Preliminary Detailed Design: Phase-End Summary

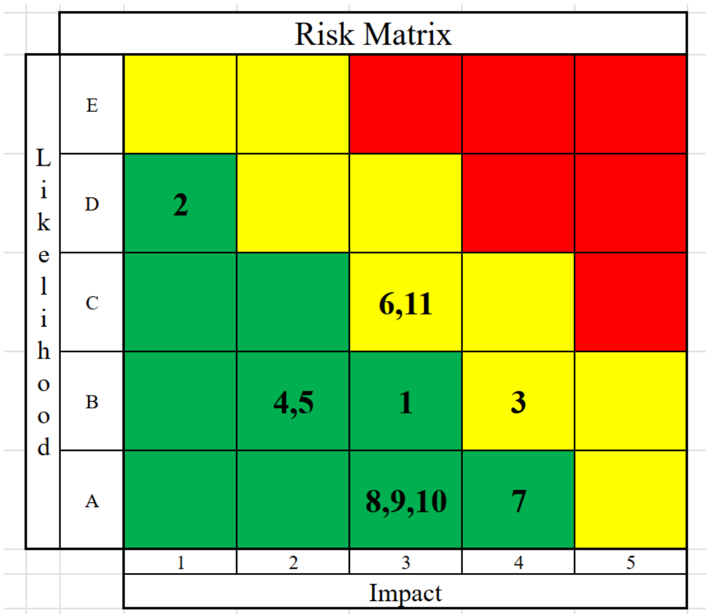
Individual and Team Vision for Preliminary Detailed Design Phase:

Team plan for this phase:
We planned to start preliminary prototyping to prove the functionality of our proposed solution that we presented previously. This includes revising component selections, the development of a BOM, proposing development kits, test benches, and ordering long lead time items. It was identified that deciding upon and ordering longer-lead time items was of utmost priority. Therefore, the detailed design process was to be delayed and started if time allowed.

Accomplished during this phase:
A preliminary BOM was formed. We began ordering long-lead items including two of the MicroZed 7010 SOCs. High-level system design was considered and defined as simple block diagrams with inputs and outputs. The holdover drift characteristics of the various SIT-branded TCXOs were explored. The feasibility of the timecard was explored using MATLAB [Simulink].

Risk Assessment:

ID	IF Statement	THEN Statement	Cause	Likelihood	Cost Impact	Schedule Impact	Importance	Action to Minimize Risk
1	IF timecard is exposed to higher EMI than expected	THEN received data will become corrupted/incorrrect	Strong electromagnetic fields and RF from other satillites	B	2	3	B3	Provide error flag and power cycle device
2	IF communication protocol experiences bit flip and interference	THEN stored data will become corrupted/incorrect	Cosmic Rays	D	1	1	D1	Force developmet to parity and error detection schemes in firmaware for all communications
3	IF open source programs do not work as described	THEN design is set behind due to designing additional programs/functions/blocks	Unpredicted Factors	B	3	4	B4	Our team will produce our own open source programs for any of those which do not work as described
4	IF vaccum causes solderpoints to flake and cause shorts	THEN a high current flow (short) can occur, causing component damage	Material Science Factors	B	2	2	B2	Utilize Sn62Pb37 solder rather than lead-free (tin) solder
5	IF vaccum causes PCB to outgas	THEN surrounding components and systems experience unexpected debris which may lead to opens/shorts	Material Science Factors	B	2	2	B2	Place PCBs through vaccum cycles prior to using
6	IF cubesat vibrates more than design specifications	THEN connection would be lost between the timecard and motherboard	Rough Launch, Space Debris Collision	B	2	3	B3	Develop option to mechanically strengthen the electrical connectors
7	IF the timecard loses power	THEN the oscillator and all other components will not function	CubeSat loses power	A	3	4	A4	No resolution, other than power cycle once CubeSat regains power
8	IF Displacement Damage Dose occurs	THEN non-ionizing energy loss occurs causing device and/or component degradation	Energy deposition by impinging radiation	A	3	3	A3	If CubeSat is not protected, develop protection barrier
9	IF Single Event Effects (Single Event Latch Up) occur	THEN communication packets will contain incorrect data	Singular, stray, energetic particles	A	3	3	A3	If CubeSat is not protected, develop protection barrier. Can additional implement strongery parity detection and schemes
10	IF Atomic Oxidation occurs	THEN electrical connection including solder points may lose conductivity	Presence of strong oxidizing agents	A	3	3	A3	If CubeSat is not protected, develop protection barrier
11	IF parts have lead times over a month	THEN parts may not be in hand when required to prototype	Supply/Demand	C	2	3	C3	Order significantly early than expected, if not possible, look for other vendors or options.

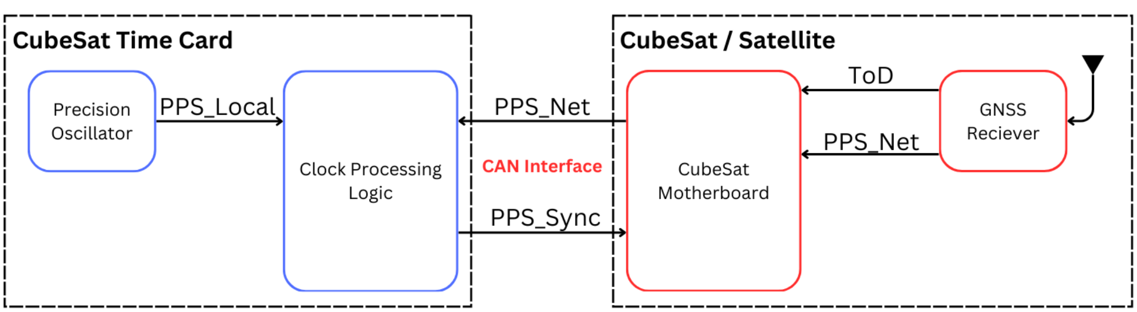


Risk assessment remains consistent from previous phases with the addition of the long lead item risk, this was populated due to the CSAC SA-45 possibly becoming an extremely long lead if we miss this current batch. This risk is placed in the yellow category on the matrix due to the significant impact of development and a moderate likelihood of occurrence.

We are prepared for this risk by shifting the design from the Atomic Clock to a TCXO implementation. Further trace studies may be needed to realize a benchmark comparison of performance using each clock.

