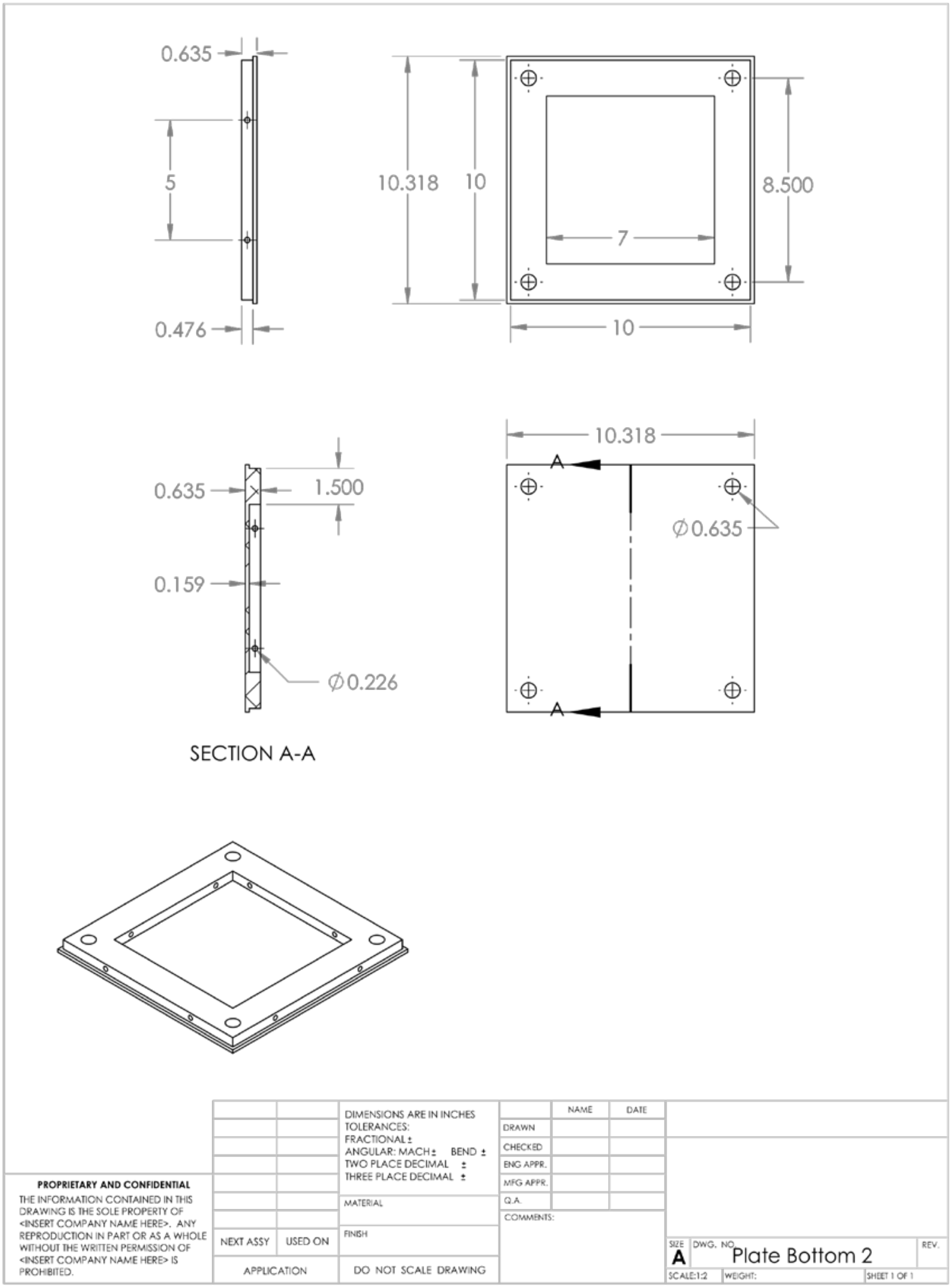

Figure A2. Mechanical drawing of bottom plate of HAXDT structure with dimensions in centimeters. This plate attaches to the HASP mounting plate (Fig. A1).

