

Internship Final Report

# Multifunction Habitat Workstation/OLED Development

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## Abstract

**This paper gives a general outline of both a multifunction habitat workstation and the research put into an Organic Light Emitting Diode (OLED) device. It first covers the tests that the OLED device will go through to become flight ready along with reasoning. Guidelines for building an apparatus to house the display and its components are given next, with the build of such following. The three tests the OLED goes through are presented (EMI, Thermal/Vac, Radiation) along with the data recovered. The second project of a multifunction workstation is then discussed in the same pattern. Reasoning for building such a workstation with telepresence in mind is offered. Build guidelines are presented first, with the build timeline following. Building the workstation will then be shown in great detail along with accompanying photos. Once the workstation has been discussed, the versatility of its functions are given. The paper concludes with future views and concepts that can added when the time or technology presents itself.**

## Nomenclature

|                |   |                                      |
|----------------|---|--------------------------------------|
| <i>LED</i>     | = | Light Emitting Diode                 |
| <i>OLED</i>    | = | Organic Light Emitting Diode         |
| <i>F.F</i>     | = | Flight Deck of the Future            |
| <i>Sandbox</i> | = | Innovation Design Center (Bldg. 348) |
| <i>EV3</i>     | = | Avionics – Human Interfaces Branch   |
| <i>HF</i>      | = | Human Factors Division               |
| <i>EMI</i>     | = | Electro-Magnetic Interference        |
| <i>T/C</i>     | = | Thermal Couples                      |
| <i>MHW</i>     | = | Multifunction Habitat Workstation    |
| <i>IC</i>      | = | Integrated Circuit                   |
| <i>PCB</i>     | = | Printed Circuit Board                |

## I. Introduction

**H**ow many times have you found yourself on an excursion, lonely, and in need of some comfort from a significant other? If your answer is never, well you're better than 99.99% of human beings. This very problem has been around since the beginning of time and will be for the foreseeable future. Knowing that people have to interact with others to stay sane is rooted in the fundamentals of science and human nature. Now that the problem has been identified, take your normal camping trip that lasts a week and change that into a three year trip to another planet. Oh, and don't forget that you will be about 40 million miles away from home. It is only natural that those trials of loneliness will get increasingly important. Issues of sanity are going to be in question 100% of the time on a trip as such. This is where solutions need to be implemented to negate the effects that will be felt by an astronaut, and where the Multifunction Workstation Habitat comes into focus. This multi-purpose workspace will allow users to interact with humans on earth in a whole new way that has never been done before. The tele-presence capabilities

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will enable them to feel home and surrounded by the environment while actually in a cramped space module. Many features will be utilized to make this idea a reality, including the development of commercial OLED displays. OLED displays are starting to blossom in the reaserach world today with new iterations and creations coming out every few months. The newest technology using OLED technology is the flexible monitor. This monitor allows the screen to be curved around the user to engage the pereferal vision and give a completely immersive feel. For space flight purposes, it is only necessary to test the standard OLED displays to see if their usage could be implemented on future space crafts.

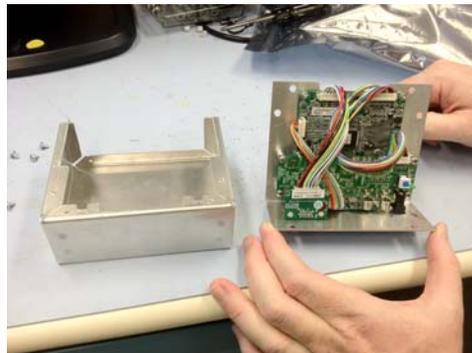
## II. OLED Development

Implementing a new technology or piece of hardware into a space craft, unfortunately, is not as easy as sticking in there and hoping it works. There are a number of different tests that equipment must pass in order to get the approval for space flight. Some of these tests are vibration testing, EMI testing, Thermal/Vacuum testing, and radiation testing. The OLED device that we have will only be submitted to three tests: EMI, thermal/vac, and radiation. These tests will give a good indication of whether or not the display can handle the elements that it may meet in a space adventure. Another important fact that should be stated is that the testing that will be completed is solely for engineering evaluation. The display is not in the process of being flight prepared at this point. An evaluation of this caliber will simply give us baseline data and information of whether or not it can be taken to the next step in the process which is yet to be determined. Now that the testing and purposes for the testing have been identified, it is time to figure out what is necessary to execute all of the tests. To begin, the OLED device to be tested is from Honeywell and came with very little information. It consists of four circuit boards to drive the display and interact with other inputs. The four boards consist of display adjustments, an input terminal that is VGA for the display and two boards to help drive the display. The PCB that drives the board is attached to the display by a very short, thin flexible information strip. Keeping all of these pieces together and in tact proved to be an issue when mounting the components.

### IIa. Containment Apparatus Guidelines/Build

The first task that needed to be done before testing, was to take the Bud boxes previously purchased and mount the hardware onto or into it. This included mounting the PCB's inside the box and the display onto the lid of the box, along with fact that the display needed to be at a 90 degree angle to the top. The reason the components needed to be separated from the display, were rooted in the description of what was actually to be tested and the EMI test. The main goal of this project was to test the OLED display and not the boards that drive it. With this in mind, it was essential that we block off the PCB's from the EMI emissions that would be bombarding the display. Making this a very difficult task, was the fact that the flexible information strip is only an inch and half long. This meant that the board driving the display had to be very close. Along with the close proximity of these two components, the Bud box that was ordered did not have much room to play with. Setting the complications aside, solutions for mounting everything needed to be formulated. Glen Steele and I, spent a large amount of time troubleshooting ideas on how to manage the space and get everything mounted on the limited real estate. With a tentative idea in place, it was time to modify the box to our liking. The first step taken was to drill holes for the display PCB. This board is the most vital part to the operation and needed to be placed first. The placement for the board was determined keeping in mind that the display couldn't be more than 1.5 inches away and must be normal to the top surface. After some small alterations in order for the board to be situated properly and allow for adequate room for the display, it was time to move onto the other three boards that needed to be mounted. Again, Glen and I followed the same steps we had taken with the first board, keeping in mind that some of the components on the board would need to be accesable.

Figure 1: Show to the right is a picture depicting the location of the PCB's that needed to be mounted to drive the monitor from a VGA cable. All of the boards were mounted on the lid of a Bud Box to alleviate any hassles with repairing or replacement in the future.



The final task to be completed before testing could begin included making a mount to hold the display at a 90 degree angle to the top of the box. Many different ideas were brought into question when discussing this topic, but only a few were feasible. After much internal debate, it was decided that a 3-D model would be generated and printed using a Makerbot Replicator. This machine and its software allow a user to input a CAD drawing from many different programs and print the object desired. There are a number of different 3-D printers today that print with a number of different materials, but ours used PLA and ABS plastics. Due to lack of prior experience, there was a learning curve to understand how the objects should be printed and in the manner to do so. After a few different iterations and manipulations, a suitable mounting bracket came about as shown in figure 2 and figure 3.

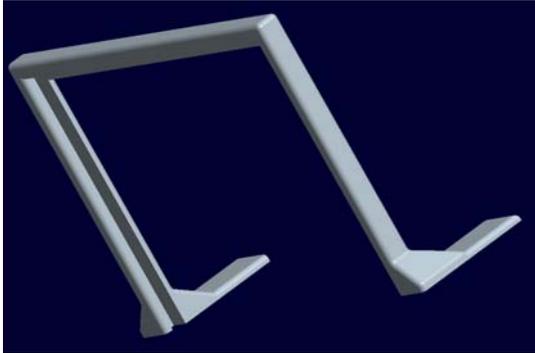


Figure 2: Shown above is the display mounting bracket to allow for 90 degree viewing. Created using Pro/E CAD program and printed using a Makerbot 3-d printer.

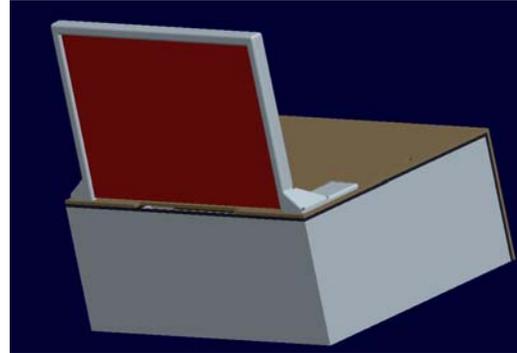


Figure 3: Above is the final rendering of the Bud Box with the display mounted using the 3-d generated mount.

Incorporating all of these steps and objects into the Bud Box completed the main build and allowed us to move into the testing phase of the OLED display.

### **IIb. Electro-Magnetic Interference Testing**

Starting off the OLED evaluation was the EMI testing performed by Jacobs technology in their building 14 chamber. EMI testing is broken up into two different categories that are very closely related, but result in two very different tests. The first test that was to be performed, was EMI emissions. Testing of this kind analyzes how much electro-magnetic emission our display puts out on its own. The main reason for this test being important is that with the amount of technology put into new space crafts, it is imperative that the components do not give off large amounts of emissions to become hazardous to other instruments. The second test conducted was EMI susceptibility. This test bombards the display with large amounts of EMI emissions to determine if the test article will have negative reactions to it. Susceptibility testing is a much more invasive and intensive process than the display would normally meet, but with the harsh conditions of space, it is ever important to test its durability. As with almost every testing



Figure 4: Above, is showing the instrumentation used to perform the EMI tests.

procedure that is conducted, there must be a number review and safety sessions. These sessions ensure that the testing will be conducted on a timeline and that safe measures will be followed throughout the test. Safety is the most important factor when performing these tests. As mentioned previously, it was very imperative to separate the display from the circuit

boards driving the display in the EMI test. In order to do this, copper tape was used to seal all of the corners and edges of the box to ensure no emissions would enter inside. Once these steps were taken, it was time to begin testing. Our method of testing was to drive the display using a lab provided laptop playing a scrolling 'x' pattern video provided by Honeywell. This scrolling 'x' pattern video allowed us to see all of the pixels of the display and how they were working during testing. A minor change to the video was necessary in order to take luminance measurements which included inverting the original colors. This modification was done by another intern and colleague of mine, Matt Salazar. This concluded the pre-test changes and allowed us to begin setup and testing. The following figure shows the setup that was used for EMI testing.

