CubeSat NB

Electric Power Supply (EPS) System



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For Clients:

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Table of Authorship

Table 1: Table of Authorship

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Section** | **Student #1** | **Student #2** | **Student #3** | **Student #4** |
| Introduction and Customer Requirements | % | % | % | % |
| Team Roles | % | % | % | % |
| Management Roles | % | % | % | % |
| Example: Milestone Leader (task management) | % | % | % | % |
| Example Technical Role: Software subsystem #1 | % | % | % | % |
| Continue, adding cross-references to all sections | % | % | % | % |
|  |  |  |  |  |
|  |  |  |  |  |

Record each author’s percentage contribution to each section. Be as detailed as possible.

By signing the cover page, you are agreeing that your contribution to this Milestone document is accurately represented in the Table of Authorship.

# Introduction

The introduction includes the problem statement: a written description of the project that may include:

* All of the issues/needs that must be addressed
* Who the target customer is
* Scope (technologies, budget, resources, etc.)

It is critical in written documentation and oral presentations to have a good introduction. A good introduction emotionally invests the audience in your group and project. Why is your project important? Why should your audience care? If you do not demonstrate an interest in the project then it is impossible for your audience to have any interest in it.

Include, in written form, the current state of the customer requirements which have been generated through client meetings and consultation with others. Do all requirements have the same importance? Determine the difference between client wants and needs. What value-added features has the client proposed?

*Identify the background, description and motivation for your product. Describe the client/customer needs in your own words, and start to ideate about how the eventual result might address them. Distinguish between the real needs (“must haves”) and the wants (“should haves”) that your product might fulfill.*

# Customer Requirements

*Identify the needs/wants of your customers through direct interviews with your clients, mentors, and through secondary research. Learn as much as possible about the needs that your product will fill. Consider not only the product/solution, but also how it will be used, how it might be used incorrectly, how long it must last for, etc.*

# Conceptual System Overview

*Develop a high-level schematic or diagram of your system, identifying the main conceptual blocks. You should include an initial estimate of the relative amounts of work and risk associated with each sub-component to aid in task assignment and planning.*

# User Interfaces and Interactions

*Develop a set of schematics, diagrams and/or descriptions about the nature of the interactions between a user and your system. Describe how it will be used, as well as areas for potential concern or added attention.*

# Team Roles

Identify the roles that each of your team members will fill throughout the term. A plan should be included detailing how the leadership and other roles will be shared equitably. All assigned roles must be documented and agreed upon by the group.

*Write a description and breakdown of the technical and non-technical roles required for this project. Non-technical roles include project management (milestone leader, Gantt chart revision, documentation review, meeting notes, etc.), documentation creation, and other important tasks.*

## Non-Technical Roles

### Example: Milestone Leader (task management)

Describe how leadership roles in your group will be organized over the various milestones. Note that the roles should change throughout the year.

### Example: Gantt Chart Revisions

Describe which individual(s) in your group will be responsible for revising the Gantt chart.

### Example: Meeting Minutes

Who will be responsible for taking notes at meetings and documenting the meeting minutes?

### Continue to list all Management Roles

What are the other management roles?

## Technical Roles

How will the technical roles and division of work between group members be shared, leveraging the background and skill sets of group members? Think about your relative strengths. Determine as a group the time requirements for each technical and non-technical task. Use it to guide roles within the group. Technical roles will need to be revised over time. A few tasks may not take as much time and resources as you expect, and many tasks will take longer than you expect.

### Example Technical Role: Software subsystem #1

State the resources required to fill this role (people, software, revisioning, and documentation). Refer to document subsections when appropriate.

### Example Technical Role: Software subsystem #2

State the resources required to fill this role (people, software, revisioning, and documentation). Refer to document subsections when appropriate.

### Example Technical Role: Hardware subsystem #1

State the resources required to fill this role (people, software, revisioning, and documentation). Refer to document subsections when appropriate.

### Example Technical Role: Hardware subsystem #2

State the resources required to fill this role (people, software, revisioning, and documentation). Refer to document subsections when appropriate.

### Example Technical Role: User Interface

State the resources required to fill this role (people, software, revisioning, and documentation). Refer to document subsections when appropriate.