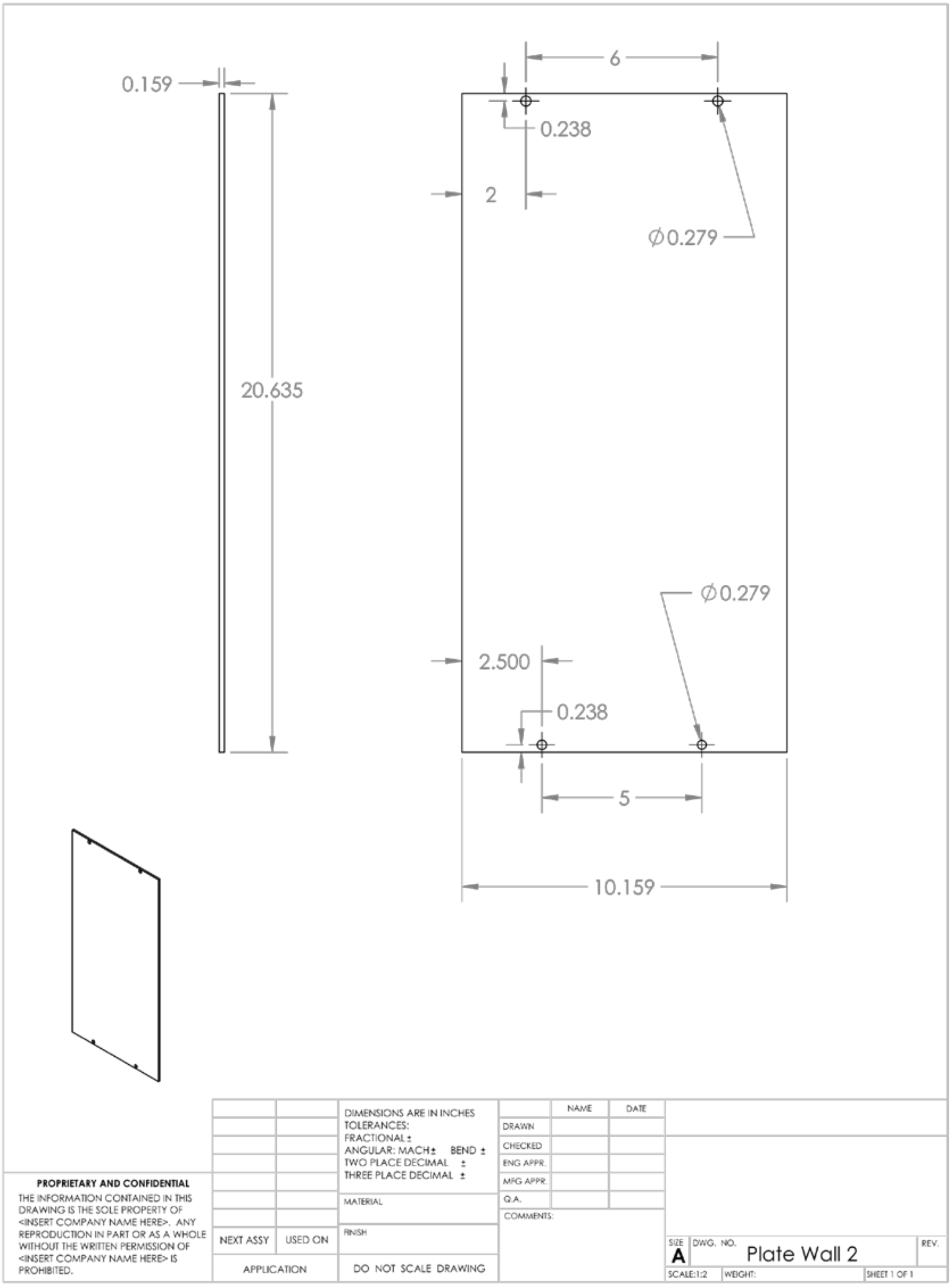

Figure A3. Mechanical drawing of HAXDT structure wall with dimensions in centimeters. This wall mounts to the bottom (Fig. A2) and top (Fig. A4) plates on all four sides of the structure.