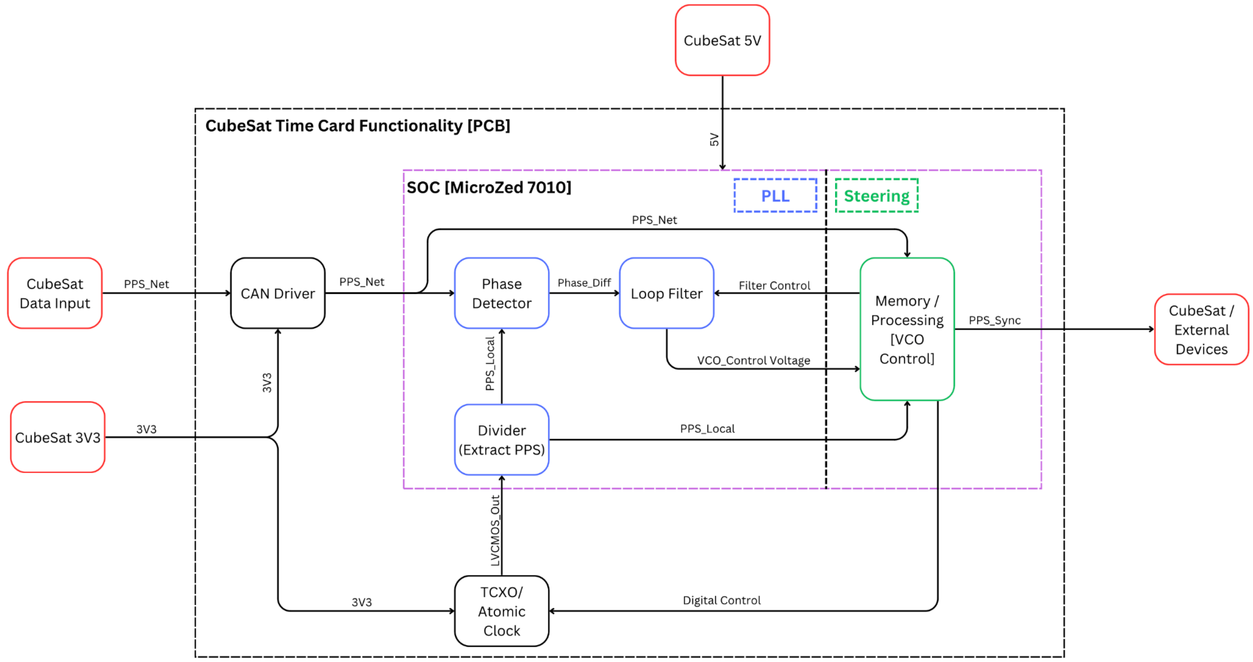
System Design and Flowcharts/System Block Diagram:

High-Level System diagram:



The figure above represents the high-level diagram showing the interaction between the CubeSat Satellite and the time card. This representation is very similar to the standard off-the-shelf timecard, with the major difference identified as the GNSS receiver is onboard the satellite, not the timecard.

Board Functionality Diagram:



<u>Diagram Link:</u>
https://www.canva.com/design/DAGU9_wbepU/3GgiWLj0Og3cwYhZnoNWGQ/view?utm_content=DAGU9_wbepU&utm_campaign=designshare&utm_medium=link&utm_source=editor

Functional Block Explanations:

<u>Phase Detector:</u>
Takes two PPS inputs, produces output that is proportional to the phase difference between the two input signals. Traditionally output a pulse width proportional to the phase difference.

<u>Loop Filter:</u>
Reduces noise, improves stability, shapes the transient response, and controls the phase margin. Outputs a VCO control signal, used to tune/adjust the characteristics of the local TCXO/Atomic clock.

<u>Steering Process:</u>
Produce coefficients to alter/tune the TCXO or Atomic clock to match phase with the PPS produced with the GNSS receiver.

Divider:
Receives the LVCMOS signal produced from the TCXO/Atomic Clock. Reduces the frequency of the input by a specific ratio. This must be an accurate and precise process.

Phase Lock Loop [PLL]:
Often used for frequency synthesis, clock recovery, and motor controllers. The PLL receives two input signals, identified as the reference and feedback signals. In this case, the feedback signal is represented by the locally produced PPS. Similarly, the reference signal is represented by the PPS produced from the GNSS. The difference in phase between the two input signals is extracted through the use of a phase detector. This difference is then fed into a loop filter that produces a correlated value to the phase difference. This, in turn, gives a variable that can be used to “tune” the local TCXO/Atomic clock, to be in phase with the external network GNSS-produced PPS.

Drawing, Schematics, Diagrams:

Due to time constraints, little work was completed developing “in-depth” drawings and schematics. However, the **Board Functionality Diagram** shown above will greatly assist throughout the development process as it identifies significant hardware components, as well as general blocks that will have to be implemented within the MicroZed 7010 SOC. An environment within Vivado was created to start the process within the SOC, however no significant process was made.

Feasibility - Analysis & Simulations:

Bill of Material (BOM):

Team #:	P22257	Team Name:	Atomic Clock	Budget:	$4,000		Budget:	$4,000	KEY	
Date:	10/17/2024	Document Owner:	Team Member	Total Projected:	$6,858.25		Total Spent:	$694.78	Ordering Early	
Revision #:	1			Remaining Projected:	-$2,858		Remaining:	$3,305		