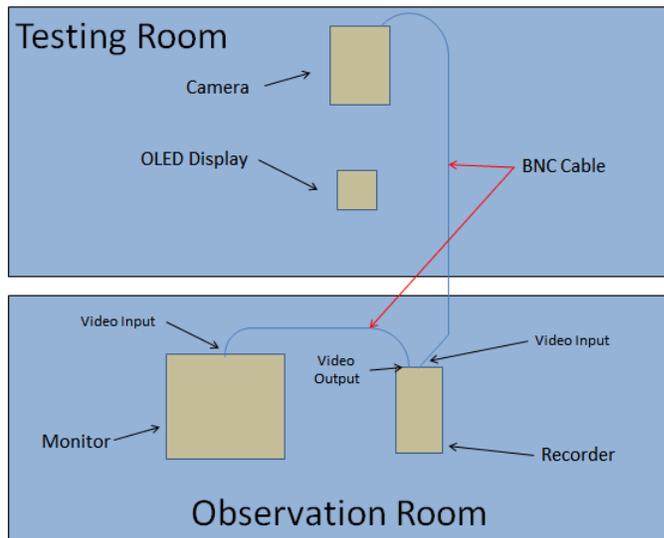
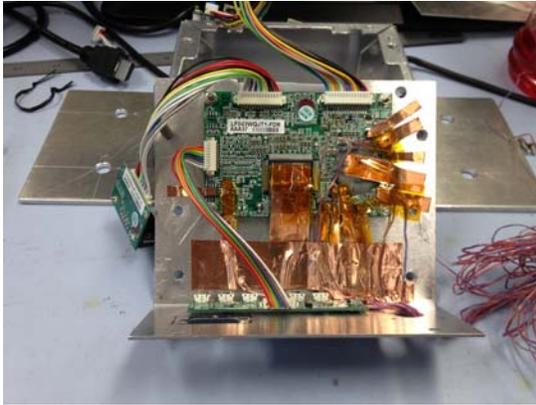


Figure 5: the figure to the left shows an illustration of how the EMI facility would be setup with all of the devices necessary.

As shown in the figure, a recorder was placed in line with the observing monitor to replay any anomalies that may have occurred. Most of testing procedures performed were done by the Jacobs professionals, and therefore, I cannot comment much on details of the test. With that, there were a number of different susceptibility tests done. These tests ranged from 200 MHz to 18 GHz with varying V/m strengths. The highest value we tested our display at was 75 V/m which far exceeded our expectations. In conclusion, the EMI test was a major success and the display experienced zero failures along the way.

### Iic. Thermal/Vacuum Testing

With the conclusion of the EMI testing, the next major hurdle to clear was thermal/vac testing. Thermal/vac testing is much more vigorous and intensive than the EMI testing we have done. There are a few main reasons to do this type of test on equipment; the first is to see if the devices can handle the extreme temperature changes it will experience in space. The second reason is to see if the device can operate properly in a vacuum atmosphere. Being able to work flawlessly and be robust during these two tests are very imperative. The thermal/vac test that was performed would be separated into 3 different parts. The first being pressure changes from 10 to 8 to 4 psi with a 15 minute soak in between stages. Following the initial test, is the second and most laborious section of testing. It consists of temperature changes at 10, 8 and 4 psi sequentially. The test includes lowering the pressure of the chamber to the desired value, dropping the temperature of the display to -20 degrees fahrenheit, giving the display a soak of 30 minutes, raising the temperature of the display to 120 degrees fahrenheit, followed by a soak of 10 minutes. This cycle was then repeated for the remaining two pressures. The third and final test, was a constant pressure drop at a rate of 1psi/min and 2psi/min from 14 psi to 0 psi. Knowing how the display would be tested, allowed us to prepare the test article as best as possible. There were a number of modifications that needed to be done in the short amount of time after the EMI test and before the thermal/vac test. Among them, was adding additional conduction to the hotter components of the PCB's. This extra pathway (shown in figure 6), made of copper tape, will help make up for the loss of convection in the vacuum-like atmosphere. Another addition to the device was applying thermal couples on the important or hotter components. The thermal couples allow us to monitor the temperature of such components while the test is in progress. There were a total of 11 T/C's used in the test article with 9 being inside attached to the boards, one attached to the back of the display and one attached to the top of the display box. During testing, we were initially going to use the T/C on the top of the box as a constant for the testing procedure, but changed to the display T/C due to a major temperature drop on the display.



After some initial hiccups in the testing, the three tests were finalized with the display having zero malfunctions. The following results proved that the display can handle some of the tortures of space adventure.

Figure 6: Shown to the left, is the lid of the display box with the copper tape and the T/C's attached.

The graphs and values that are shown in figure 7-9 are in raw form and are still being processed, but they show primary results. The first graph is showing the luminance vs. time measurements that were taken in 30 minute intervals.

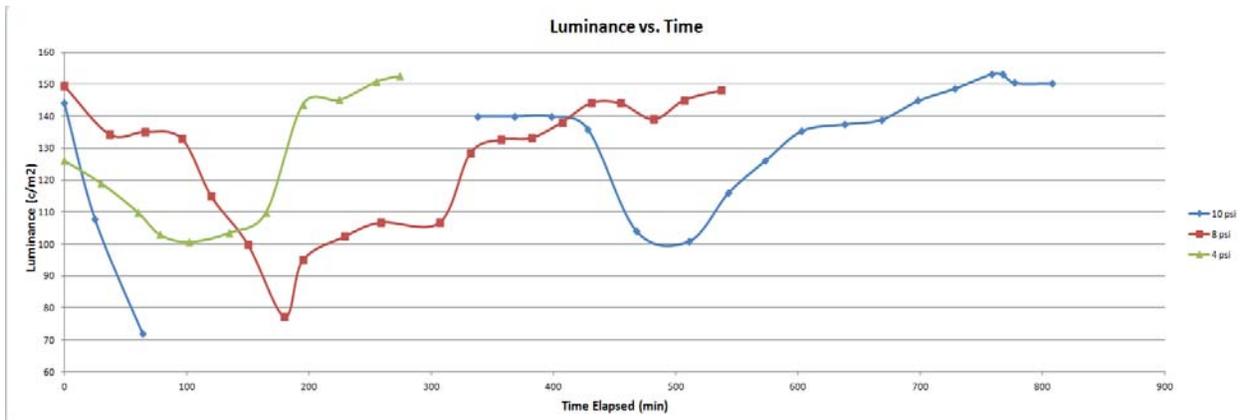


Figure 7: Above is the luminance vs. time graph for the Thermal/Vac Testing.

Luminance measurements give us an inclination as to how much light the display is actually outputting at a given time. As shown, the graph gives direction as to what is happening within the test chamber with the ups and downs of the graph. The portions of the graph where the values dip down are periods where the chamber is lowering the temperature to -20 degrees Fahrenheit. The portions of the graph where the lines are increasing are periods where the chamber is raising the temperature to 120 degrees Fahrenheit. The second graph that was generated shows the current draw of the display with respect to time.

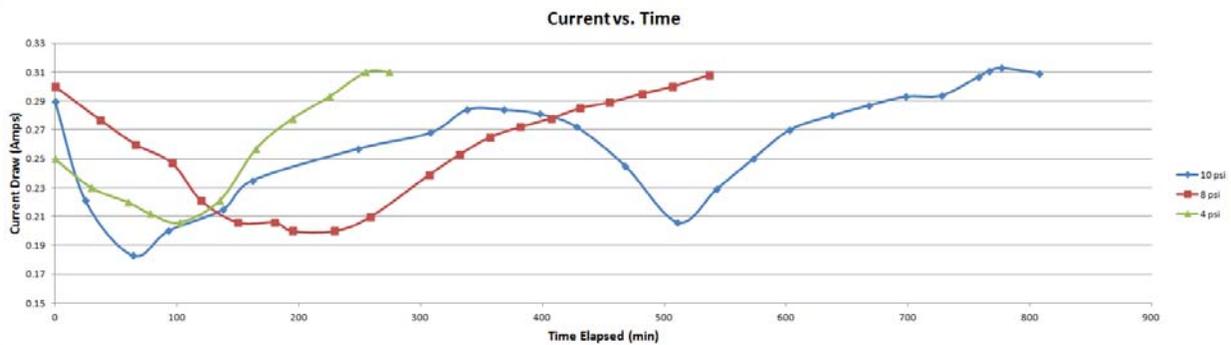


Figure 8: Above is the current draw vs. time graph for the Thermal/Vac Testing.

## Internship Final Report

The idea behind taking current readings was to compare the current draw data and the luminance data. These two data will allow us to make conclusions as to why the luminance may drop or why it may rise with temperature changes. By looking at the two graphs simultaneously, it is evident that when the current draw drops, the luminance drops. The opposite is also true when the temperature rises. This phenomena will give us some insight into the characteristics of the display and how it behaves with varying temperatures. The third and final graph that was formed through the second test shows four T/C temperatures versus time.