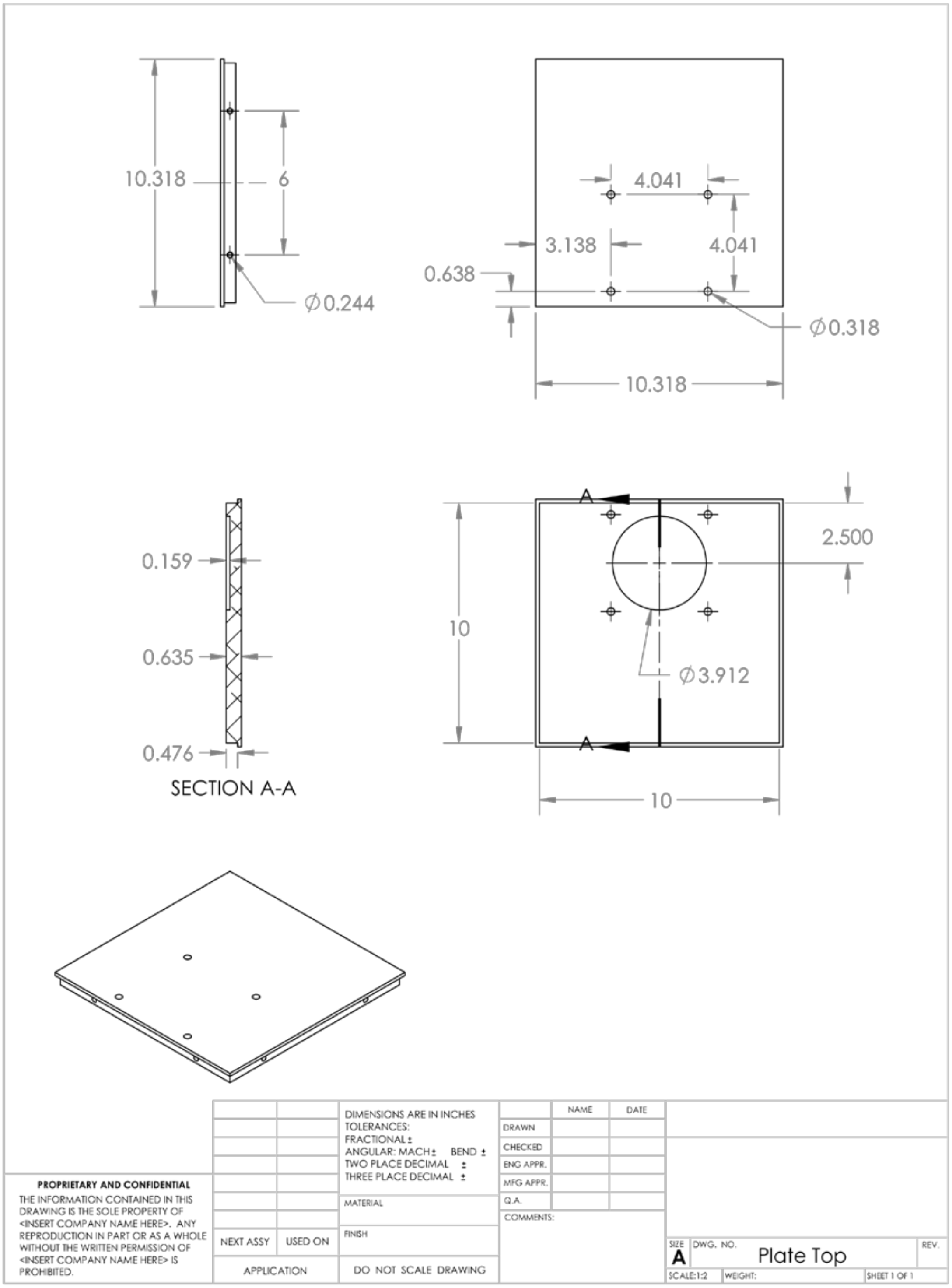

Figure A4. Mechanical drawing of top plate of HAXDT structure with dimensions in centimeters. The detector housing (Fig. A5) attaches to this plate.

