Monarch-3
Integrated Subsystem Testing Review

Old Dominion University
Cian A. Branco, Connor Huffine, Jason Harris, Andrew Zegler,
Aaron Calkins, Dr. Dimitrie Popescu

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1.0 Mission Overview

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Mission Overview

- Monarch 3 will employ a pressure sensor in a special port to measure boundary layer pressure through rocket ascent.
- Monarch 3 will also implement all lessons learned in data transmission above Wallops to transmit part of our data to Norfolk, real time, in-flight.
- This experiment will benefit ODU’s continued development of space exploration education and the ongoing CubeSat project.
ODU ConOps, “Monarch-3”

- **t = 0 min**
  - G switch triggered
  - All systems on
  - Begin data collection
  - Begin Transmitting

- **High Tumble Rate**
  - t ≈ 4.0 min
  - Altitude: 95 km

- **Apogee**
  - t ≈ 2.8 min
  - Altitude: ≈115 km

- **End of Orion Burn – Spin Rate Largest**
  - t ≈ 0.6 min
  - Altitude: 52 km

- **Low N2, Low spin**
  - t ≈ 5.5 min
  - Chute Deploys

- **Karman line:**
  - t ≈ 2.4 min
  - Altitude: 100 km
  - Pressure eff. 0

- **t ≈ 15 min**
  - Splash Down

- **t ≈ 5.5 min**
  - Chute Deploys

- **t ≈ 2.4 min**
  - Altitude: 100 km
  - Pressure eff. 0
Changes since STR

• Pressure sensors have arrived

• Power boards are finished

• Sensor boards are in-progress

• Battery deck slated for assembly this weekend
2.0 Subsystem Status

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Subsystem Overview

• Subsystems List:
  – Structure/Port
  – Electrical/Radio
  – Power
  – Software

• Special Port design simple tweaks from last year.

• PCB dictates port layout, but little deviation from last year’s design.
Subsystem Testing Status:

Mechanical/Structural: 50%

Overall Design is finished

Final testing dependent on assembly

Battery Brackets in-print now, power deck assembly this weekend, full assembly within the next two weeks.
Subsystem Testing Status:

Power

Power system has been tested on benchtop
• 3.3v and 5v Operation
• G-switch and Wallops line operation

Battery integration is pending
Processing board has been received and is currently being fabricated. Board level testing will occur this weekend. Individual components have been validated.

To Be Tested:
• Processor Data Lines
• Power Supply Connections
• DC/Signal Coax Bridge
• Sensor Operation
• Data Storage
• Packet Generation
Subsystem Testing Status:

Radio

15%

Radio Board is ordered and will be fabricated with priority upon arrival.

To Be Tested:
• Signal Generation
• Output power
• Antenna Effectiveness
• Thermal Environment
2.0 Integrated Subsystem Testing Status

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Integrated Subsystem Testing Status:

Overall Structure and Port

Mechanical structure ensure all other components fly. Robust design paradigm will ensure no in-flight structural failure:

• Power Deck
  • Fully Designed
  • Awaiting completion of brackets
  • Construction this weekend

• Main Deck
  • Fully Designed
  • Awaiting final board mass for CG centering
  • All other required materials procured

• Port
  • Refinement of last year’s design
  • Final layout awaiting PCB completion
  • Very fast turn-around once PCB design complete

Outstanding work constitutes roughly 3 hours of design refinement and about 5 hours of labor.
Power to Other Boards

Power supply is a critical portion of our system’s proper functionality. There are three boards to supply power to:

- **Processing**
  - Low current
  - Low voltage
  - Ideal regulation

- **Radio**
  - Moderate Power
  - PA stage draws direct battery voltage
  - PA draws <15 Watts
  - Radio draws ~1 Watt

- **Port**
  - Subset of the processing board
  - Supplied over Coax

All of these processes need to be covered.
Data Communication

This test will ensure that the communication between data sources and sinks

- Port and Processing Board
  - Serial Communications

- Processing Board and Radio
  - Serial Control of Radio Module
  - DAC Generated Message Signal

All other data lines are integrated into the main processing PCB and fall under the purview of Subsystem testing.
Integrated Subsystem Testing Status:

Radio Transmission

Radio Signal from the Radio board to the port and antenna system

- Coax Link to Port
- Antenna Linkage through door
- Signal Quality

0%
3.0 Full System Integration Plan

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Canister Integration

- Canister Integration should be a straight-forward process

- Little concern in the way of mounting or fit

- We have access to a multimeter to ensure no voltage
Vibe Test

• From previous year’s payloads, expect minimum effect on systems

• Systems are robustly designed

• Only problem child may be the pressure sensor: we have a spare
Electrical Testing

Full system test will be performed for an appropriate amount of time to ensure proper operation of the system.