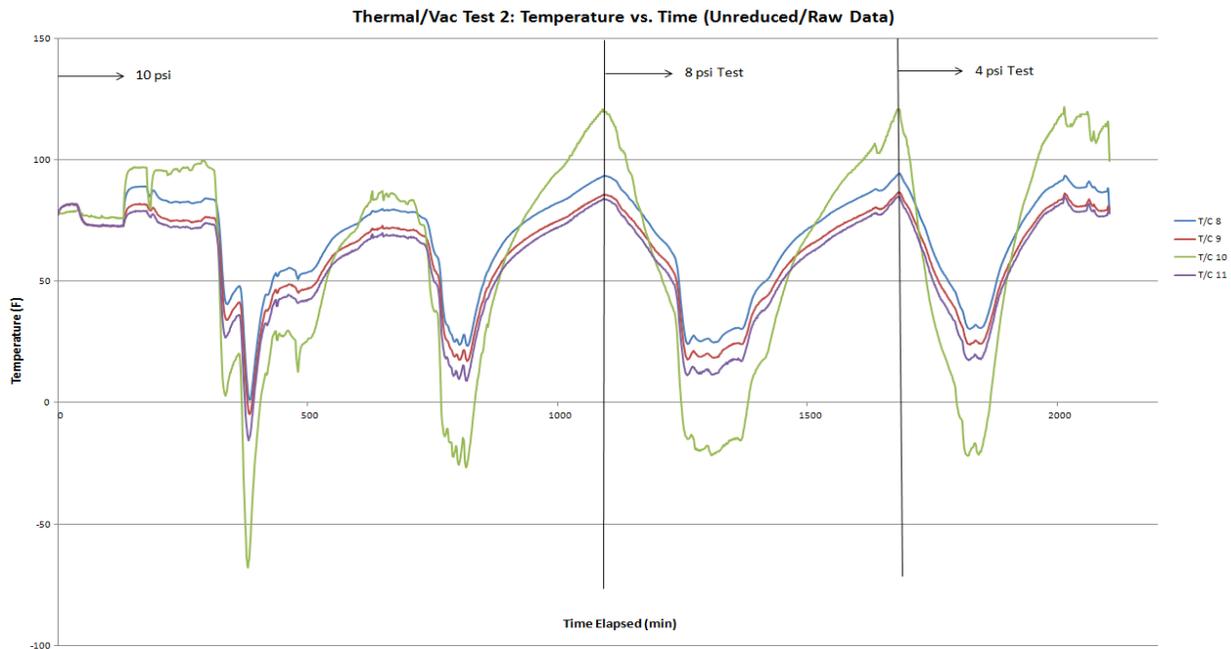


Figure 9: Above is the current T/C temperatures vs. time graph for the Thermal/Vac Testing.

The four T/C's that are shown in figure 9 were the most important spots either on the box or inside the box that we wanted to measure during the test. The graph emphasizes the change in temperatures that occurred during each pressure change and the issues that crept up along the way. The first major dip down in the graph represents the excursion that happened when the display reached -69 degrees fahrenheit. Unfortunately, the display was only supposed to reach -20 degrees fahrenheit, but due to a lack of previous knowledge, the mishap went undetected for a period of time. To our benefit, the display handled the extreme temperature very well and helped solidify its performance. The rest of the testing went smoother and can be represented by the following peaks and valleys on the graph. The thermal/vac testing helped us gather a great deal of information regarding our display and its functionality. Despite the doubts that the display would handle the treacherous conditions of the testing, it performed perfectly and gave a good outcome for OLED technology.

### IId. Radiation Testing

Radiation will be the third and final test for the OLED display that is being analyzed. This radiation testing will happen late August at Indiana University in their research facility. I will not be able to attend this testing, and therefore, the data will be compiled elsewhere by George Salazar.

### III. Multifunction Habitat Workstation

The second project that I worked on for this summer internship was the multifunction habitat workstation (MHW). The concept behind its development is very straightforward which aided the creation of the workstation. To begin, there was one main reason for the MHW. This reason was telepresence. Telepresence has been developing more and more in the past years and is something NASA is on the forefront of. This technology will help bring control, sanity, and development to astronauts. Telepresence allows the user to feel as if he is immersed in the environment

with which he is interacting with. With 3-D monitors and 5.1 surround sound, he/she will be fully engaged with the other end/user. Using these devices, we can simulate the feeling of being on earth and create a sense of comfort that would normally be lacking. Even though telepresence was the main driving force for the MHW, it has the ability to do so much more. It can play 3-D videos from two blu-ray players, record and playback 3-D videos, build 3-D objects using the printer on the workstation and communicate with ground stations. Having all of this functionality packed in one workstation will allow the user to do almost everything necessary without moving to another device. This build was much more laborious than the OLED display project, but took about the same amount of time commitment. Once the ideas for the workstation had been covered, it was time to begin the building process.

### IIIa. Workstation Guidelines/Build

Oron Schmidt was the initial designer of the MHW and supplied myself with the first ideas of how to approach the build. We knew that we wanted to put as much functionality in as little space as possible. Some of the restrictions we had on keeping the size down was to keep the width small enough to fit through a standard door, the height to be short enough to fit in a work van and to make room for a 3-D printer. The next step into making this workstation possible was to generate models using the CAD software Pro/E. Using Pro/E, we could build a model, troubleshoot the design, then make adjustments as needed. A process like this allows builders to make many different designs and find the problems without wasting any material or money. Making all of the guidelines happen were almost impossible with the addition of 5 inch caster wheels on the bottom, so a different approach was taken to keep the height down. It was determined that the wheels and bottom frame could be made as its own part (act as a dolly) and the rest of the components could be another piece all together. Once this hurdle was crossed, it was time to move on to the other guidelines that needed to be met. The MHW needed to hold 2 large touchscreen monitors on the outside and hold 4 standard monitors on the inside along with all of their equipment. It needed to have a desk that could be accessible by the user to place objects such as a keyboard, mouse or anything else on. It also needed to have adequate room for the sound system that was to be placed strategically on the arms and workstation itself. The first iteration of the design was provided by Oron Schmidt as shown in figure 10. From this original design, Matt and I were then able to convert our ideas for the workstation into a Pro/E design which is shown in figure 11.

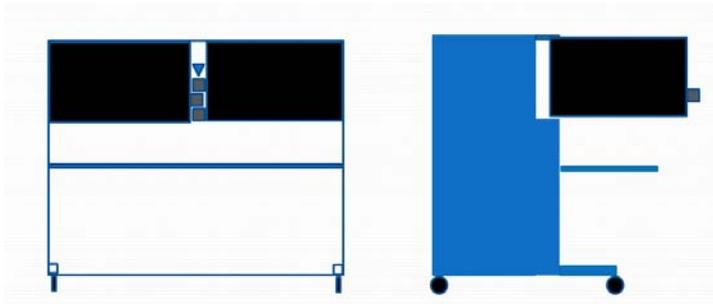


Figure 10: Left, is the preliminary design that Oron Schmidt had designed.

Figure 11: To the right, the first design using Pro/E is shown.

As you can see, the first design had a number of issues that needed to be addressed in order for it to be practical. The arms to hold the display are not present, the desk for the user was not practical, and the height was too large to fit in the standard van. But with this primary design, we were able to assess the changes that could be done, and implement them into the second revision. This second revision included re-designing the entire frame design to make it lighter, easier to maneuver and fit in the work van. Figure 12 shows the updated model.



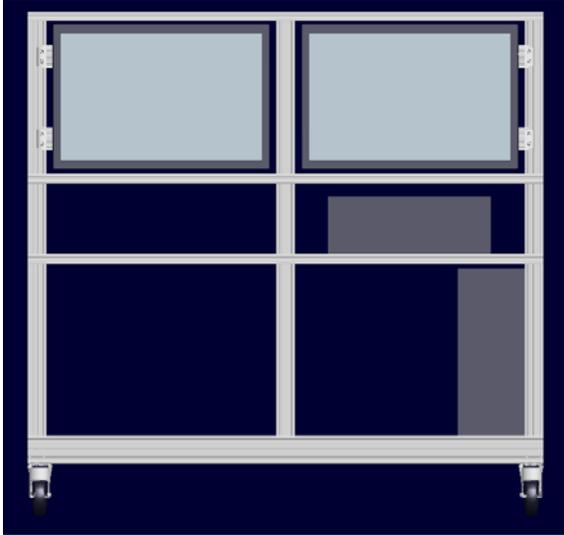
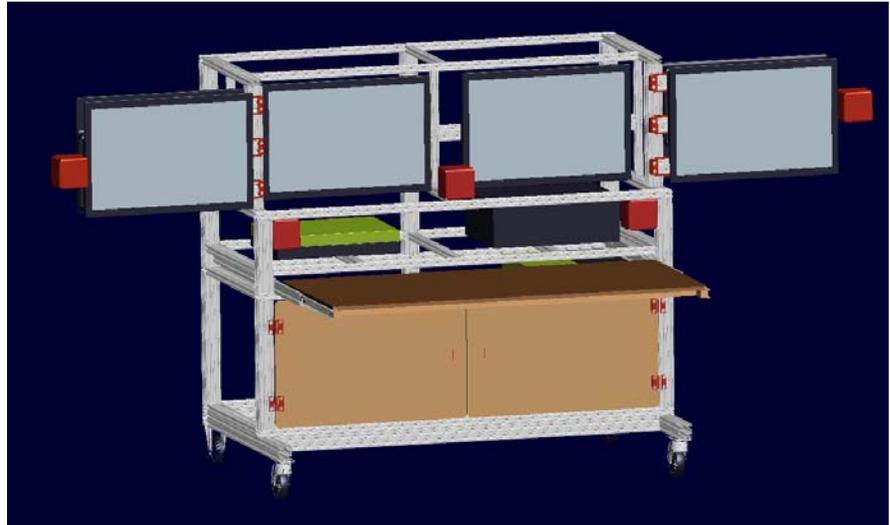


Figure 12: To the left, the second design using Pro/E is shown.