### Continue to list all Technical Roles

# Version Control and Documentation Design

*Identify the methods and tools that will be used for software and documentation version control. Also describe how you will ensure that version control is followed, and the individual team member responsibilities for making sure that those systems are followed. Detail what software will be used to generate figures and flowcharts during the project.*

*Note: It is strongly recommended that you use the MS Teams software available to you as a UNB student. The use of toggl.com, or a similar tool is also recommended for time management and tracking.*

## Software Version Control

Describe what software version control system you will use.

## Documentation Version Control

Describe what documentation version control system you will use.

## Add additional sections

Add additional sections as appropriate. What software tools will you use to generate your state diagrams and flowcharts?

## Add additional sections

Add additional sections as appropriate.

# Initial Research

## Existing solutions

*Provide the results of your initial research that helped guide the development of your Engineering requirements (see below). Include existing product solutions, or relevant research literature that helped you frame the feasibility/requirements (but not research towards any specific solution). Please include a formal list of references* for example the Microchip PIC family [1].

Include comparison Tables to minimize the amount of written text.

## Subsystem Research

What existing subsystems (components, microcontrollers) has the client stated as required or recommended that you use? Be sure to include

### Subsystem Name #1

Research results for subsystem name #1.

### Subsystem Name #2

Research results for subsystem name #2.

### Continue

Research results for next subsystem.

## Applicable Standards

What standards (electrical, mechanical, etc.) do you have to meet?

# Engineering Requirements

**NOTE**: If this document does not include subsections and content that address the following:

* Appropriate engineering requirements for all hardware subsystems
* Appropriate engineering requirements for all interfaces between subsystems
* Appropriate State requirements or dataflow diagrams for all hardware and software subsystems
* Appropriate GUI mockups (if appropriate)

Your group will be informed by the course instructors that the document will not be marked and your group will need to revise the document, with a **10% penalty per day** until this Milestone document provides an acceptable level of detail.

Include any text required to introduce the requirements section and how the engineering requirements relate to the product. Include a high-level overview diagram of your system and refer to it (see Figure 1 System Overview Diagram) in later sections. Properly documented requirements do not require long text introductions. Remember, a “picture is worth a thousand words”.

*The Engineering requirements document is an engineering interpretation of the customer requirements that frames them in terms of hard design targets (generally a set of performance criteria expressed in numbers, or usability criteria). They expand on the customer requirements using the engineers’ experience, knowledge, and skills (e.g., safety considerations, standards, regulations, etc.). Note that requirements should be detailed, exhaustive, quantifiable, and testable. The test plan (to be completed later in the term) will directly test the requirements identified in this document. Note that at this stage, you should not identify or favour any particular solution(s).*

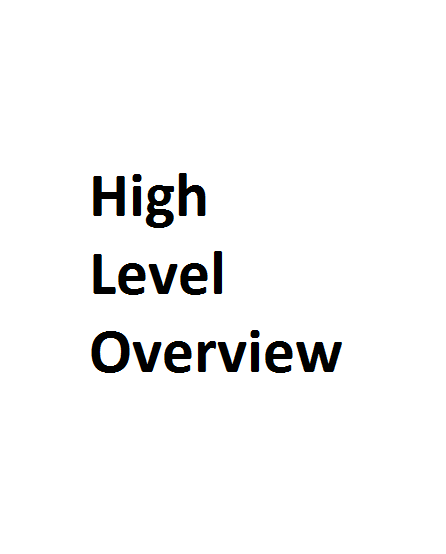


Figure 1 System Overview Diagram

## State Requirements

*The required states, modes and transitions by the system*. Dataflow and/or flowchart diagrams, order of operations, etc., and all subsections; describe all state requirements (software, GUI, control).

### Datalogger Software flow (Example)

Write an introduction to the software flow, and include stateflow diagram. Include enough text so the reader understands the dataflow when referring to the diagram. Depending on the complexity of your system, create a stateflow diagram for each major subsection.



Figure 2 Datalogger state diagram

### Graphical User Interface

Include GUI mockups and stateflow diagram for GUI usage. Include enough text so the reader understands the dataflow when referring to the diagrams. Proper visualization through diagrams/mockups reduces the amount of written text required. Large stateflow diagrams should be broken down into subsections. Be certain to include interfaces between subsystems.



Figure 3 GUI Stateflow Diagram



Figure 4 Datalogger GUI

### Feedback Control System (Example)

Example additional subsection. If your product includes a control system, include a separate state flow diagram.