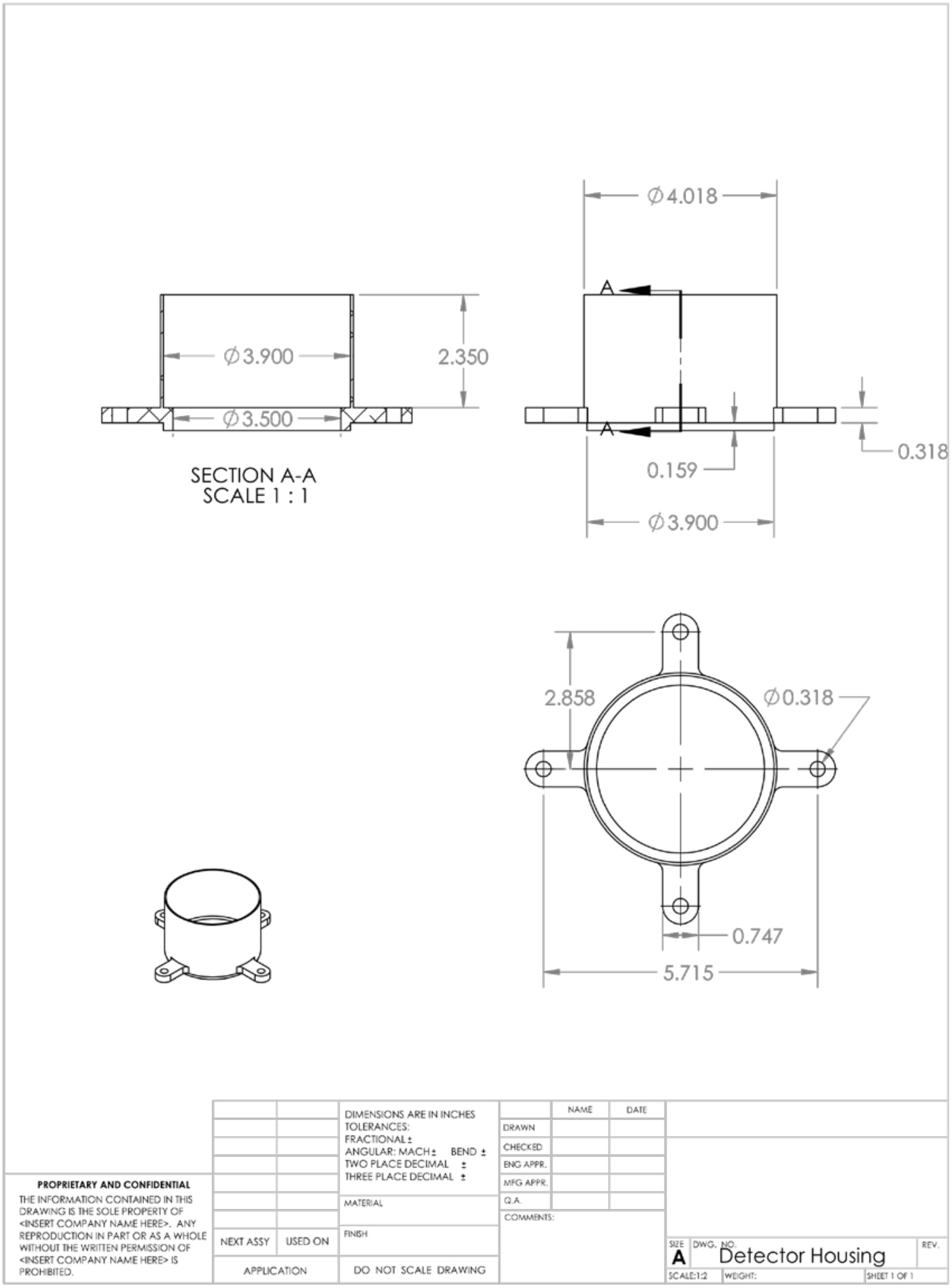

Figure A5. Mechanical drawing of detector housing with dimensions in centimeters. This housing attaches to the top plate (Fig. A4).

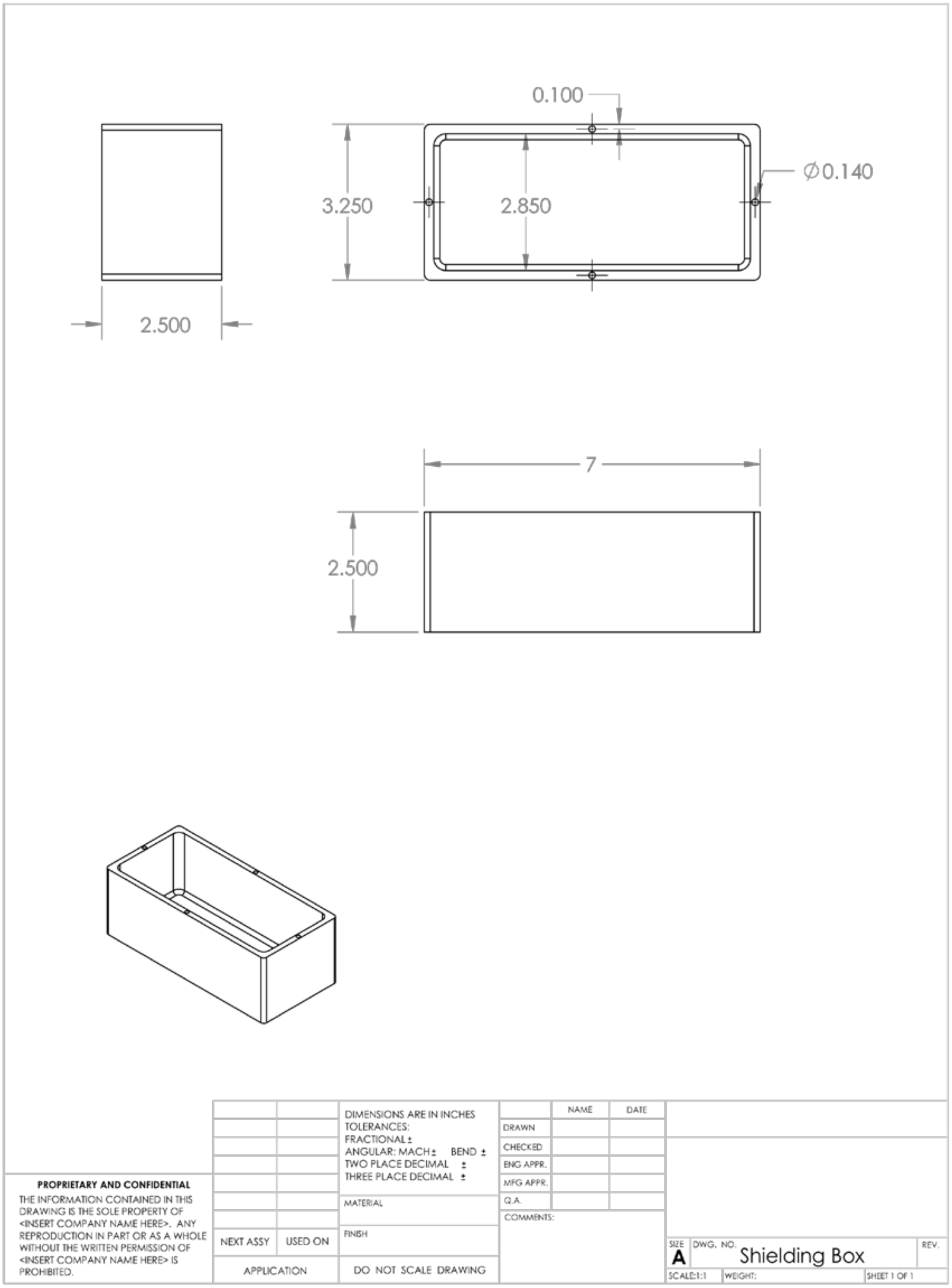

Figure A6. Mechanical drawing of electromagnetic shield for the detector board with dimensions in centimeters. See Figure A8 for positioning on detector board.