The dolly method was the most important step that was taken on this second revision. It allowed us to remove the dolly from the rest of the cart to fit it in the van, then replace the dolly when moving within a building. Along with the dolly, the monitors and the mounting devices were created in this draft. These two additions helped propel the MHW into its final design stages which are to be found in figure 13.

Figure 13: Shown below, is the final design for the MHW using Pro/E.

With the addition of the slide out desk, the extra room for the stereo receiver/ 3-D printer and the swivel arms, the modeling was completed. Oron and I went over some design reviews to make sure all of the bases had been covered, and finalized the concept. This design was a vast improvement over the first designs and allowed us to bring all the functionality we wanted into the MHW. Now that the designing phase was done, it was time to begin building the workstation. Due to the short duration of our internships, Oron had placed the order for 80/20 material that we would be using for the frame weeks



in advance. This advancement in order placing allowed the aluminum material to be in our hands just as we wanted to start building. There were a few more parts that needed to be purchased throughout the 10 weeks which were ordered and received as well. The building process with 80/20 is as simple as it gets. After cutting the desired size of 80/20 to your specified length, t-nuts and ¼ 20 screws allow you mount the pieces together. After repeating this process many times, our bottom dolly was formed (as shown in figure 14). The learning curve for 80/20 is not extremely complex, but it seemed to take a few days to figure out the tendencies of the hardware. This dolly was the first piece of the many that would create the MHW. The process that we wanted to take for building this workstation was to build from the ground up, step by step. Therefore, the next step was to build the bottom cabinet, followed by the desk and receiver shelves.

Figure 14: The dolly is created and ready to be used by the MHW.



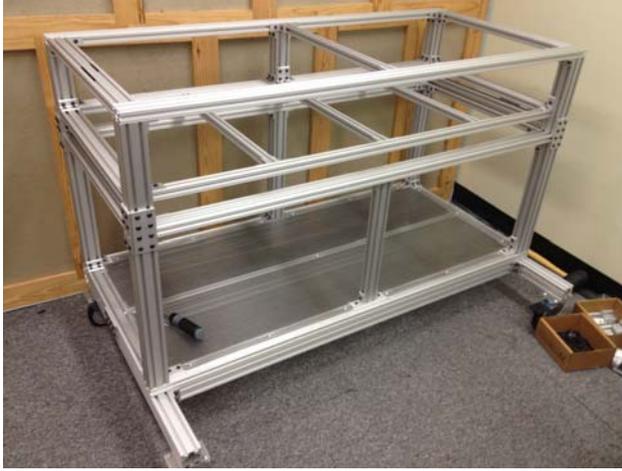


Figure 15: The bottom cabinet, desk and stereo receiver shelves have been added to the dolly.

Figure 15 shows the advancements in the building process for the MHW. Again, these additions were built in the same way using three different types of 80/20 (1010, 1020, 2020). With the progress of the build coming along very well, we were able to make large leaps every day. For the most part, we were able to get one section done per day. All in all, it took about a week and a half to get the outer framework and perforated aluminum shelves done. With the completion of the frame, it was time for us to begin adding the arm mounts and displays. These pieces took quite a bit more time as they were much more precise than the frame needed to be. Along with them being

more precise, it was necessary to make mounts for the monitors to be held on by the arms. These plates were made in the sandbox with the help of James Brown. The plates were made out of .25 inch aluminum sheets, and drilled to meet the mounting requirements for the different monitors. The next figure you see (figure 16) shows the MHW very nearly completed with the addition of the monitors, 3-D cameras, blu-ray players, receiver, speakers, cabinet doors and desk.

Figure 16: The MHW has been finished with the addition of the monitors, cameras, receiver, speakers, blu-ray players, desk, and cabinet doors.



The completed workstation will be located in the flight deck of the future in building 29 for demo purposes.

### IIIb. Workstation Functionality/Future Plans

As previously stated, the driving force for the workstation was to have as much functionality placed in one location as possible. With all of the hardware that is placed on the workstation, I think that concept has been fulfilled. So many tasks and objectives can be done without getting out of the head seat. Even though there are many different things that the MHW can do, the future holds even more versatility. One of the near future additions would be to add 3-D scanning using a Kinect or comparable device. This would allow a user to put an object on the desk, and scan it into the computers hard drive. This file would then be accessible by the user to manipulate and even print another identical part. Some of the other future plans for the MHW include: tele-medicine, motion/gesture controls, tele-operation of robotics, beam-splitter displays, auto-stereoscopic displays and a holographic generation device. Implementing these technologies into the workstation would allow it to be vastly superior to anything else that is currently available. Along with advancing space flight, it would revolutionize the way we work in space.

#### **IV. Conclusion**

Working with these two projects not only gave me a great appreciation for the work that NASA does, but allowed me to gain knowledge and experience in my working field. The space readiness tests that were performed on the OLED display were stressful and required a large amount of time, but were an amazing learning experience. The OLED technology also got a major boost to its reputation after performing flawlessly in the EMI and thermal/vac tests. With this project, I was able to get more experience in the electrical engineering field and expand my knowledge past mechanical purposes. The mechanical engineering experience I gained while working on the MHW is something I will carry with me for the rest of my life. It allowed me to take an idea and build it from the ground up. Going from the design to build to completion phases, is something I will need to be able to do in my working life. These two projects went better than I could have ever expected, and I'm so grateful I had the help and support to finish them in my short 10 weeks here at JSC.

#### **V. Acknowledgments**

A thanks goes to George Salazar for mentoring myself and helping me move forward through my internship.  
A thanks goes to Oron Schmidt for mentoring myself and helping me move forward through my internship.  
A thanks goes to James Maida and Toni Clark for helping with setup and evaluation process.  
A thanks goes to Matt Salazar for helping with much of the MHW and other projects through the summer.

#### **VI. References**

<sup>1</sup>Marmolejo, Joey, "Thermal/Vacuum Testing Evaluation," Jacobs Technologies, 2013.

<sup>2</sup>Neighbors, Helen, "Thermal/Vacuum Test Procedures", NASA JSC EV3 Division, Avionics, 2013.



**Shawn Schumacher  
Matt Salazar  
2013 Summer Interns  
EV3 - Exit Presentaiton**

**Multifunction Habitat  
Workstation/OLED  
Development**

# Overview



- Background
- Personal Information
- Project Information
- Technical Data and Facts
- Expected Outcomes
- Future Plans of Project
- Experience Gained/Future
- Questions/Acknowledgments





# Background

- From: Columbus, Nebraska
- Education:
  - Scotus Central Catholic High School
  - Hastings College – Nebraska
  - University of Nebraska – Lincoln
- Degree: Mechanical and Materials Engineering
  - Graduation Date: July, 2014
- Work Experience:
  - 2012 Summer Intern – JSC
  - Trauma Mechanics Research Assistant



# Personal Information

- University Organizations:

- Microgravity University (2011-2013):
  - Octa-Copter Designer (2013)
- Formula SAE (2011-2013):
  - Power train Team Member
    - » Fuel System Designer



- Partnership:

- Undergraduate Student Research Program (USRP)
- Internship Funding





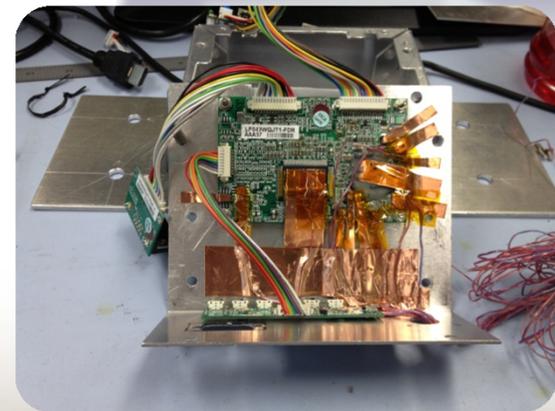
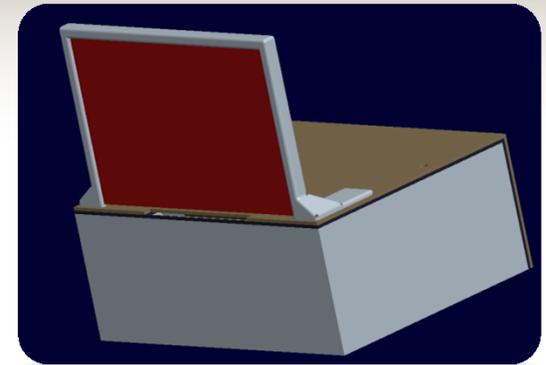
# Project Information – Part 1

- Experimental OLED Display – SAA Honeywell
  - Three Environmental Tests:
    1. Electro-Magnetic Interference (Completed)
      - EMI Emissions
      - EMI Susceptibility
    2. Thermal/Vacuum – Three Separate Tests (Completed)
      1. Pressure Reduction with Soak
      2. Temperature Change at 10,8,4 psi
      3. Constant Pressure Drop at 1,2psi/min – 14-0psi
    3. Radiation Testing (Indiana University – August)