## Functional Requirements

*What is the system is required to do?* See below some examples of function requirements and a table of minimum vs desired performance (see Table 3: Specific Requirements). Break down into subsections as required (microcontroller, battery, network, power, etc.)

### Microcontroller Example

* 10-bit A/D input from two thermocouple transducers (5Vpp)
* 10-bit A/D input from two pressure analog transducers (5Vpp)
* 10-bit A/D input from two displacement transducers (3.3Vpp)
* 10-bit A/D input from two strain gauge transducers (3.3Vpp)
* TTL GPIO read STATUS[1-4] LVTTL.
* Measure ambient air temperature via SPI bus.
* Save transducer, temp, status information to a cloud database.
* Calculate motor1 PWM value (10-bit unsigned).
* Configure/Set motor1 PWM value.

Table 2: Specific Requirements

Include tables when requirements have minimum and desired parameter values. Number each entry for easy reference.

|  |  |  |  |
| --- | --- | --- | --- |
| **Ref #** | **Requirement:** | **Minimum:** | **Desired:** |
| 7.2.1 |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

### Battery example

Text + Table. Example: engineering requirement that a rechargeable battery power the product.

### Network example

Text + Table. Example, product must be able to access the internet. How much data must be transferred?

### Power example

Text + Table

## Performance Requirements

This section documents *how well the system must perform functions*. Break down into subsections. Note: It is acceptable to merge the Functional and Performance requirements into one section.

### Microcontroller

Example:

* Sample analog signal Fsample=100Ksps

Include tables when requirements have minimum and desired parameter values.

|  |  |  |  |
| --- | --- | --- | --- |
| **Ref #** | **Requirement:** | **Minimum:** | **Desired:** |
| 7.3.1 | Fsample | 100Ksps | 500Ksps |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

Calculation time of FFT (1ms)

### Battery

Text. Example:

* Battery must recharge in less than 8h from a full discharge state

|  |  |  |  |
| --- | --- | --- | --- |
| **Ref #** | **Requirement:** | **Minimum:** | **Desired:** |
| 7.3.2 | Battery full recharge time from full discharge | 8h | 4h or less |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

### Power Subsystem # 1

Text Example:

* 5V/2A power supply, Vripple <= 10mV

## External Interfaces Requirements

Describe any external input/resource that influences system usage. Signal pin assignments, location and geometry of connectors, etc.

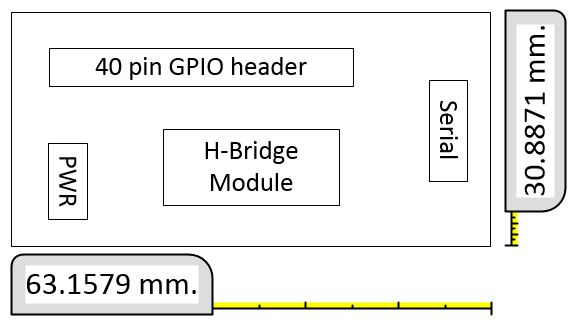


Figure 5 Datalogger external interfaces example

## Environmental Requirements

What are potential environmental effects?

Printed Circuit Board – RoHS (lead free) required?

Product Disposal – Li-ion battery Canadian disposal guidelines?

## Resource Requirements

Any external input/resource that influences system usage? Battery life and cloud storage are two examples.

## Physical Requirements

Document any physical constraints or requirements in a table, and refer to the table in your written text (cross-reference). For example: the prototype dimension requirements for the final product are provided in Table 4.

Table 3: Physical Requirements Example Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Ref #** | **Parameter:** | **Range:** | | **Desired:** |
| 7.7.1 | Width | Min: 20mm | Max: 100mm | 80mm |
| 7.7.2 | Length | Min: 80mm | Max: 200mm | 140mm |
| 7.7.3 | Depth | Min: 20mm | Max: 80mm | 40mm |
| 7.7.4 | Weight | 100g | 120g | 100g |
|  |  |  |  |  |

Add additional tables if appropriate or if the attributes require new table headings such as Table 5.

Table 4: Battery Enclosure Physical Requirements

|  |  |
| --- | --- |
| Parameter: | Requirement: |
| Battery Enclosure | State location, access panel, latch type, etc. |

## Other (General) – Possibly N/A.

State any requirements that does not fit into the above and is not a Manufacturing Requirement. For example, any specific microprocessor SDK requirement, programming language, manufacturing cost requirements, etc.