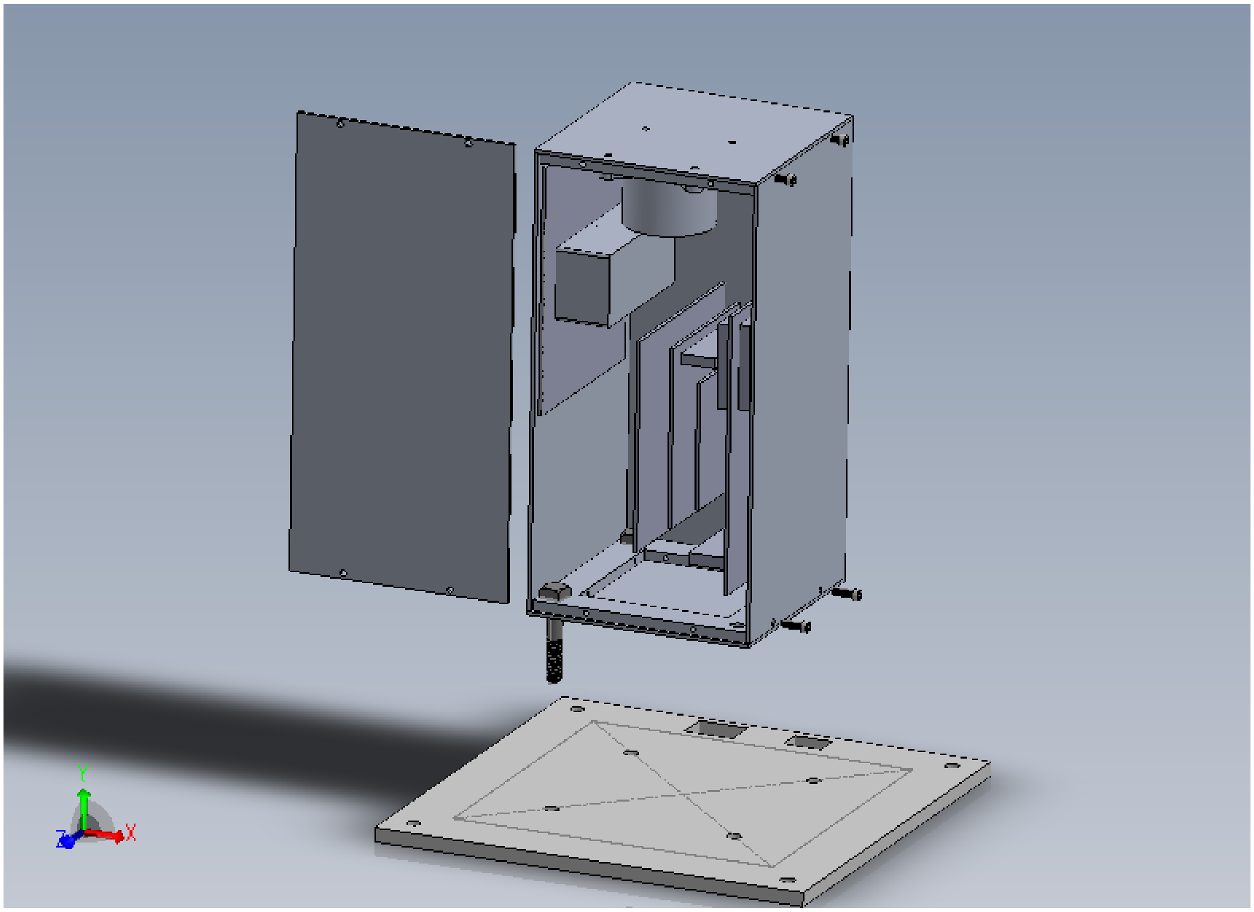

Figure A7. 3-D rendering of partially exploded view of structure.