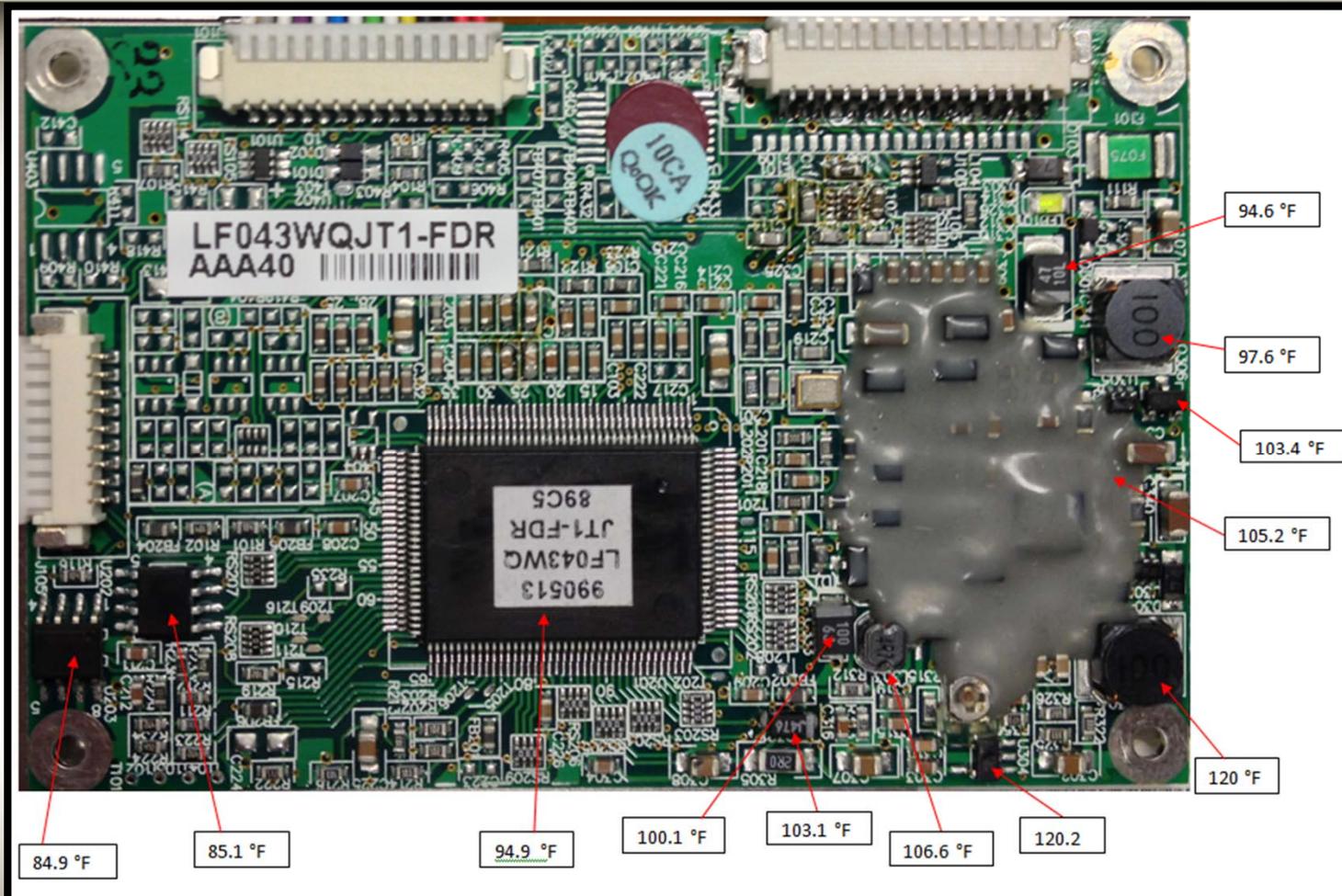
# OLED Development

- Isolate Display – Testing Purpose
  - Build Guidelines:
    - Separate PCB's from Display
    - Mount Display at 90° - 3-D Print
    - Use Bud Box
    - Seal Box
    - Power Pass-through
    - Lid Mounting
    - Attach T/C's for Thermal/Vac
    - Conduction Cool Components





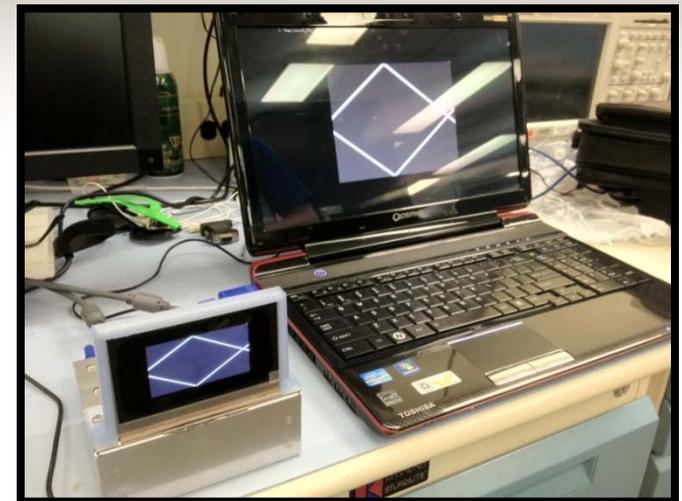
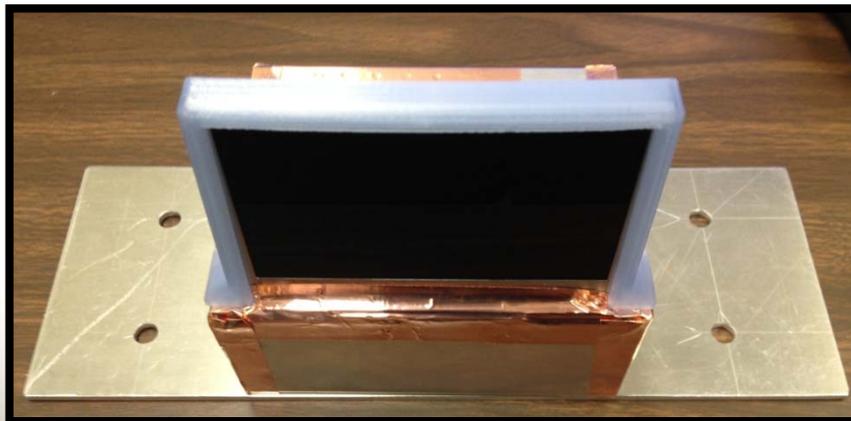
# OLED Development

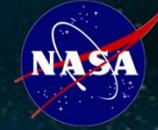




# OLED Development

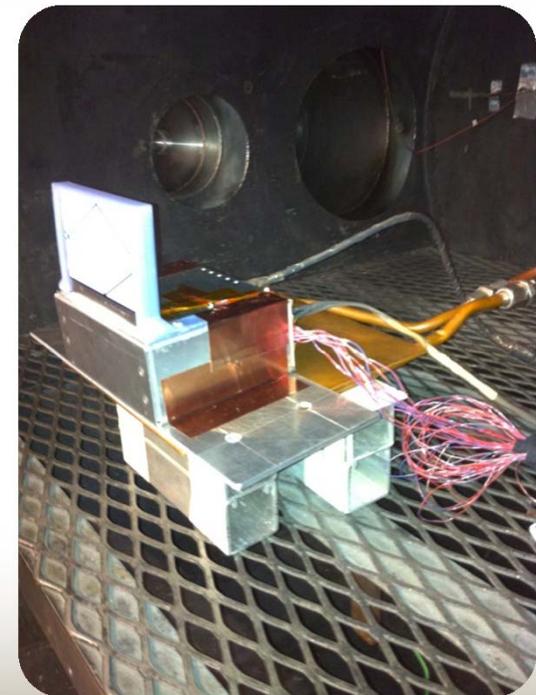
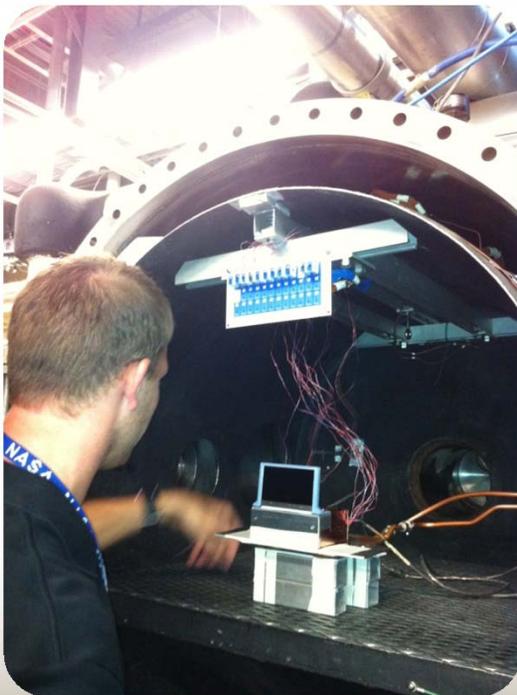
- Display Functions
  - Testing Guidelines:
    - Create Moving 'X' Pattern
    - Make 3m Power Cord
    - Comply with Thermal/Vac