## Manufacturing Requirements – Possibly N/A

How the product should be manufactured, or how it should not be manufactured.

# Client Approval

***Milestone 2****: Describe the process by which you have iterated and reviewed these requirements with your client. Indicate if you have received their approval for this presented set of Engineering requirements or describe how that process will take place. This approval will be a formal requirement as part of the* ***Milestone 3*** *deliverable.*

# Approval of Engineering Requirements

***Milestone3****:* *Your engineering requirements should now be complete, including any necessary revisions. As evidence of approval of these requirements, include a document, signed by your client, stating that they have read and agreed to the requirements as included in this deliverable.*

*The completed requirements documents must be submitted to your client for approval at least two full business days prior to the submission of this document. Failure to provide a signed and approved requirements document will result in a rejection of this document, at a cost of a 10% penalty per day.*

What if any changes have been made to the engineering requirements by client request? How do you track the engineering change orders? Include a timeline of meetings and correspondence leading up to the client approval, and inclusion of the signed approval sheet by the client (in an Appendix if appropriate).

# Research Results

*Describe the process and results of your engineering research. This should reflect the work done to understand and identify potential design solutions. Include IEEE-style references to similar designs or products and the research literature. Include any calculations that have been completed to support or arrive at conclusions. Use visuals such as figures, block diagrams or data flow diagrams to explain your findings. You can use the example table below for your research comparisons, or you can create your own version (See example* Table 5*) if it suits your project better.*

## Research Topic #1

For each research topic provide a written introduction. For what purpose will this part or technology be used? What features, capabilities, and price engineering requirements do you need to meet? Those requirements will guide your research and selection process.

Table 5 Example of Research Selection Process – Topic #1

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Factor 1** | | **Factor 2** | | **Factor 3** | | **Factor 4** | |  | |
| **Factor Title** | | **Factor Title** | | **Factor Title** | | **Factor Title** | |
| **Weight** | % | **Weight** | % | **Weight** | % | **Weight** | % |
| **Research Topic** | **Rank** | **Wtd Rank** | **Rank** | **Wtd Rank** | **Rank** | **Wtd Rank** | **Rank** | **Wtd Rank** | **Total** | **Wtd Total** |
| Option 1 |  |  |  |  |  |  |  |  |  |  |
| Option 2 |  |  |  |  |  |  |  |  |  |  |
| Option 3 |  |  |  |  |  |  |  |  |  |  |
| Option 4 |  |  |  |  |  |  |  |  |  |  |
| Option 5 |  |  |  |  |  |  |  |  |  |  |
| **Notes** | Provide written description. What is the factor and why is it important? | | Provide written description. What is the factor and why is it important? | | Provide written description. What is the factor and why is it important? | | Provide written description. What is the factor and why is it important? | |  | |

## Research Topic #2

For each research topic provide a written introduction. For what purpose will this part or technology be used? What features, capabilities, and price engineering requirements do you need to meet? Those requirements will guide your research and selection process.

Table 6 Example of Research Selection Process – Topic #2

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Factor 1** | | **Factor 2** | | **Factor 3** | | **Factor 4** | |  | |
| **Factor Title** | | **Factor Title** | | **Factor Title** | | **Factor Title** | |
| **Weight** | % | **Weight** | % | **Weight** | % | **Weight** | % |
| **Research Topic** | **Rank** | **Wtd Rank** | **Rank** | **Wtd Rank** | **Rank** | **Wtd Rank** | **Rank** | **Wtd Rank** | **Total** | **Wtd Total** |
| Option 1 |  |  |  |  |  |  |  |  |  |  |
| Option 2 |  |  |  |  |  |  |  |  |  |  |
| Option 3 |  |  |  |  |  |  |  |  |  |  |
| Option 4 |  |  |  |  |  |  |  |  |  |  |
| Option 5 |  |  |  |  |  |  |  |  |  |  |
| **Notes** | Provide written description. What is the factor and why is it important? | | Provide written description. What is the factor and why is it important? | | Provide written description. What is the factor and why is it important? | | Provide written description. What is the factor and why is it important? | |  | |

## Research Topic #3

For each research topic provide a written introduction. For what purpose will this part or technology be used? What features, capabilities, and price engineering requirements do you need to meet? Those requirements will guide your research and selection process.

