

Technical Memorandum**No. EDSGN100.002**

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To: Lockheed Martin Corporation

From: EDSGN100 Section 002
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Subject: Penn State University
EDSGN 100: Introduction to Engineering Design
Client-Driven Design Project, Spring 2016

Purpose. The purpose of this Memorandum is to present a redesigned USB Hub Mounting Bracket as a debug and auxiliary mounting device for a custom avionics mission system. The Mounting Bracket will have a reduced number of parts for its assembly and will provide a vertical installation configuration.

Background. The subject of this memorandum is a USB Hub Mounting Bracket. Mounting brackets are typically used to hold USB Hubs in place on a given surface while preventing attached cables from being disconnected. The objective of this project is to redesign the mounting bracket that will be used as a debug and auxiliary mounting device for a custom avionics mission system. The primary goal of this project is to reduce the total number of parts for this assembly. As a stretch goal, design teams should consider methods for increasing the capacity of USB connections as well as a vertical installation. Prototype designs may be for use with any COTS USB hub that meets the overall total port requirement.

Sponsor. Lockheed Martin is headquartered in Bethesda, Maryland and is a global security and aerospace company. The company employs nearly 126,000 people around the globe. Specifically, Lockheed Martin is involved in research, development, design, manufacturing, integration, and technology systems sustainment.

Project Description. The Design Team's rationale to work on the USB Hub Mounting Bracket was that the Mounting Bracket could be easily modeled in SolidWorks. The redesigned Mounting Bracket is meant to reduce the number of assembly parts and provide a vertical installation configuration. The bracket is designed for a seven-port USB hub, for vertical mounting, and for new cable retention for USB and power tables. As part of the analysis of the design, the design team identified the necessary and required components of the mounting bracket, researched similar mounting brackets, created a unique design that was deemed efficient, and reduced the amount of material used for the bracket to decrease the price of manufacturing.

Procedures. When coming up with an improved design for the mounting bracket, the design team first began by sketching possible alternatives based on previous designs. In an effort to improve the economic efficiency the new bracket design, materials were removed where they were deemed unnecessary for the bracket (Image 1 in attachments). The group also made two assumptions: six holes for mounting would be more appropriate to use and a retention clip would be unnecessary. Once a final concept for the new alternative bracket was visualized, the design team used SolidWorks to create a 3-D model of the bracket (Images 2 and 3 in attachments). Following the design criteria, the initial sketch, and the assumptions made, the SolidWorks model of the mounting bracket that was created ended up having a unique, cage-like design. The front of the model eliminates the need for a retention clip as the “cage” will be placed over any wires/cables connected to the hub. After a final 3-D design was agreed upon, a model of the mounting bracket was created using a 3-D printer (*Image 4 in attachments). Unfortunately, there was an error with the 3-D print so the model created is not entirely correct. Due to the defective 3-D print, a direct evaluation of the physical mounting bracket could not be completed by the design team.

Results and Discussion

Findings:

Upon review of the original USB Hub Mounting Bracket, it was apparent that the model could be optimized by including fewer parts while retaining the same function. To do this, the design team found that the object could be made using a unibody building technique to reduce many individual parts yet retain the same function.

Results:

After testing some possible solutions, the most optimal model was constructed. The new model:

Original Model:

Total Unique Part Count:1
Total Part Count:1
-Base Hub Enclosure:1
-Power Retention Bar:1
-USB Retention Bar:1
-Screws:6
-Washer:0
-Lock Washer:0

Total Unique Part Count: 6
Total Part Count: 27
Base Hub Enclosure:1
Power Retention Bar: 1
USB Retention Bar:1
Screws:8
Washer:8
Lock Washer:6

Evaluation:

Evidently, the design team drastically reduced the amount of materials needed to construct the USB Hub Mounting Bracket by reducing the amount of screws. Further, since the product is unibody, the need for washers and lock washers was eliminated. Despite the major reduction in parts used to make the USB hub mounting bracket, the product retained its original function.

Conclusions and Recommendations. The re-designed bracket is unibody rather than the original six unique parts. Retention bars for both the power and USB are part of the unibody and are

essentially prongs that are close enough together to ensure the wire does not slip through. Rather than eight screws, washers, and lock washers, there are now only six screws and zero washers and lock washers. The new 7-port USB hub has minimized total part count by about 20 parts. Working on this project was very enjoyable and we welcome any other tasks and future projects. Thank you for allowing us the opportunity to work on this project and please feel free to contact us about any questions or other inquiries at 814-865-4700.

References. References for the memorandum include the Statement of Work and the Lockheed Martin Presentation discussing the project kickoff. Both references can be found on ANGEL in PDF formats.

Attachments. Images 1, 2, 3 and 4 are present below as attachments.