Subsystem	Team Part #	Item	Qty	Unit Cost	Total Cost	Total Spent with Shipping/Tarrifs/Tax	Vendor	Website	Ordered	Received	Notes
Electrical	00001	AES-Z7MB-7Z010-SOM-I-G/REV-H	2	$259.00	$518.00	$694.78	Avnet	https://www.avnet.com/shop/us/products/avnet-engineering-services/aes-z7mb-7z010-som-i-g-rev-h-3074457345644698176/#	[redacted]		Includes a $119.14 tariff
Electrical	00002	Ceramic Capacitor Kit 10pF ~ 10µF	1	$48.24	$48.24		DigiKey	https://www.digikey.com/en/products/detail/kemet/CER-ENG-KIT-29/5039067			
Electrical	00003	Resistor Kit 1k ~ 9.76k Ohm ±1% 1/10W	1	$38.30	$38.30		DigiKey	https://www.digikey.com/en/products/detail/stackpole-electronics-inc/KIT-RMCF0603FT-04/2773766			
Electrical	00004	Resistor Kit 10k ~ 97.6k Ohm ±1% 1/10W	1	$38.30	$38.30		DigiKey	https://www.digikey.com/en/products/detail/stackpole-electronics-inc/KIT-RMCF0603FT-05/2773767			
Electrical	00005	SiT5356AI-FQ233IT-10.000000F	3	$68.81	$206.44		SiTime	https://www.sitime.com/products/super-tcxo/sit5356#buy-now%20			
Electrical	00006	SiT5356AI-FQ133IT-10.000000F	3	$68.81	$206.44		SiTime	https://www.sitime.com/products/super-tcxo/sit5356#buy-now%20			
Electrical	00007	SiT5356AI-FQ033IT-10.000000F	3	$68.81	$206.44		SiTime	https://www.sitime.com/products/super-tcxo/sit5356#buy-now%20			
Electrical	00008	090-03240-003	1	$5,377.76	$5,377.76		MicroChip	https://www.microchip.com/en-us/product/csac-sa45s#document-table			
Electrical	00009	MCP251863T-H/SS	10	$2.34	$23.40		DigiKey	https://www.digikey.com/en/products/detail/microchip-technology/MCP251863T-H-SS/15985649			
Electrical	00010	SMT Breakout PCB for SOIC-28 or TSSOP-28 - 3 Pack!	1	$4.95	$4.95		Adafruit	https://www.adafruit.com/product/1208			
Electrical	00011	Large Premium Solderless Breadboard	1	$19.95	$19.95		Adafruit	https://www.adafruit.com/product/443			
Electrical	00012	Hook-up Wire Spool Set - 22AWG Solid Core - 6 x 25 ft	1	$15.95	$15.95		Adafruit	https://www.adafruit.com/product/1311			
Test Setup	00013	Raspberry Pi 5	1	$60.00	$60.00		DigiKey	https://www.digikey.com/en/products/detail/raspberry-pi/SC1111/21658261			
Test Setup	00014	Raspberry Pi 5 PSU	1	$12.00	$12.00		DigiKey	SC1153 Raspberry Pi | Power Supplies - External/Internal (Off-Board) | DigiKey			
Test Setup	00015	64GB Micro-SD card	1	$24.19	$24.19		DigiKey	https://www.digikey.com/en/products/detail/sahasra-electronic-solutions-limited/CA227-004/21089320			
Test Setup	00016	GPS-14986 - GNSS Antenna	1	$12.95	$12.95		Mouser	https://www.mouser.com/ProductDetail/SparkFun/GPS-14986?qs=byeeYqUIh0OBAxR%252BCRKDBA%3D%3D			
Test Setup	00017	GPS-18037 - GNSS Reiever	1	$44.95	$44.95		Mouser	https://www.mouser.com/ProductDetail/SparkFun/GPS-18037?qs=rQFj71Wb1eUM7j0Oxt1D1A%3D%3D			
Test Setup	00018	61083-102402LF	6	$8.82	$52.92		DigiKey	https://www.digikey.com/en/products/detail/amphenol-cs-fci/61083-102402LF/1002007?msockid=2b5da0f773a26a542cf1ae04720a6b04			

[BOM Spreadsheet]

At this moment, 2x MicroZed SoCs are ordered. CSAC SA-45 (Atomic Clock) is recognized as the only contention item listed as 32 currently available. This device is $5,377.76 and is estimated to ship within 1 week of ordering. If we miss this batch, the next batch is estimated to be a long lead item with availability in May 2025.

Clients have prepared a proposal to MoonDAO and reached out individually to MicroChip to attempt to secure this item at a significantly reduced cost or even as an “in kind” donation to support undergraduate research development at RIT. The status of this is currently unknown.

If this is not possible, our team is prepared to purchase on our own. To make this happen, clients and MSD guide need to increase the EduSourced budget and approve the high-price purchase.

Overall purchase status reflects EduSourced in that of the $4,000 populated budget we have $3,305.22 remaining.

Please note all items highlighted in light green are to be “ordered early” in MSDI.

Test Plans:

Vibe Analysis Test using Ansys (ER 4):

Subsystem/ Function/ Feature Name:	Vibe Analysis
Date of Test:	
Performed By:	Eva Czukkermann
Tested By:	Eva Czukkermann
Concluded Condition of meeting Engineering Specification:	

I. TESTING SPECIFICATION

Specification Number	Importance	Source	Function	Specification (Metric)	Unit of Measure	Marginal Value	Ideal Value	Comments/Status
S4	3		System	IAW MIL-STD-810H Figure 514.8D-6 and Figure 514.8D-9	N/A	Yes	Yes	

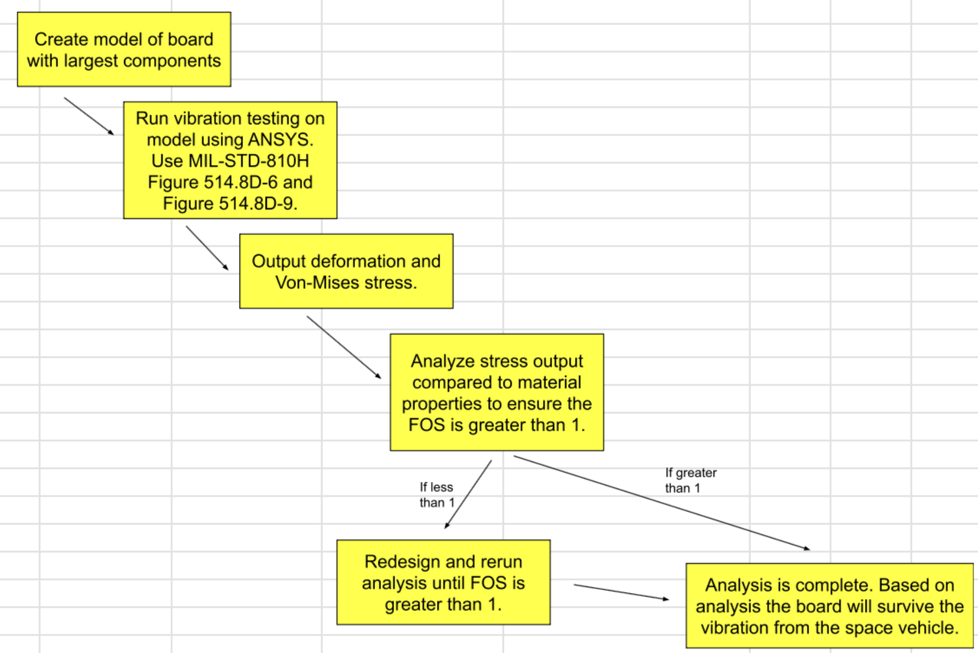
II. EQUIPMENT REQURIED

Specification Number	Equipment or Instrumentation required
S4	Ansys, CAD

III. DATA COLLECTION STRATEGY

Specification Number	Data acquisition strategy
S4	The goal of this test is to ensure the board can survive the frequencies/vibrations it will experience while assembled in a space vehicle.