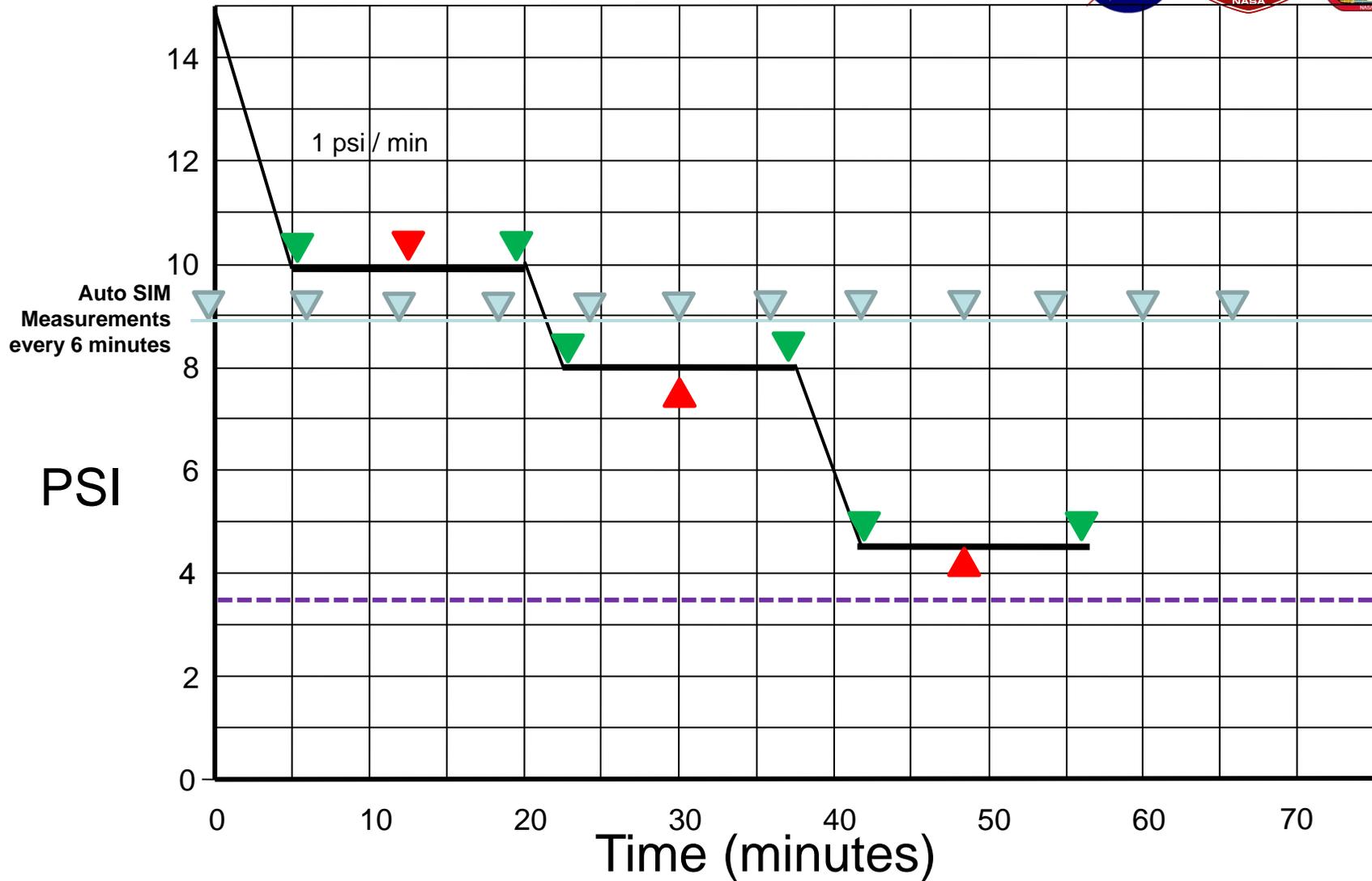
# OLED Development

- Thermal/Vac - Setup/Data
  - Data from Temperature Change at 10,8,4 psi

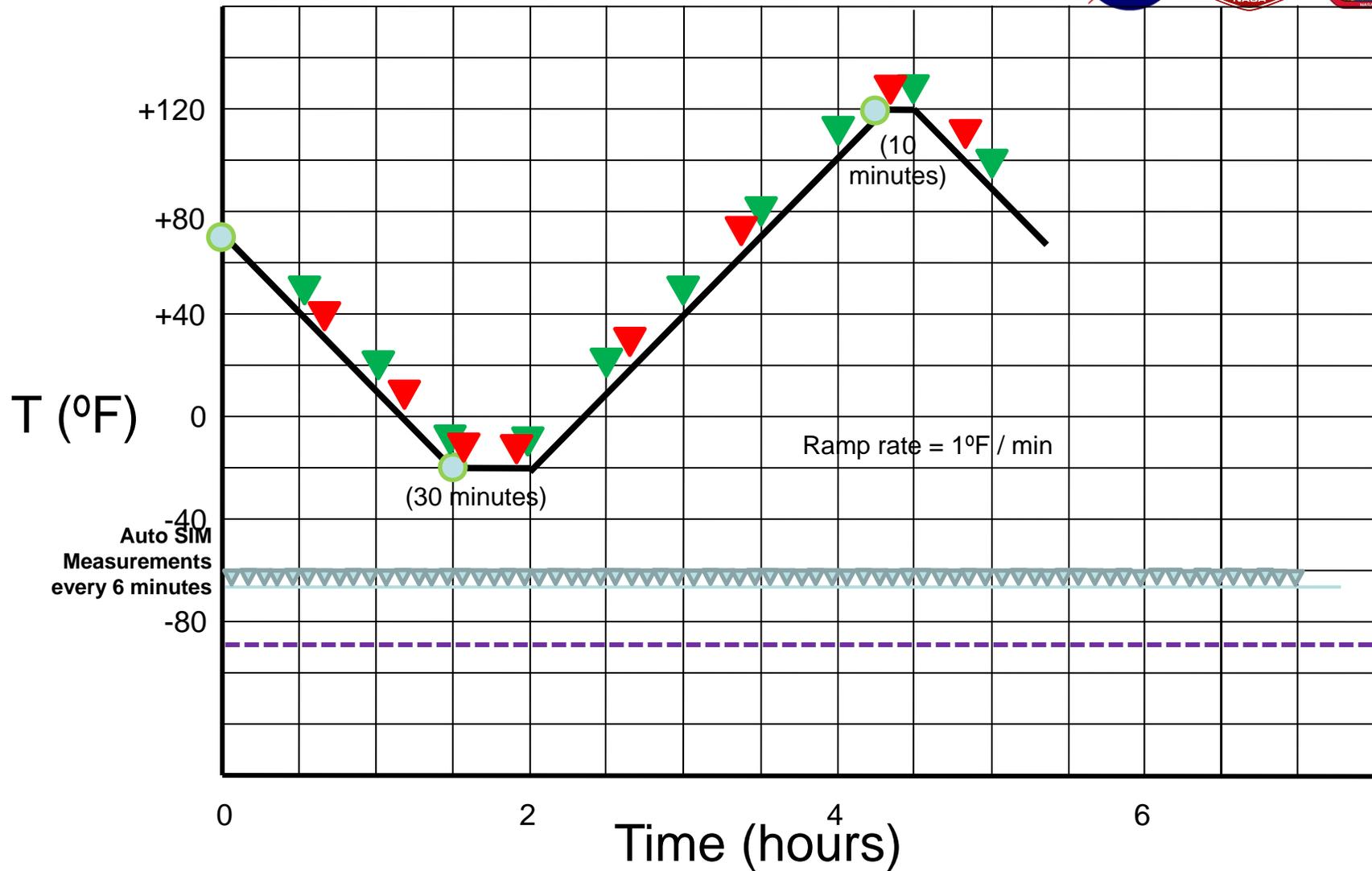


# Test 1) Measurement schedule

T = 77°F



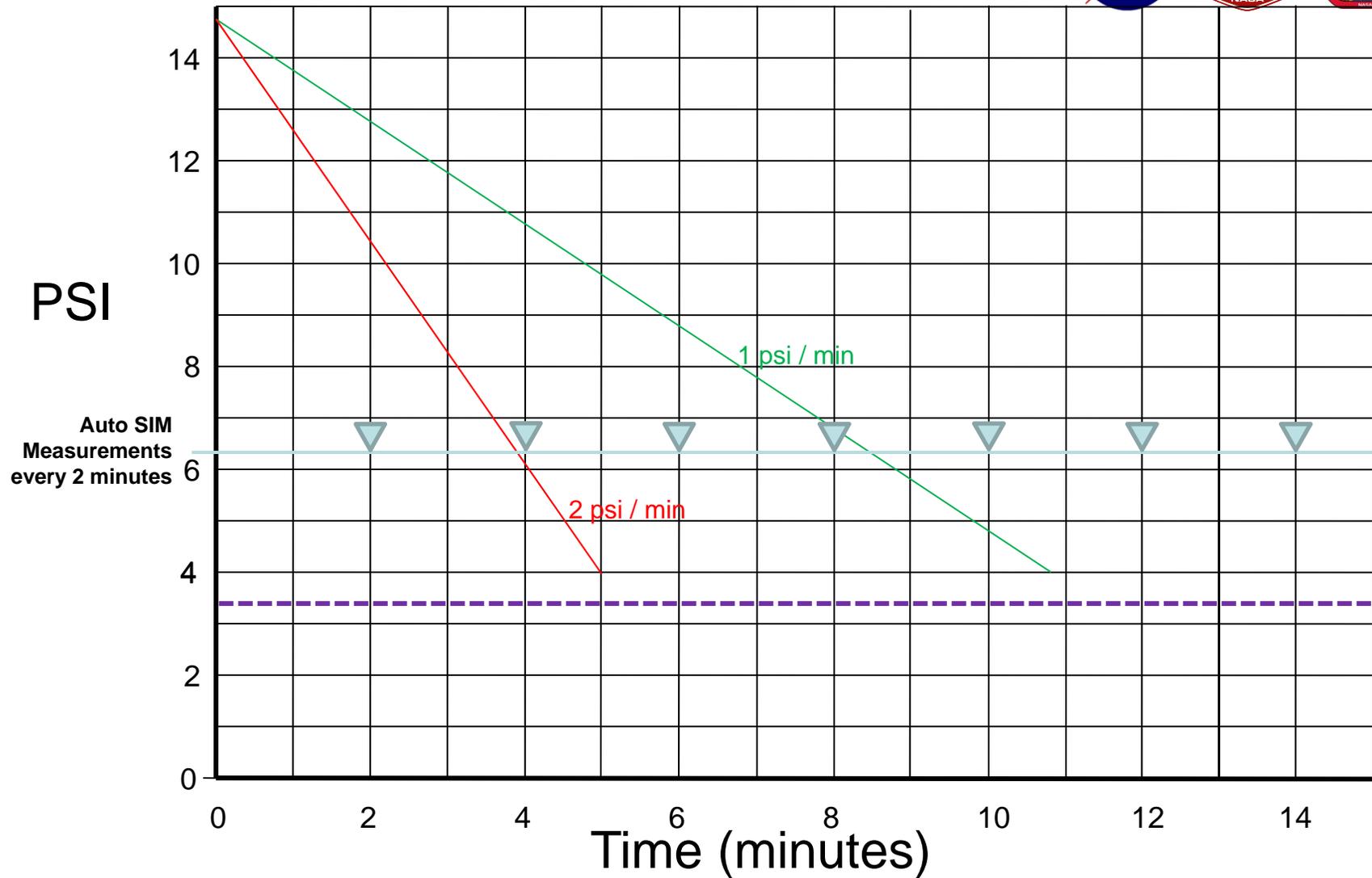
# Test 2) Measurement schedule



1<sup>st</sup> pass: P = 10 psi