Image 1
Initial Sketch

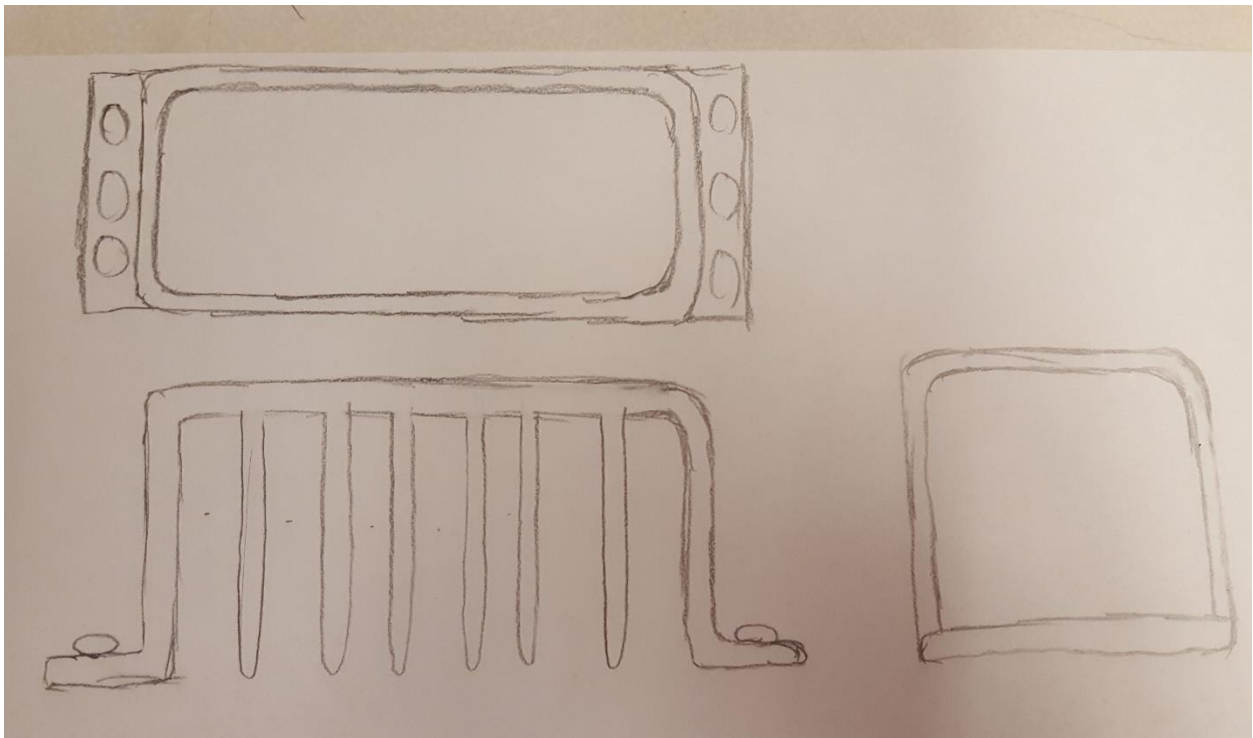


IMAGE 2
SolidWorks Model View 1

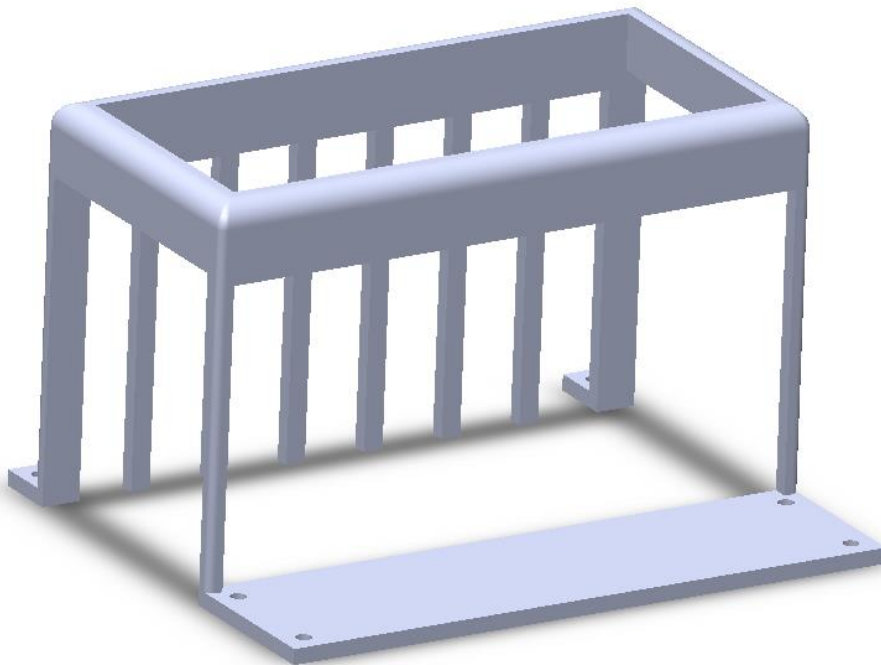


IMAGE 3
SolidWorks Model View 2





IMAGE 4
3-D Printed Prototype (*defective)