III. TESTING FLOWCHART



MIL-STD-810H Figure 514.8D-6 and Figure 514.8D-9 reference Table 514.8D-IV for levels (W_1, W_2, f_0, f_1). See the figures and table below:

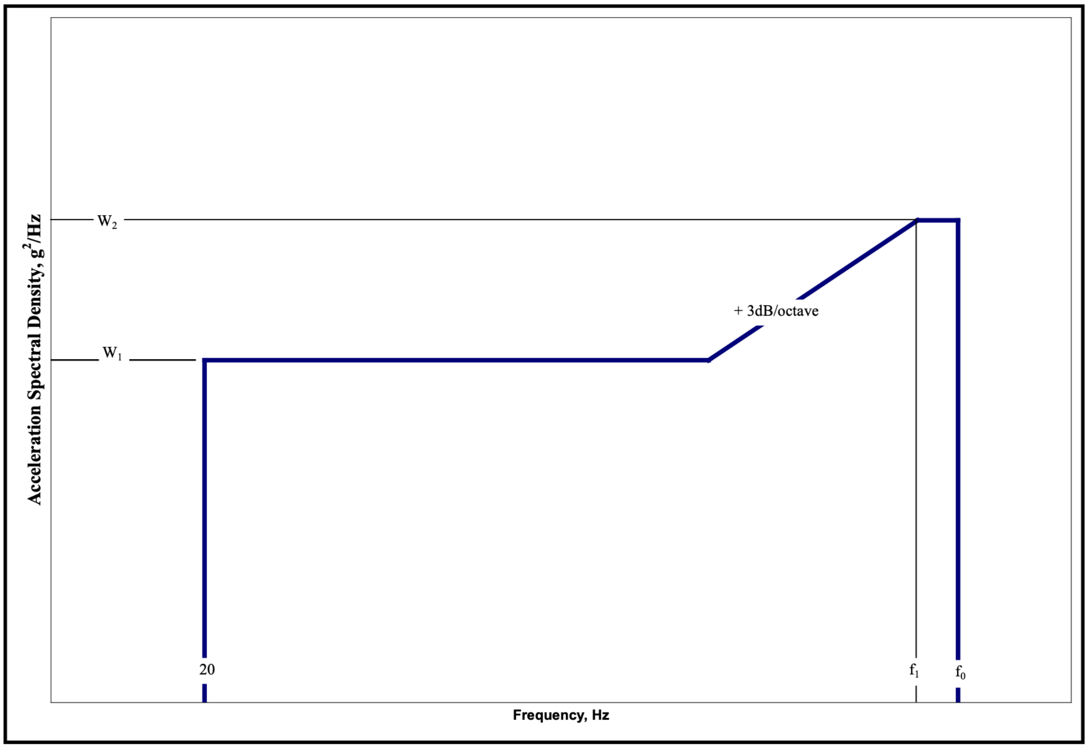


Figure 514.8D-6. Category 15 - Jet aircraft store vibration response.

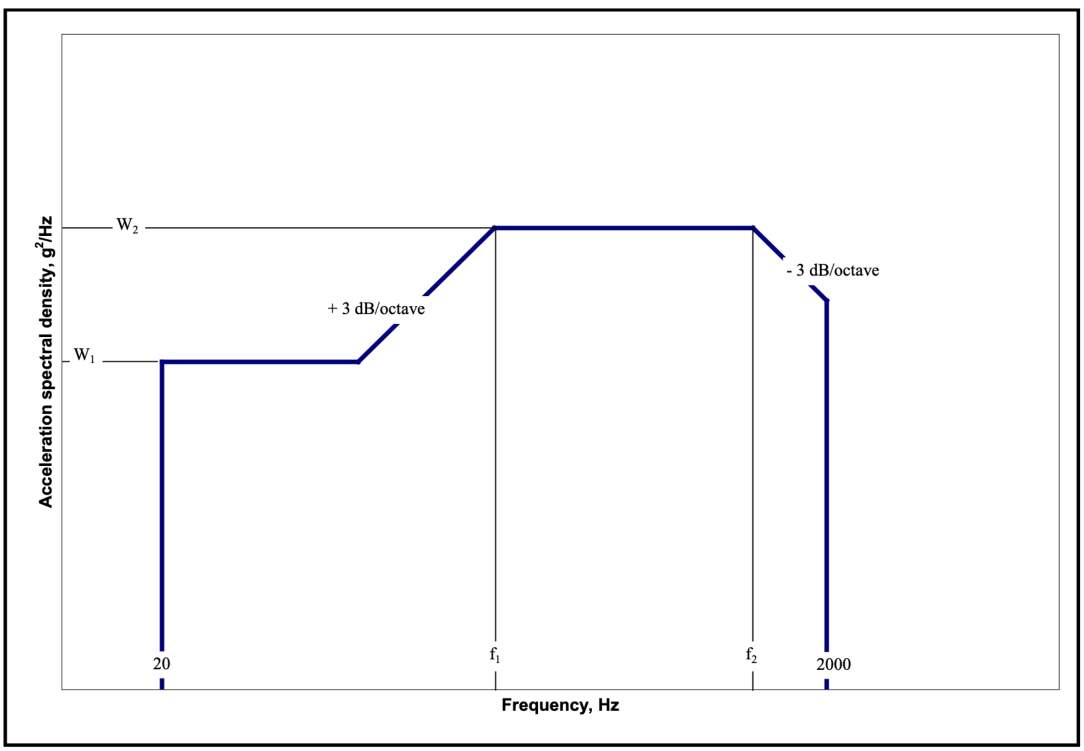


Figure 514.8D-9. Category 16 - Jet aircraft store equipment vibration exposure.