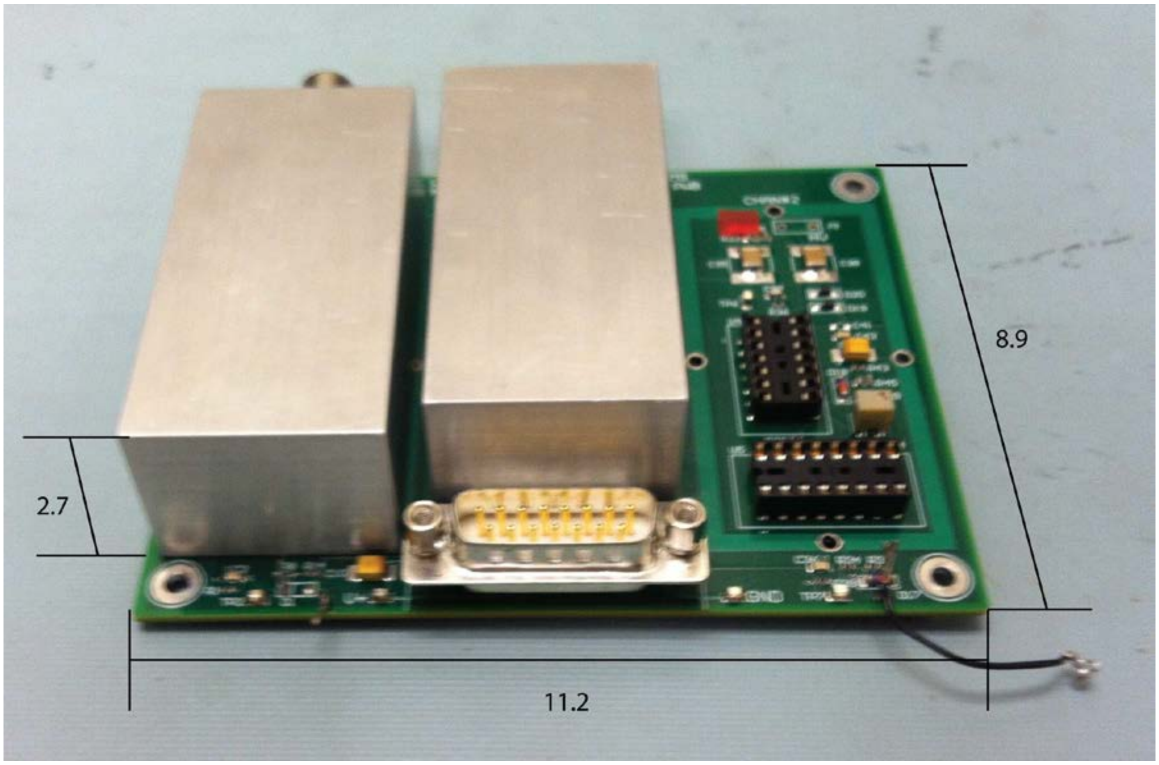

Figure A8. Picture of detector board with dimensions in centimeters.

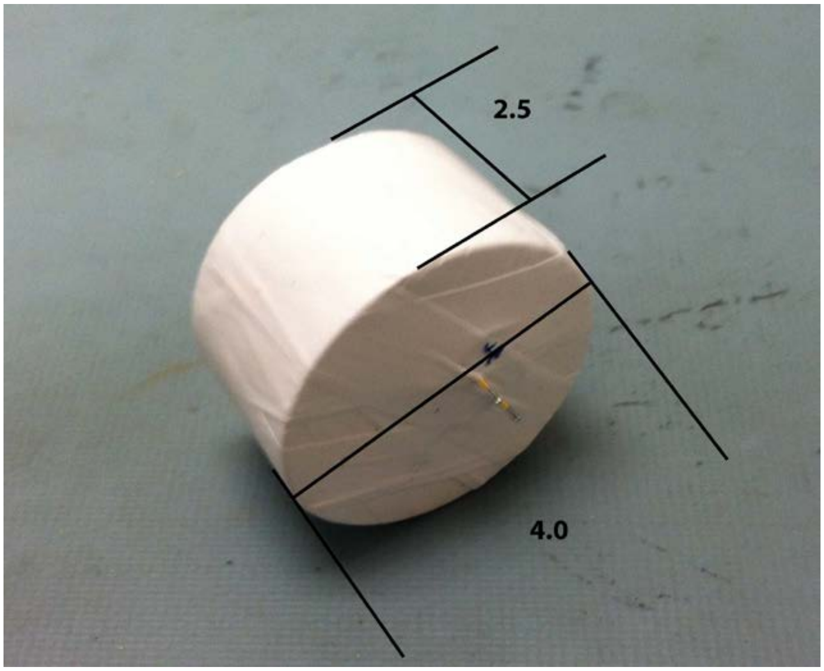

Figure A9. Detector assembly (photodiode affixed to scintillator and wrapped with Teflon tape) with dimensions in centimeters.

