Section	Design Considerations/Requirement	Capability	Comments	Verified?	Verification Method	Associated Test Number	Verification Comments	Validated?	Status
1	**System**								
1.1	**Operation**								
1.1.1	The system shall record intertial measurement data at least 64 Hz	104	Expected motion characteristic to be about 16 Hz; to gather accurate sinusoidal image requires at least 4x signal rate	Y	Demonstration	AT/GT/MT	2023-02-11: The current version of the software samples at the maximum possible rate (90-100 Hz). A future update will enable more uniform update rates	N	TIP
1.1.2	If GPS is present, the system shall record position, velocity, and course data at least 1 Hz, when fix is valid	201		Y	Demonstration	GPST		N	TIP
1.1.3	The system shall record all data onto onboard storage of at least 1 GB	105		Y	Inspection			Y	D
1.1.4	Data contained within the onboard storage shall be able to be retrieved either physically, over the air, or through a serial connection	111		Y	Inspection	Any	2023-02-11: As of writing, data has been retrieved physically (by removing the uSD card) and OTA. Serial not tested yet.	N	TIP
1.1.5	The system shall fit within a water-tight enclosure	101		Y	Inspection			Y	D
1.1.6	The system shall be capable of being mounted to a surface with bolts, screws, or zipties			Y	Inspection			Y	D
1.1.7	The system shall be operable by a single person			Y	Demonstration			Y	D
1.1.8	The system shall be able to load user configurations from a file in the onboard storage unit when booted	204		Y	Test	Any		Y	D
1.1.9	The user shall be able to overwrite the user configurations through the serial console or over the air	204		Y	Test	Any		Y	TIP
1.1.10	The user shall be able to turn on and off the system using a physical switch	107	Power supply for the regulator should automatically be chosen when the swtich is flipped. USB power has priority over the battery.	Y	Test	Any		Y	D
1.1.11	The system shall be able to power down peripherals (sensors, indicators, radios, etc.) when entering a sleep mode	304	This can be done either by setting each chip individually to their sleep or low power states, or by turning off a dedicated peripheral voltage regulator	N	Test		We can measure the power draw by supplying 5V throught the test pads and monitoring current draw in the different modes	N	R
1.1.12	When plugged into a USB data cable the system shall enter a diagnostic mode		Need a sense line on the V_USB bus to detect USB is present	Y	Test	Any		Y	D
1.1.13	When plugged into a USB data cable, the system shall not start the main firmware loop until a diagnostic serial terminal is opened			Y	Test	Any		Y	D
1.1.14	The system shall have an RGB LED that can be used to provide operational feedback to the user without a diagnostic console	107	Different color codes for system states - error codes for failure modes	Y	Test	Any		Y	D
1.2	**Sensors**								
1.2.1	The system shall utilize an IMU with at least 6 DOF	104		Y	Inspection	AT/GT/MT		Y	D
1.2.2	If the IMU has only a gyroscope and accelerometer, the system shall integrate another sensor to determine heading	104	In GPS-enabled environments, the GPS sensor will suffice. Otherwise, a 3DOF magnetometer will need to be added	N	Inspection	MT		N	R
1.2.3	Accelerometer shall be capable of measuring accelerations up to ±24g	104		Y	Inspection			N	A