Table 514.8D-IV. Category 15 - Jet aircraft external store vibration exposure.

$$W_1 = 5 \times 10^{-3} \times K \times A_1 \times B_1 \times C_1 \times D_1 \times E_1 ; \quad (g^2/Hz) \quad \underline{1/}$$

$$W_2 = H \times (q/\rho)^2 \times K \times A_2 \times B_2 \times C_2 \times D_2 \times E_2 : \quad (g^2/Hz) \quad \underline{1/}$$

$M \le 0.90$, $K = 1.0$; $0.90 \le M \le 1.0$, $K = -4.8 \times M + 5.32$; $M \ge 1.0$, $K = 0.52$ 2/

$f_1 = 10^5 C(t/R^2)$, (Hz) 3/, 4/, 5/; $f_2 = f_1 + 1000$, (Hz) 3/:

$f_0 = f_1 + 100$, (Hz) 6/, 7/

Configuration	Factors		Configuration	Factors	
Aerodynamically clean	A_1	A_2		B_1	B_2
Single store	1	1	Powered missile, aft half	1	4
Side by side stores	1	2	Other stores, aft half	1	2
Behind other store(s)	2	4	All stores, forward half	1	1
Aerodynamically dirty 8/	C_1	C_2		D_1	D_2
Single and side by side	2	4	Field assembled sheet metal		
Behind other store(s)	1	2	fin / tail cone unit	8	16
Other stores	1	1	Powered missile	1	1
	E_1	E_2	Other stores	4	4
Jelly filled firebombs	1/2	1/4			
Other stores	1	1			

M – Mach number.
H – Constant = 5.59 (metric units) ($= 5 \times 10^{-5}$ English units).
C – Constant $= 2.54 \times 10^2$ (metric units) (= 1.0 English units).
q – Flight dynamic pressure (see Table 514.8D-V) – kN/m^2 (lb/ft^2).
ρ – Store weight density (weight/volume) - kg/m^3 (lb/ft^3).
Limit values of ρ to $641 \le \rho \le 2403$ kg/m^3 ($40 \le \rho \le 150$ lb/ft^3).
t – Average thickness of structural (load carrying) skin - m (in).
R – Store characteristic (structural) radius m (in) (Average over store length).
= Store radius for circular cross sections.
= Half or major and minor diameters for elliptical cross section.
= Half or longest inscribed chord for irregular cross sections.

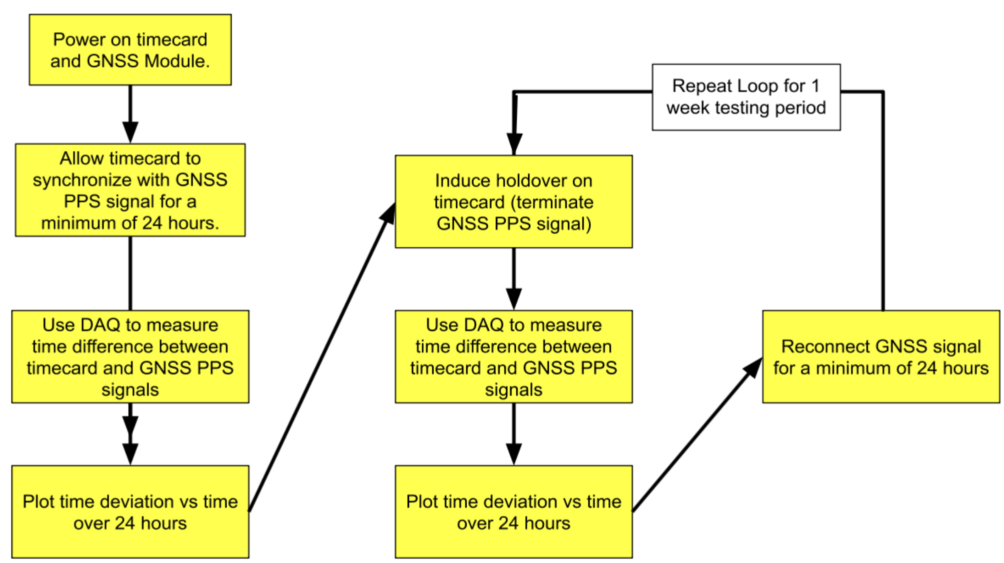
1/ – When store parameters fall outside limits given, consult references.
2/ – Mach number correction (see Annex B).
3/ – Limit f_1 to $100 \le f_1 \le 2000$ Hz
4/ – Free fall stores with tail fins, $f_1 = 125$ Hz
5/ – Limit length ratio to: $0.0010 \le C(t/R^2) \le 0.020$
6/ – $f_o = 500$ Hz for cross sections not circular or elliptical
7/ – If $f_0 \ge 1200$ Hz, then use $f_0 = 2000$ Hz
8/ – Configurations with separated aerodynamic flow within the first ¼ of the store length. Blunt noses, optical flats, sharp corners, and open cavities are some potential sources of separation. Any nose other than smooth, rounded, and gently tapered is suspect. Aerodynamics engineers should make this judgment.

Representative parameter values

Store type	Max q		ρ		f_1	f_2
	kN/m^2	(lb/ft^2)	kg/m^3	(lb/ft^3)	Hz	Hz
Missile, air to ground	76.61	(1600)	1602	(100)	500	1500
Missile, air to air	76.61	(1600)	1602	(100)	500	1500
Instrument pod	86.19	(1800)	801	(50)	500	1500
Dispenser (reusable)	57.46	(1200)	801	(50)	200	1200
Demolition bomb	57.46	(1200)	1922	(120)	125	1100
Fire bomb	57.46	(1200)	641	(40)	100	1100

See this document for an explanation of why these figures and the table are used. They will be used to perform a structural analysis to ensure the time card can withstand the vibrations it will experience.