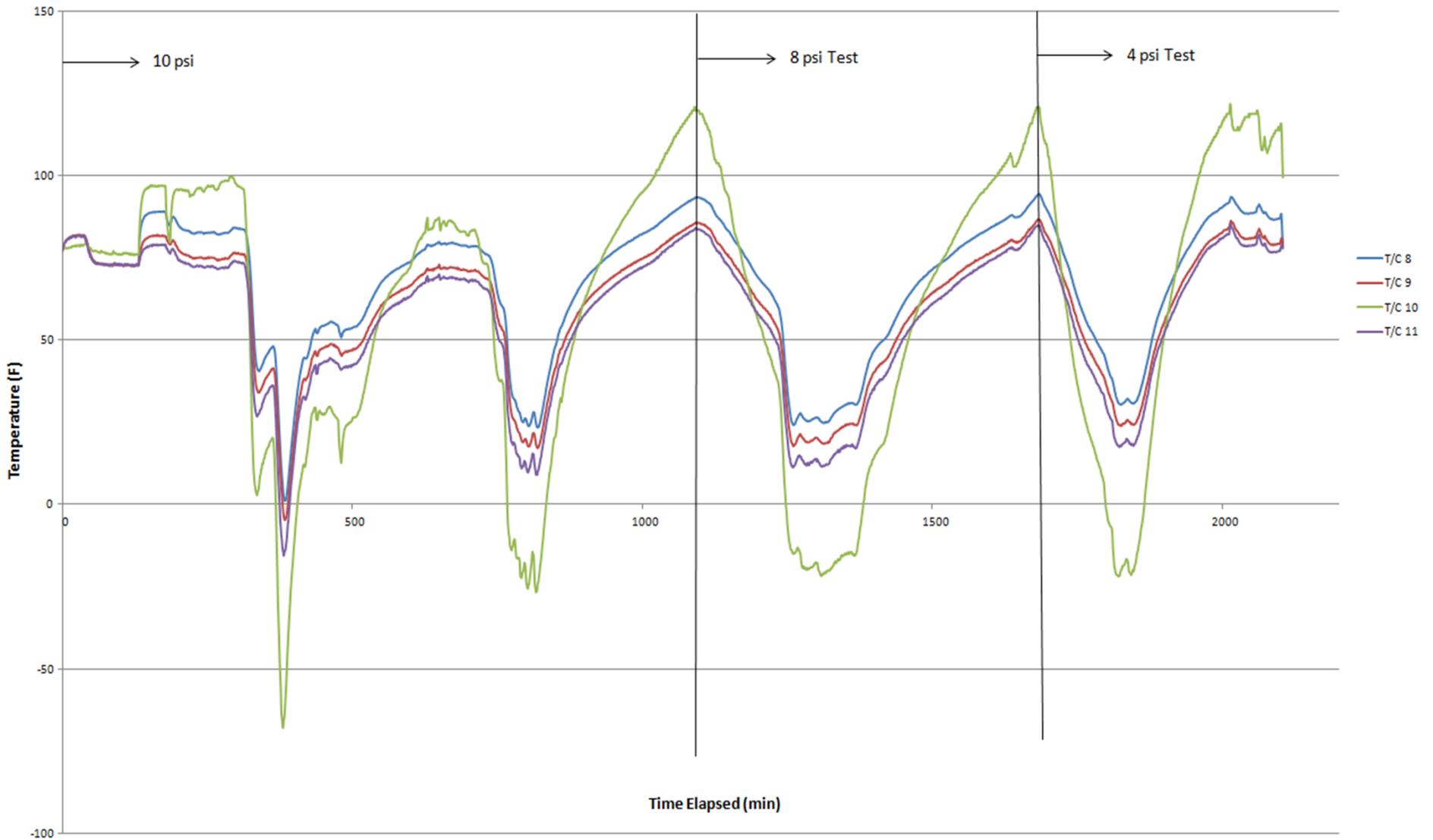
Test 2 : thermal cycling @  
10 psia, 8 psia, & 4 psia

# Test 3) Measurement schedule



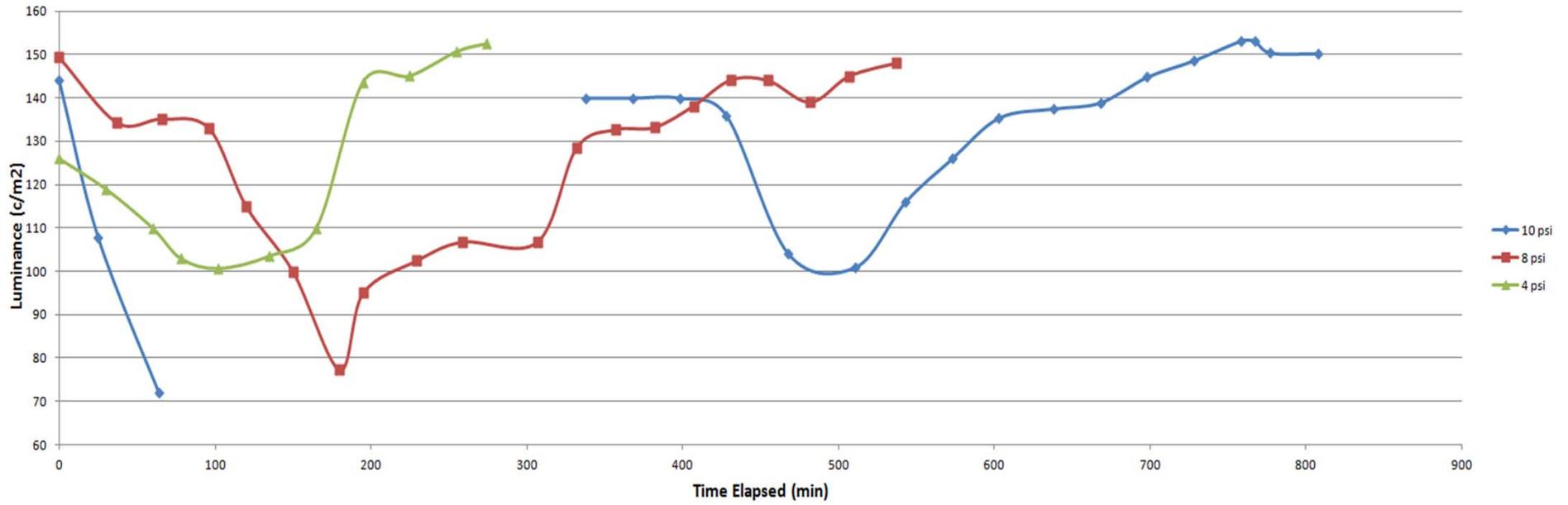
- ▼ SIM - Spectral Irradiance Meter Measurements (automatic every 2 minutes)
- - - Automatic sampling of Thermocouples by EC facility (1/sec)