1.2.4	Accelerometer shall have a sensor resolution of at least 12 bits at ±8g sample range	104		Y	Inspection			N	A
1.2.5	Gyroscope shall be capable of measuring rotation rates of up to 2000 deg/sec	104		Y	Inspection			N	A
1.2.6	Gyroscope shall have a sensor resolution of at least 12 bits at ±500 deg/sec sample range	104		Y	Inspection			N	A
1.2.7	Magnetometer shall be capable of measuring magnetic fields up to ±8G	104		Y	Inspection			N	A
1.2.8	Magnetometer shall have a sensor resolution of at least 12 bits at ±2G sample range	104		Y	Inspection			N	A
1.2.9	When in realistic conditions, the GPS shall report position data with an accuracy of at least ±3m	201		Y	Analysis			N	A
1.2.10	The GPS shall be capable of reporting NMEA-encoded data at least every 1 Hz	201		Y	Demonstration	GPST		N	A
1.2.11	The polling rate of the sensors shall be configurable by the user through the configuration file and must conform to the sensor's options	204		Y	Demonstration	AT/GT/MT		N	A
1.2.12	The sample rate of the sensors shall be configurable by the users through the configuration file	204	1, 2, 4, 8, 16, 32, 64 Hz options	Y	Demonstration	AT/GT/MT		N	A
1.3	**Units**								
1.3.1	Unless otherwise specified, internal processing units shall be metric (SI)			Y	Inspection			Y	D
1.3.2	Unless otherwise specified, measurements shall be reported in metric (SI) units			Y	Inspection			Y	D
1.3.3	Unless otherwise specified, internal timing shall be done with microsecond-precision		Arduino: micros()	Y	Inspection			Y	D
1.3.4	Unless otherwise specified, internal timestamping shall be done with POSIX epoch		Seconds since January 1, 1970 @ 00:00 UTC	Y	Inspection			Y	D
1.3.5	Unless otherwise specified, reported timestamps shall be in ISO8601 format with millisecond precision		YYYY-MM-DDTHH:mm:SS.sss	Y	Inspection			Y	D
1.3.7	Unless otherwise specified, reported timestamps shall be in the Universal Time Coordinated			Y	Inspection			Y	D
1.3.8	The user shall be able to override the timestamp format using the configuration file	204		N	Demonstration			N	UR
1.3.9	The user shall be able to override the recorded timezone using the configuration file	204		N	Demonstration			N	UR
1.3.10	Whenever possible the internal RTC shall be synchronized with external time sources like NTP and/or GPS	201		Y				N	TIP
1.3.11	In the absence of a synchronization source like NTP or GPS, the device shall report time in terms of time since power on			Y	Demonstration			Y	D
2	**Mechanical**								
2.1	**Physical dimensions**								
2.1.1	The system shall fit within a 8" x 5" x 1.25" space	102		Y	Inspection			Y	D
2.1.2	The system shall not weight more than 500 grams	102		Y	Inspection			Y	D
2.2	**Enclosure**								
2.2.1	The enclosure shall be rated to withstand at least submersion in 1 meter of water for up to 4 hours	101		Y	Test			Y	A
2.2.2	The enclosure shall not allow any dust to enter it	101		Y	Test			Y	A
2.2.3	The enclosure shall be sealed using a replaceable gasket or o-ring	101		Y	Inspection			Y	D
2.2.4	The enclosure shall not exceed the physical dimensions specified in Requirement 2.1.1	101		Y	Inspection			Y	D
2.2.5	The enclosure shall be able to be bolted, screwed, or ziptied to a surface with at least 2 points of contact			Y	Inspection			Y	D
2.2.6	The enclosure shall have external markings indicating the system's measurement axes and sensor location			Y	Inspection			N	A

2.2.7	The enclosure shall be made of a non-RF blocking material, unless an external antenna is available	205		Y	Inspection			N	A
2.2.8	The enclosure shall be made of a material resistant to continuous submersion in salt water (>25 ppt NaCl)	101		Y	Test			N	A
2.2.9	The enclosure shall be made of a material that can withstand constant exposure to sunlight (UV radiation)	101		Y	Test			N	A
2.2.10	The enclosure shall be capable of withstanding multiple drops without compromising its integrity	101		Y	Test			N	A
2.2.11	The enclosure shall have multiple points on which to mount the instrumentation board	101		Y	Inspection			Y	D
3	**Electrical**								
3.1	**Power**								
3.1.1	The system shall operate off a 1S (3.7V nom.) lithium polymer battery			Y	Inspection			Y	D
3.1.2	The system shall use appropriate onboard voltage busses, as necessary			Y	Inspection			Y	D
3.1.3	The system shall not exceed the current draw of the battery			Y	Test	PWT		N	A
3.1.4	The system shall be optionally powered from a USB or other external source			Y	Demonstration			Y	D
3.1.5	In accordance with Requirement 3.1.4, the system will not allow current to flow unregulated from the external source to the battery			Y	Analysis			N	A
3.1.6	The system shall not have multiple power sources being used at once			Y	Analysis	PWT		N	A
3.1.7	In accordance with Requirement 3.1.6, the system shall draw power from the external voltage source, before the battery			Y	Analysis	PWT		N	A
3.1.8	The system shall use low quiescent-current regulators, where feasible			Y	Analysis	PWT		N	A
3.1.9	The system shall provide a battery backup voltage to the GPS module, if supported			Y	Inspection			N	A
3.1.10	The system shall provide a battery backup voltage to the RTC, if supported			N	Inspection			N	R
3.1.11	The system shall be able to recharge the battery when plugged into USB power			Y	Demonstration			Y	D
3.2	**Mechanical Connections**								
3.2.1	Where possible, the system shall be assembled using lead-free solder that passes ASTM standards	112		Y	Inspection			N	A
3.2.2	Components shall be soldered to the PCB following IPC J-STD-001 standards for electrical soldering	112	More information: https://www.protoexpress.com/blog/ipc-j-std-001-standard-soldering-requirements/	Y	Inspection			N	A
3.2.3	When possible, components shall be placed on a single side of the PCB	112		Y				Y	D
3.2.4	Any PCB designs will be made in accordance with the IPC-2221B standard	112	More information: https://www.protoexpress.com/blog/ipc-2221-circuit-board-design/	Y	Inspection			N	A
3.2.5	Any board-to-board or board-to-cable connections shall use keyed receptacles that prevent connector reversal	112		Y	Inspection			N	A
3.2.6	Any board-to-board or board-to-cable connections shall use components that are rated for automotive use	112		Y	Inspection			N	A

3.2.7	Any board-to-antenna connectors shall use locking, friction-fit connectors with appropriate strain relief	112	This is meant to ensure that the antenna connectors do not dislodge during use	Y	Inspection			N	A