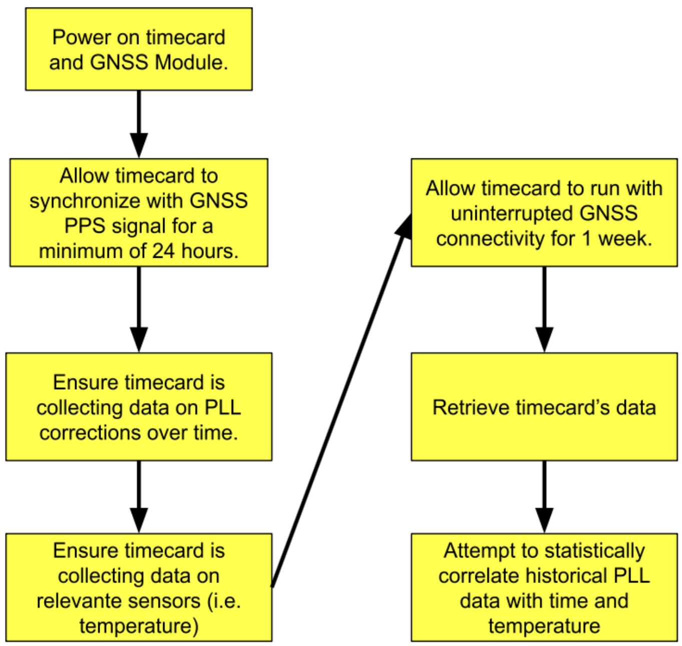
Holdover Accuracy Verification (ER 9):

Subsystem/ Function/ Feature Name:			Holdover Accuracy					
Date of Test:								
Performed By:								
Tested By:								
Concluded Condition of meeting Engineering Specification:								
I. TESTING SPECIFICATION								
Specification Number	Importance	Source	Function	Specification (Metric)	Unit of Measure	Marginal Value	Ideal Value	Comments/Status
S9	1	ITU-T G.8273	Timing	Timekeeping drift *shall* not exceed 30 nanoseconds.	Nanoseconds per Earth day	1	30	
II. EQUIPMENT REQURIED								
Specification Number	Equipment or Instrumentation required							
S9	Oscilloscope, GNSS Module							
III. DATA COLLECTION STRATEGY								
Specification Number	Data acquisition strategy							
S9								

This test allows us to verify the metrics of ER9: “Timekeeping drift shall not excede 30ns per day”. This test is performed by monitoring the time error of the timecard while doing the following: synch the timecard to GPS for a day, cut off gps communications for a day, resync for a day, and repeat as needed (we chose one week total for this test). The metric obtained from this test is the maximum time error of the timecard during any given time of this experiment except for the initial synchronization.

Functionality of Historical Data (precursor to ER 9):

Subsystem/ Function/ Feature Name:		Functionality of Historical Data						
Date of Test:								
Performed By:								
Tested By:								
Concluded Condition of meeting Engineering Specification:								
I. TESTING SPECIFICATION								
Specification Number	Importance	Source	Function	Specification (Metric)	Unit of Measure	Marginal Value	Ideal Value	Comments/Status
Precursor to S9	3		Timing Corrections		N/A	Yes	Yes	
II. EQUIPMENT REQURIED								
Specification Number	Equipment or Instrumentation required							
Precursor to S9	Computer, GNSS Module, temperature DAQ							
III. DATA COLLECTION STRATEGY								
Specification Number	Data acquisition strategy							
S9								



While designing our system, we must be able to statistically correlate frequency errors of the clock to both time and temperature. This test serves as a way to obtain the data to perform this statistical correlation. The timecard runs for a long time (1 week is chosen) while already locked to GPS and constantly in communication with GPS, and data is collected on the frequency adjustments that are needed for this clock over time, along with temperature data.

Link: [Requirements and Testing Document]

Open Items:

Meta’s timecard can adjust its time from up to 2 GNSS sources which can be configured independently.

- The timecard switches to the next source when one fails or switches to the GNSS receiver with a more stable signal.
- This can mitigate jamming and spoofing by switching to another source or the oscillator when disruptions are detected.

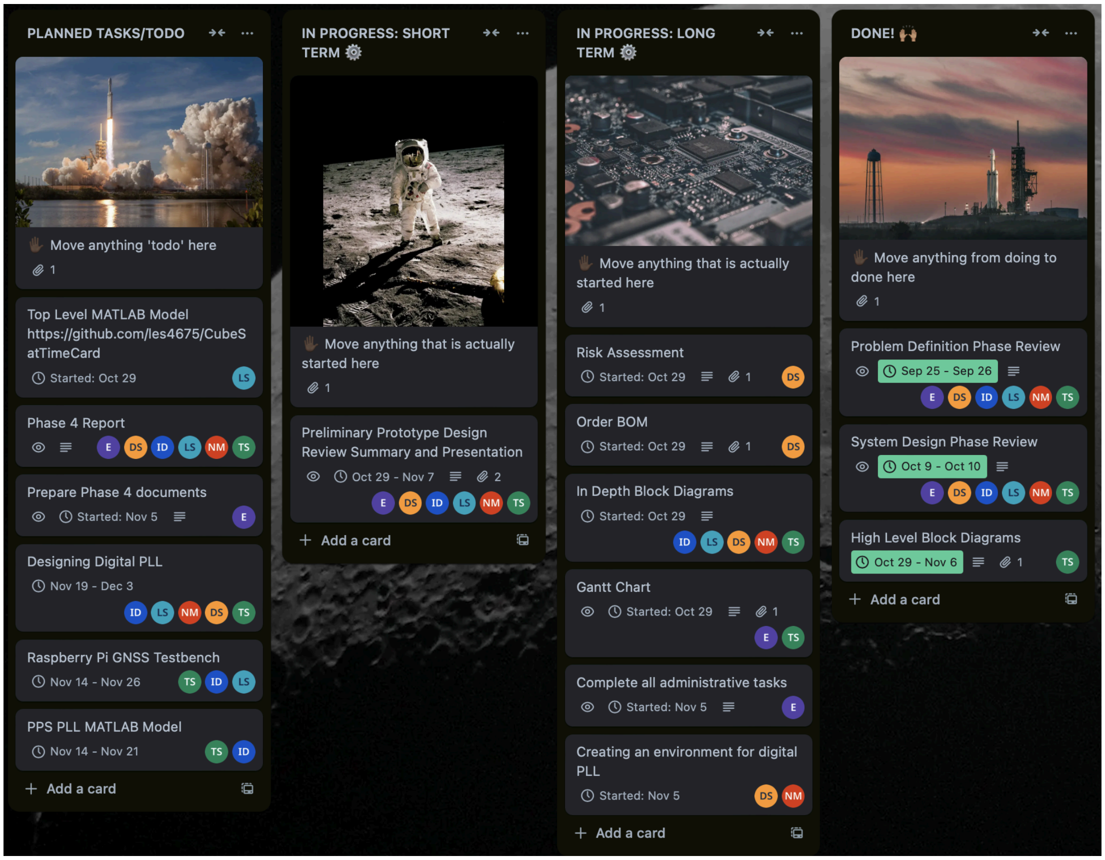
Time of Day(ToD) output pulse requirements and expectations.