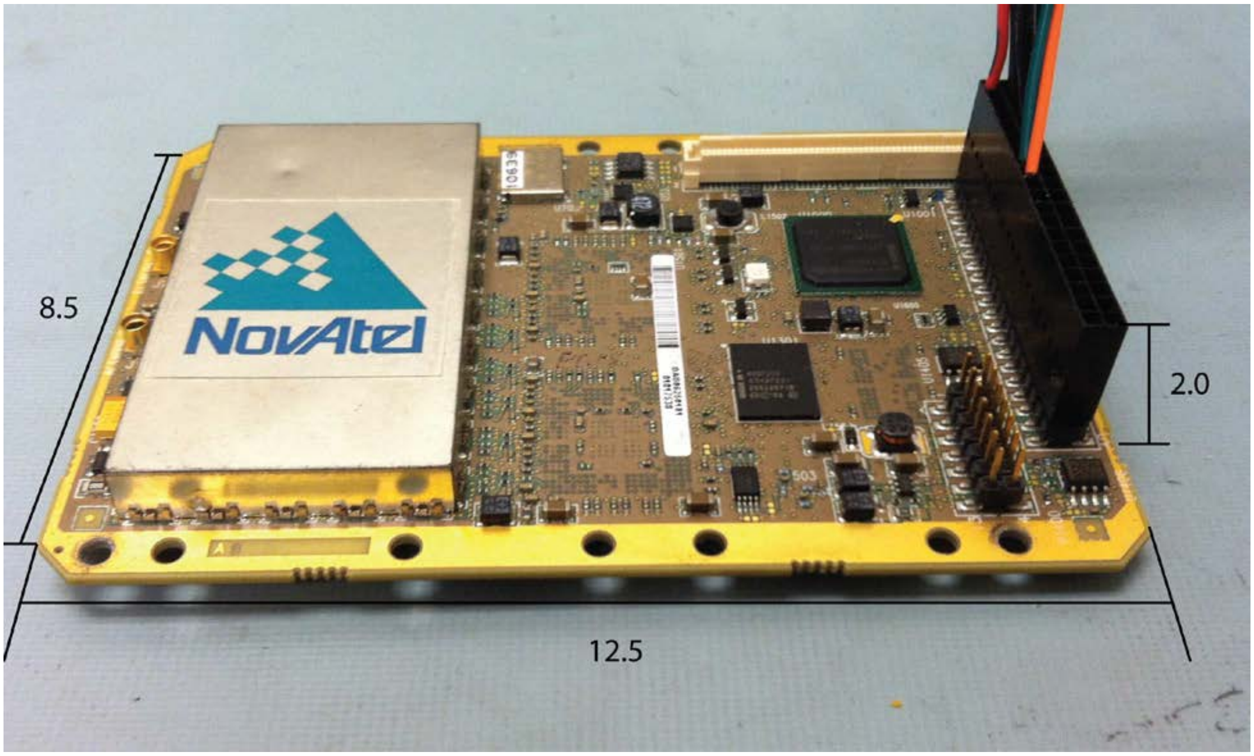

Figure A10. Picture of Novatel GPS receiver and wiring harness with dimensions in centimeters.