### Thermal/Vac Test 2: Temperature vs. Time (Unreduced/Raw Data)

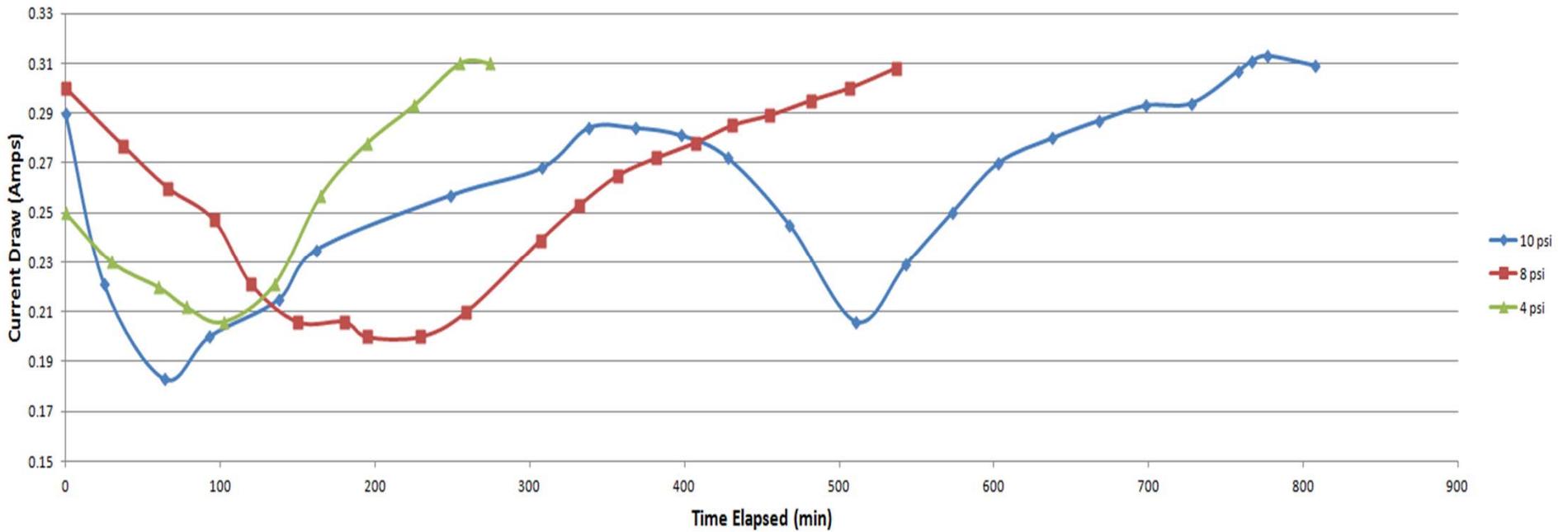


T/C 8 – Thermal Couple on Major IC  
T/C 9 – Thermal Couple on Hottest Component  
T/C 10 – Thermal Couple on Display  
T/C 11 – Thermal Couple on Top of Display Box

### Luminance vs. Time



### Current vs. Time





# Project Information – Part 2

# Multifunction Habitat Workstation



# Matt Salazar - Background

- High School Sophomore
  - Clear Brook High School
- First Robotics Competition 118 Robonauts
  - iPad Scouting App
  - Website
- Vex 118 CyberVex
  - Designed and Built 118c
  - Driver
- Programmer
  - C++/C



ROBONAUTS



# Multifunction Workstation

- Multifunction Habitat Workstation - Objectives
  - Telepresence Video Conferencing – Why?
  - Operational Communications
  - 5.1 Surround Audio
  - 3-D Printing
  - Host CAD Drawings of all Spacecraft Components
  - Provide Situational Awareness Info and Imagery
  - 3-D Recording
  - Interactive Touch Screen Commanding



# Multifunction Workstation

- Multifunction Habitat Workstation
  - Build Guidelines:
    - 80/20 Aluminum Material
    - Must Be Easily Transported
    - Heavy Components Removable
    - Fit Through Standard Doors
    - Hold Up to 6 Monitors
    - Swivel Arms for Viewing
    - Pull out Desk
    - Adequate 3-D Printer Space
    - Roll With Standard Caster Wheels





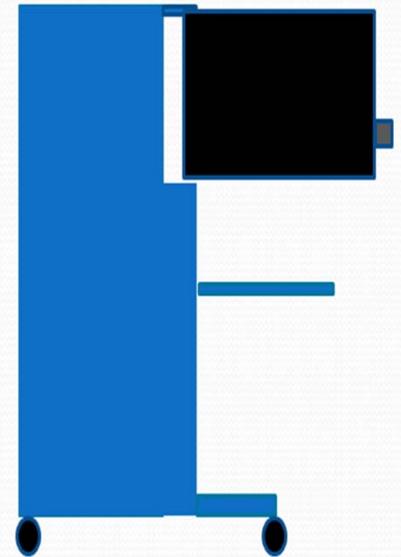
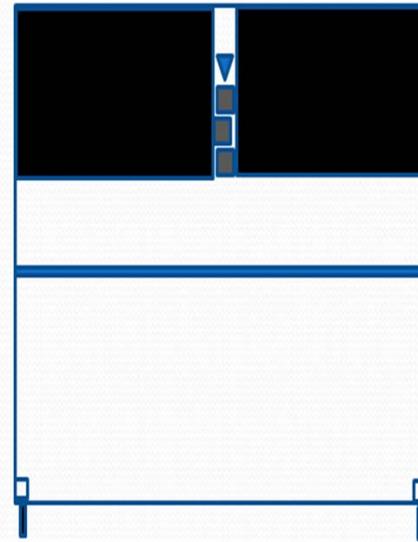
# Multifunction Workstation

- Why 80/20?
  - Lightweight Aluminum
  - Strong
  - Sturdy
  - Reusable
  - Easy to work with
  - Readily available
  - Multi-Purpose
- Components
  - 6 Monitors
    - 2 Touch Screens
    - 4 Regular
  - 2 Blu-Ray Players
  - 1 Audio Receiver
  - 5 Speakers/1 Subwoofer
  - 2 HP Desktop Workstations
  - 2 3-D Cameras
  - 1 3-D Printer



# Multifunction Workstation

- Multifunction Habitat Workstation
  - Build Timeline:
    - Create Model Using CAD Software – Pro/E
    - Troubleshoot Problems
    - Informal Reviews
    - Finalize Drawings
    - Order Parts
    - Begin Build





# Multifunction Workstation

- Multifunction Habitat Workstation

- Future Capabilities:

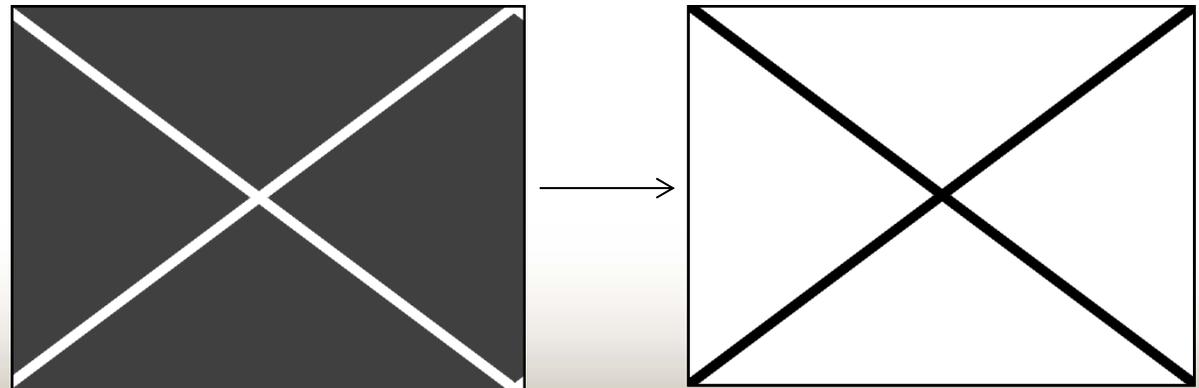
- 3-D Scanning
- Motion/Gesture Controlled
- Tele-Operation of Robotic Equipment
- Tele-Medicine Practice
- Beam-Splitter Display
- Auto-stereoscopic Displays
- Holographic Projection of Objects
- Print Spacecraft Hardware from Interactive Software
- Demo of Hardware & Software
- [Interactive ISS Tour](#)





# Other Projects

- Arduino UNO
  - Built Program to Manipulate LED Lighting
  - Program to Play Sound
- TI Microcontrollers
- Modified Python Code for Moving 'X' Pattern
  - OLED Testing





# Other Projects

- Built PC for GPU Testing
  - Radiation Testing
  - Test Multiple GPU's
  - Mount PC to Test Bench

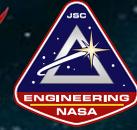




# Experience Gained

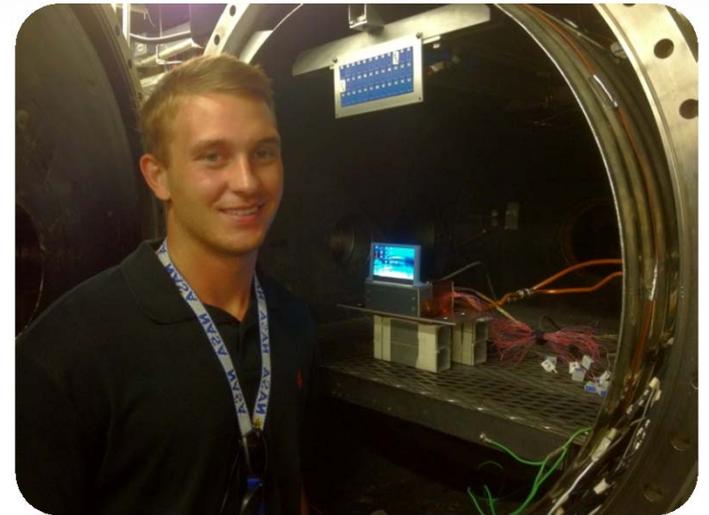
- First Internship/Job
- Pro/E CAD Software
- Fiber Networking
- Real World Applications
  - Hands on Experience
    - Building Workstation
    - Building Computer
- Teamwork Solutions
- An Abundance of College Advice





# Experience Gained

- Test Readiness Review Knowledge
- Pro/E CAD Program
- 80/20 Manufacturing
- Teamwork
- Meeting Deadlines
- 3-D Printing – Techniques
- Electronics Cooling/Conduction
- Flight Readiness Tests
- Mentoring





# Future Plans

- Matt's Future Plans

- Continue to Intern with NASA
- Graduate High School
  - Spring 2016
- Attend MIT or UT for College
  - Major in Computer Science
  - Minor in History
- Attend Graduate School
  - Computer Science

- Shawn's Future Plans

- Graduate From UNL
  - Summer 2014
- Master's Degree?
  - Aerospace Engineering
- Begin Working?
- Become a Grad Co-op?
  - NASA Pathways Intern



# Acknowledgments

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# Questions/Comments