Project Management:

Sprint-End Retrospective:

- What went well?
    - We continued to communicate with our clients to ensure we are on the correct path forward.
    - We took all feedback from our clients into account when working on the design.
    - We all worked together to come up with a high-level design.
- What could be improved?
    - We should use the Phase Summary Report template to guide our conversations throughout the phase. This will allow our discussions to be more structured with an end goal.
- What do we commit to improving in the next Sprint?
    - We will stay on topic and have specific goals for each discussion/meeting.
    - We will track what we complete at each meeting, what needs to be completed by the next meeting, and what will be discussed at the next meeting.

Trello: We are using Trello to organize and track our tasks.



Link to Trello:
https://trello.com/invite/b/671a78edf4f62e22545281ae/ATTI2b4091480a6eaea83d203fbbd5bb69d9F87302C9/atomic-clock

Design Review Materials:

Pre-read: Summary Report and Presentation

- Agenda
  - Discuss progress made in the Preliminary Detailed Design Phase
- Presenters
  - Eva Czukkermann, Ian Dolfi, Nsadhu Muyinda, Drew Schacke, Luke Schrom, Tanner Smith

Notes from Review with Action Items: Design Review Notes

Supporting Documentation:

Presentation

System Block Diagram

Trello Board

Risk Assessment

Gantt Chart

[Requirements and Testing](#)
[Bill of Materials](#)
[Vibe Figure Explanation](#)

Notes from Design Review Meeting:

Date November 7, 2024

Attendees
- Team - Ian, Tanner, Luke, Drew, Eva, Nsadhu
- Guide - Dr. McCauley
- Client - Philip Linden, Ashley Kosak

Goals
- Present current progress of project

Agenda and Discussion Notes

Time	Item	Who	Notes
10 min	Feedback	Phil	See notes in feedback section
50 min	Preliminary DDR	All	Split between action items and issues raised

Issues Raised
- Recreating everything - should reuse as much as possible from other open-source time cards
- 30 ns ER is not looking feasible - still good to go through the process trying to achieve it
- How many receivers does GNSS have?
    - Make an assumption - use 1
- Time of Day output pulse requirements and expectations
    - Time stamp is fine

Decisions Made
- Continue with project even if 30 ns requirement is a should instead of shall
- Take as much as possible from open-sourced time cards

Action items
- COMPLETED - Complete your peer evaluations in EduSourced
- COMPLETED - Update meeting notes document
- Close the loop with your client afterward
- Identify what we can borrow from other time cards and carve out what we will be designing ourselves - Team

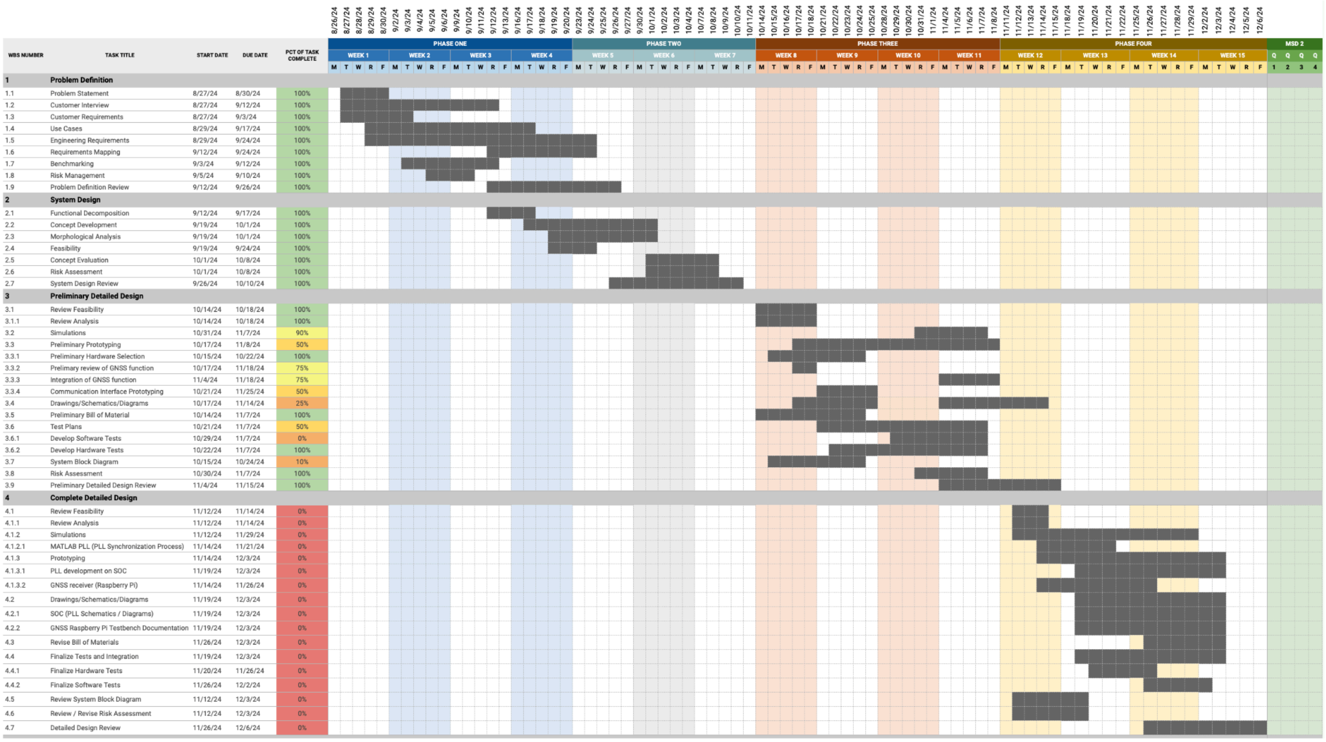
- Need to look into how Meta controls their frequencies? - Team
- Send resources on analog vs digital PLL - Tanner
- Show how allen deviation changes error (holdover specifications slide) - Ian
- One pager summarizing with equations and thoughts (holdover specifications slides), Phil will send to contact at Meta (Amad) - Ian
- How does drift affect 1 year, 5 years, 10 years down the line? - Ian
- Graph of error line from Simulink model - Luke
- COMPLETED - Show path of how vibe figures were determined (different sections that called out figures) - Eva -> see this document
- Look into getting Meta time card (~$250) to help us
    - Phil will look into sponsorship
- Phil will provide emails to contacts at Meta
- COMPLETED - Need to color-code BOM materials that are early purchase - Drew
    - Customers approve purchase
    - Will still need to include on the BOM the materials that are donated (get invoice so we can put on BOM)