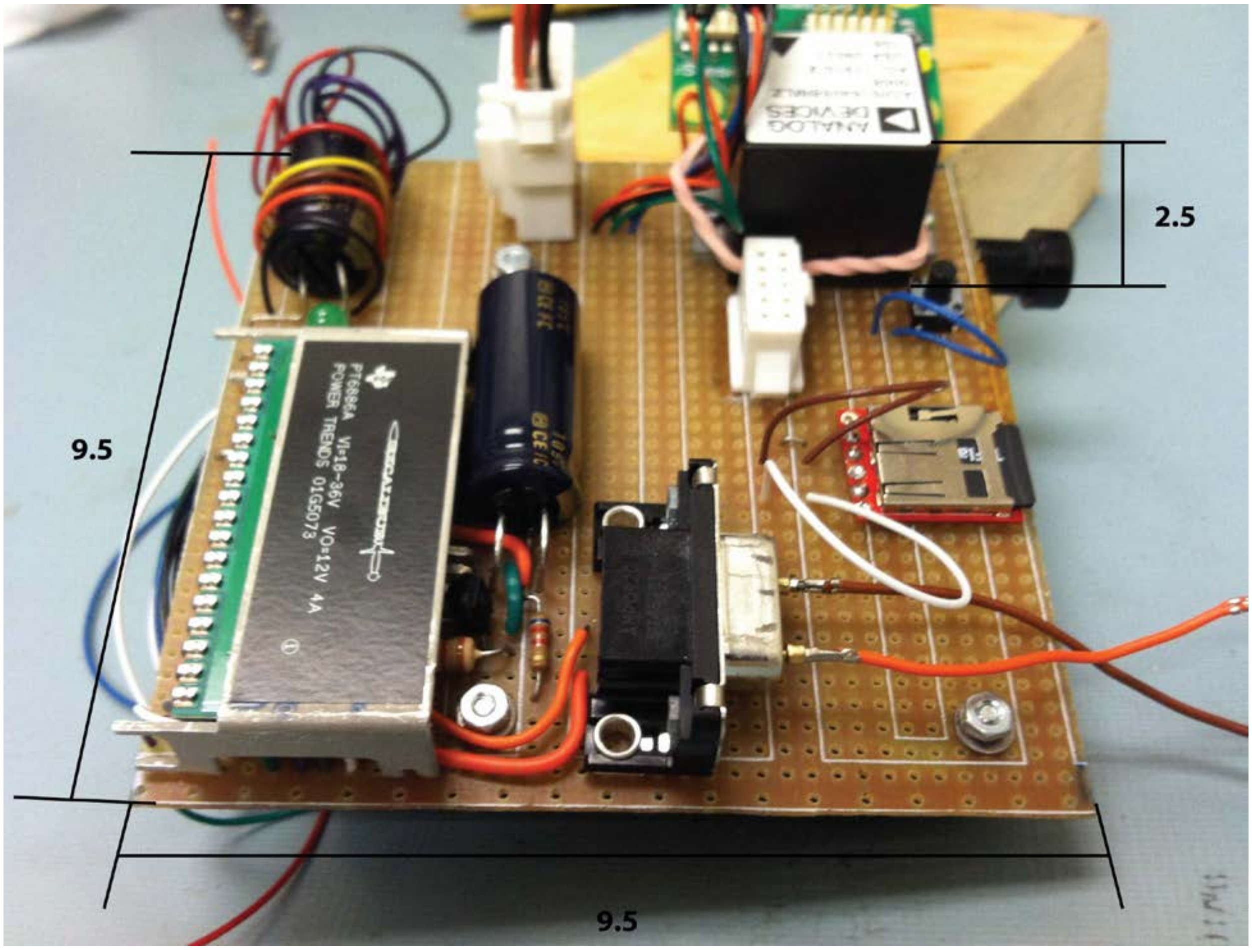

Figure A11. Picture of power circuit and IMU with dimensions in centimeters. This board serves as the mounting base for the daughter board and flight computer (see Figure A5).

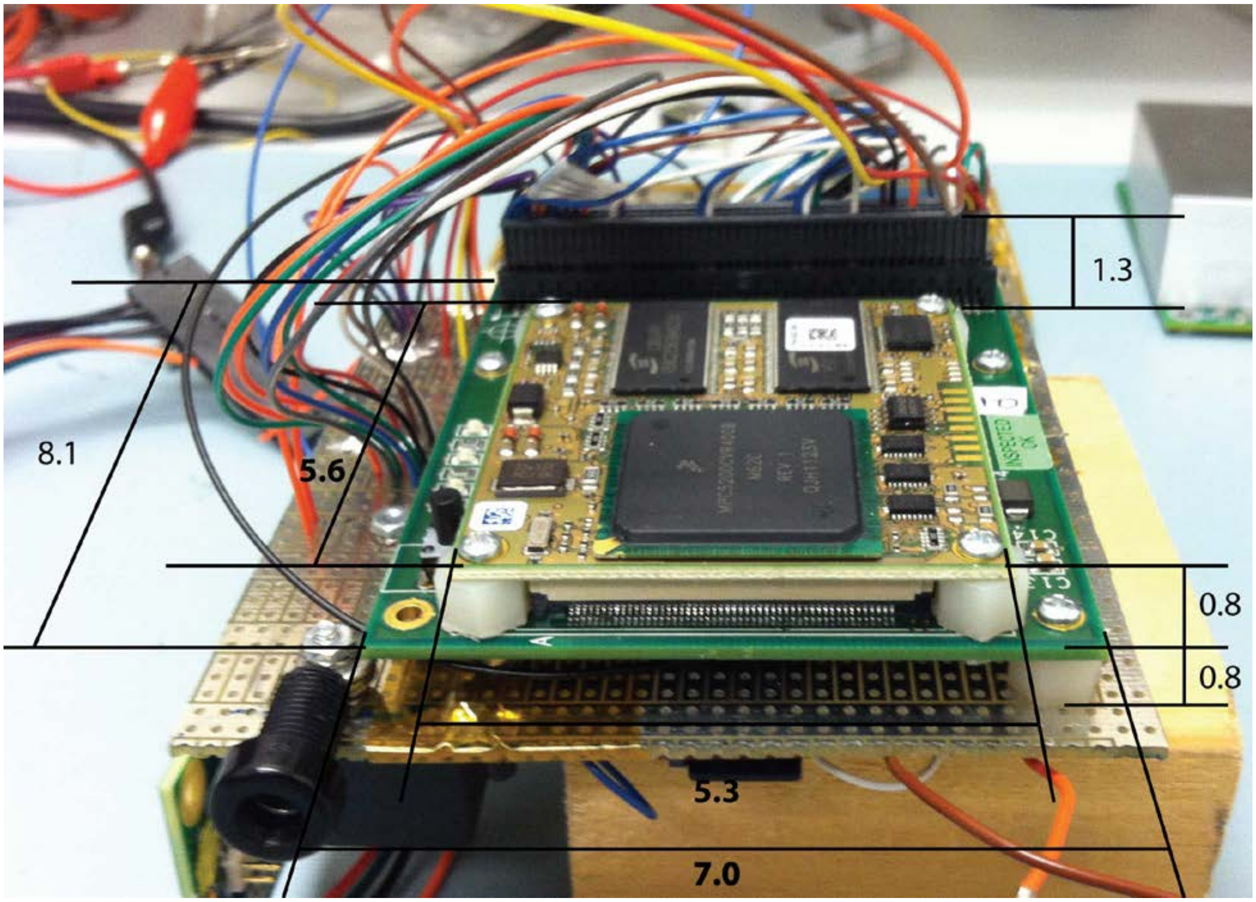

Figure A12. Picture of daughterboard (green board) and flight computer (tan board) stacked and mounted to power circuit with dimensions in centimeters.