Table 7 Example of Research Selection Process – Topic #3

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Factor 1** | | **Factor 2** | | **Factor 3** | | **Factor 4** | |  | |
| **Factor Title** | | **Factor Title** | | **Factor Title** | | **Factor Title** | |
| **Weight** | % | **Weight** | % | **Weight** | % | **Weight** | % |
| **Research Topic** | **Rank** | **Wtd Rank** | **Rank** | **Wtd Rank** | **Rank** | **Wtd Rank** | **Rank** | **Wtd Rank** | **Total** | **Wtd Total** |
| Option 1 |  |  |  |  |  |  |  |  |  |  |
| Option 2 |  |  |  |  |  |  |  |  |  |  |
| Option 3 |  |  |  |  |  |  |  |  |  |  |
| Option 4 |  |  |  |  |  |  |  |  |  |  |
| Option 5 |  |  |  |  |  |  |  |  |  |  |
| **Notes** | Provide written description. What is the factor and why is it important? | | Provide written description. What is the factor and why is it important? | | Provide written description. What is the factor and why is it important? | | Provide written description. What is the factor and why is it important? | |  | |

# Test & Verification Plan

*Provide a detailed test and verification plan which will be used to measure your progress towards the project requirements. This plan should include specific tests for sub-components and requirements of your design, as well as general function testing. Details should include the item to test, how it will be done, the expected result, with place to later add the actual results and whether the test was successful or not, as illustrated in* Table 5.

Table 6: Example Test Plan

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test** | **How to Test** | **Expected Result** | **Actual Result** | **Pass/Fail** |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

# Design Description

*Describe the high-level features of your design at a level suitable for a general audience. Use visual aids such as sketches or block diagrams, making sure to highlight any interfaces to users or other devices.*

# Detailed Design

*Provide a detailed, technical description of your design. Include design schematics, CAD drawings/models, equipment and part numbers. Design considerations such as reliability, manufacturability, maintenance and cost should be demonstrated. Identify any high-risk aspects of your design or areas of concern, so that they can be monitored and planned for. There must be sufficient detail to order any parts needed for your prototype.*

# Health, Safety, Environmental and Social Considerations

*What are the possible health and safety, environmental, and social impacts associated with your design? How do you plan to mitigate them? Be thorough.*

# Gantt Chart

*Develop a detailed Gantt Chart for both terms of the project. Include all anticipated tasks required to complete the project, including time requirements for each task, whether or not tasks have dependencies (and which ones), and which may be done in parallel. Describe the human resources and materials needed for each task. Include the time and location for scheduled meetings with instructors and clients, as well as internal group reviews and course deliverables. Be detailed and specific!*

Refer to and supply additional information on project management through Gantt chart usage. How will the Gantt chart be utilized as a living document to guide your efforts and identify resource requirements? How and when will the Gantt Chart be updated? Refer to the section which includes the Gantt chart or if it is an electronic attachment to the milestone.

## Subsection Gantt

Need to add some text? Do it here!

# Budget

Preliminary budget information. Are any parts/components or equipment specified as required by the client?

Table 7: Preliminary Budget Estimation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Project Due Date: | | | | |
| Project Name: | | | | |
| COMPONENT | SOURCE | ESTIMATED | ACTUAL | DIFFERENCE |
| Component #1 |  | $ | $ | $ |
| Component #2 |  | $ | $ | $ |
| Component #3 |  | $ | $ | $ |
| Component #4 |  | $ | $ | $ |
| … |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Total |  | $ | $ | $ |

# User Guide

*Develop a “how to” user guide for your design. This should be a comprehensive laypersons guide to using your product/system, including setup, operation and maintenance. Consider that others will not have the same depth of understanding or level of concern for your design as you do.*

# Troubleshooting Guide

*Develop a troubleshooting guide for your design. This should walk the user how to identify the source and meaning of errors should they occur, how to remedy them (if applicable), or how to contact someone for assistance.*

# References

|  |  |
| --- | --- |
| [1] | Microsoft, "support.office.com," [Online]. Available: https://support.office.com/en-us/article/create-a-bibliography-citations-and-references-17686589-4824-4940-9c69-342c289fa2a5. [Accessed 13 August 2018]. |
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