We will run the payload for a simulation of the entire flight multiple times, feeding the antenna output into a dummy load, preventing spurious transmission.

Battery life will be evaluated using real time current and voltage measurements of the system to benchmark operational lifetime.
System Level Testing

• Primary test will be ensuring all systems are talking to each other properly and the pressure sensor is sending data.

• Step-up will be radio transmissions over increasing distances

• Full mission sim will be from a large structure in Va Beach to ODU over several hours in May.
4.0 Project Management Update

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Schedule Update

• Are you on schedule?
  Yes/No: we’re on schedule a month ago, but will rapidly close this gap over the next few weeks

• Mission critical parts secured

• What are your main concerns?
  PCB Revision
Summary of Progress

• We are still behind from the January delay and our EE’s work load.
• There is little we can do to mitigate this, but it’s overall impact on our mission is minimal
• Our biggest issue is Wallops potential deadlines but we will have full mission SIM data
## User Guide Compliance (Example)

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Status/Reason (if needed)</th>
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</thead>
<tbody>
<tr>
<td>Center of gravity in 1&quot; mid-can?</td>
<td>0.1in x 0.7 in y</td>
</tr>
<tr>
<td>Contained in can</td>
<td>No can yet</td>
</tr>
<tr>
<td>Connected to can by 4/5 bulkheads on top and bottom only</td>
<td>Will mount Bottom</td>
</tr>
<tr>
<td>Mass at 20±0.2lbs</td>
<td>18.9 lbs</td>
</tr>
<tr>
<td>Shared canister clearance</td>
<td>Will not interfere, 1” separation between payloads</td>
</tr>
<tr>
<td>No voltage on the can</td>
<td>Can is isolated</td>
</tr>
<tr>
<td>Activation wires at least 4 ft</td>
<td>Yes</td>
</tr>
<tr>
<td>Activation wire at least 24 gauge</td>
<td>20 gauge</td>
</tr>
<tr>
<td>T-0 Activation: current &lt; .1 A</td>
<td>G-switch as before : ~30mA</td>
</tr>
<tr>
<td>Early Activation: current &lt; 1 A</td>
<td>Not using</td>
</tr>
<tr>
<td>Battery Type</td>
<td>Lithium Polymer (will not charge at Wallops)</td>
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</table>
Shared Can Logistics

• **Who are you sharing with?**
  – Stevens Institute: Trans-sonic pressure data; free-stream

• **Plan for collaboration**
  – Via Email
  – Not currently set for Pre-June meet-up

• **Are you mounting to the top or the bottom? Are you using a mid mounting plate?**
  – ODU is using Bottom

• **What is your combined mass, with canister/mid-mounting plate included?**
  – ODU is underweight; in contact with partner, still no response.
- How much have you spent? $1104.00
- How much more do you need to spend? Around $600
- Additional $150 order placed today
- All funds are secured; the grants from ODU and VSGC cover the costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Supplier</th>
<th>Estimated, Specific Cost</th>
<th>Number Required</th>
<th>Total Cost</th>
<th>Notes</th>
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</thead>
<tbody>
<tr>
<td>Power Board</td>
<td>(various)</td>
<td>$32.38</td>
<td>*</td>
<td>$32.38</td>
<td>Cost for assembled part</td>
</tr>
<tr>
<td>G-Switches</td>
<td>(various)</td>
<td>$15.06</td>
<td>*</td>
<td>$15.06</td>
<td>Cost for assembled part</td>
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<tr>
<td>Processing Board</td>
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<tr>
<td>Radio Boards</td>
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<tr>
<td>Port Boards</td>
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<td>*</td>
<td>$52.58</td>
<td>Cost for assembled part</td>
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<tr>
<td>Extra Parts</td>
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<td>$72.15</td>
<td>*</td>
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<tr>
<td>Pressure Sensor</td>
<td>MKS Instruments</td>
<td>$552.00</td>
<td>2</td>
<td>$1104.00</td>
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Total (no margin): $1620.19
Worries and Concerns

• The budget delay has put us behind by about a month, this has continued to hamper us

• We have made progress towards catching up, but the payoff will likely be all at once rather than incremental
Conclusions

- All parts ordered, PCB designs are finalized

- Rapid closing of gaps for FMSR

- Unknown if we will have FMS data for review, but we will have several full mission sims before launch
Thank you!

http://vignette1.wikia.nocookie.net