Feedback

- Milan conference went well
    - Parts - there is a group doing educational type products
        - Making lab equipment
        - Space Motionary - could maybe help make testing equipment
            - Can give us an idea for what to make
            - Help design and share some of the cost
        - Microchip has academic path to get sponsorship
            - Can get something for cheap or free if we put their name on card
- Made proposal for MoonDOA to buy one SA45 - would cover a little over 5k to cover 1 part which should ship within a few weeks
- Talked to ansys about radiation testing
    - Radiation load - 25 kilorad
    - Ansys has simulation stuff that can hand electromagnetic high energy particle stuff
        - Phil needs to follow up
- Didn't see explicit callout of what we're borrowing from reference materials/existing time card
    - Have we identified what we can borrow versus things we definitely can't borrow?
    - Should take as much as we can so can focus energy on the part that we want to make our own
        - We know it'll work if we "steal" it - experts have been working on it for years

Goals for next phase:

Gantt Chart:



WBS NUMBER	TASK TITLE	START DATE	DUE DATE	PCT OF TASK COMPLETE
1	**Problem Definition**			
1.1	Problem Statement	8/27/24	8/30/24	100%
1.2	Customer Interview	8/27/24	9/12/24	100%
1.3	Customer Requirements	8/27/24	9/3/24	100%
1.4	Use Cases	8/29/24	9/17/24	100%
1.5	Engineering Requirements	8/29/24	9/24/24	100%
1.6	Requirements Mapping	9/12/24	9/24/24	100%
1.7	Benchmarking	9/3/24	9/12/24	100%
1.8	Risk Management	9/5/24	9/10/24	100%
1.9	Problem Definition Review	9/12/24	9/26/24	100%
2	**System Design**			
2.1	Functional Decomposition	9/12/24	9/17/24	100%
2.2	Concept Development	9/19/24	10/1/24	100%
2.3	Morphological Analysis	9/19/24	10/1/24	100%
2.4	Feasibility	9/19/24	9/24/24	100%
2.5	Concept Evaluation	10/1/24	10/8/24	100%
2.6	Risk Assessment	10/1/24	10/8/24	100%
2.7	System Design Review	9/26/24	10/10/24	100%
3	**Preliminary Detailed Design**			
3.1	Review Feasibility	10/14/24	10/18/24	100%
3.1.1	Review Analysis	10/14/24	10/18/24	100%
3.2	Simulations	10/31/24	11/7/24	90%
3.3	Preliminary Prototyping	10/17/24	11/8/24	50%
3.3.1	Preliminary Hardware Selection	10/15/24	10/22/24	100%
3.3.2	Prelimary review of GNSS function	10/17/24	11/18/24	75%
3.3.3	Integration of GNSS function	11/4/24	11/18/24	75%
3.3.4	Communication Interface Prototyping	10/21/24	11/25/24	50%
3.4	Drawings/Schematics/Diagrams	10/17/24	11/14/24	25%
3.5	Preliminary Bill of Material	10/14/24	11/7/24	100%
3.6	Test Plans	10/21/24	11/7/24	50%
3.6.1	Develop Software Tests	10/29/24	11/7/24	0%
3.6.2	Develop Hardware Tests	10/22/24	11/7/24	100%
3.7	System Block Diagram	10/15/24	10/24/24	10%
3.8	Risk Assessment	10/30/24	11/7/24	100%
3.9	Preliminary Detailed Design Review	11/4/24	11/15/24	100%
4	**Complete Detailed Design**			
4.1	Review Feasibility	11/12/24	11/14/24	0%
4.1.1	Review Analysis	11/12/24	11/14/24	0%
4.1.2	Simulations	11/12/24	11/29/24	0%
4.1.2.1	MATLAB PLL (PLL Synchronization Process)	11/14/24	11/21/24	0%
4.1.3	Prototyping	11/14/24	12/3/24	0%
4.1.3.1	PLL development on SOC	11/19/24	12/3/24	0%
4.1.3.2	GNSS receiver (Raspberry Pi)	11/14/24	11/26/24	0%
4.2	Drawings/Schematics/Diagrams	11/19/24	12/3/24	0%
4.2.1	SOC (PLL Schematics / Diagrams)	11/19/24	12/3/24	0%
4.2.2	GNSS Raspberry Pi Testbench Documentation	11/19/24	12/3/24	0%
4.3	Revise Bill of Materials	11/26/24	12/3/24	0%
4.4	Finalize Tests and Integration	11/19/24	12/3/24	0%
4.4.1	Finalize Hardware Tests	11/20/24	11/26/24	0%
4.4.2	Finalize Software Tests	11/26/24	12/2/24	0%
4.5	Review System Block Diagram	11/12/24	12/3/24	0%
4.6	Review / Revise Risk Assessment	11/12/24	12/3/24	0%
4.7	Detailed Design Review	11/26/24	12/6/24	0%

Link: [Gantt Chart]

Personal Goals / Assignments:

Drew Schacke:

Creating an environment for digital PLL within MicroZed 7010 [Vivado]. Designing Digital PLL.

Eva Czukkermann:

Prepare documents needed throughout Phase 4.
Complete all administrative tasks.
Assist with interfacing between MicroZed 7010 [SOC] and multiple TCXO/Atomic Clock breakout boards.

Ian Dolfi:

Interfacing between MicroZed 7010 [SOC] and multiple TCXO/Atomic Clock breakout boards. Designing Digital PLL. Benchmarking/Analysis on MATLAB for PLL design.

Luke Schrom:

Assist with the design of digital PLL. Benchmarking/analysis on MATLAB for PLL design.

Nsadhu Muyinda:

Assist in creating an environment for digital PLL within MicroZed 7010 [Vivado]. Designing Digital PLL.

Tanner Smith:
Interfacing between MicroZed 7010 [SOC] and multiple TCXO / Atomic Clock breakout boards. Designing Digital PLL. Benchmarking / Analysis on MATLAB for PLL design. Identify parts needed for testing and benchmarking time card. Development of GNSS Raspberry Pi testbench.