Section	Design Considerations/Requirement	Comments	Verification Method	Associated Test Number	Verification Comments	Status
1	System					
1.1	Operation					
1.1.1	The system shall record intertial measurement data at least 64 Hz	*Expected motion characteristic to be about 16 Hz; to gather accurate sinusoidal image requires at least 4x signal rate*	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*	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		Demonstration	GPST		TIP
1.1.3	The system shall record all data onto onboard storage of at least 1 GB		Inspection			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		Inspection	Any	*2023-02-11: As of writing, data has been retrieved physically (by removing the uSD card) and OTA. Serial not tested yet.*	TIP
1.1.5	The system shall fit within a water-tight enclosure		Inspection			D
1.1.6	The system shall be capable of being mounted to a surface with bolts, screws, or zipties		Inspection			D
1.1.7	The system shall be operable by a single person		Demonstration			D
1.1.8	The system shall be able to load user configurations from a file in the onboard storage unit when booted		Test	Any		D
1.1.9	The user shall be able to overwrite the user configurations through the serial console or over the air		Test	Any		UR
1.1.10	The user shall be able to turn on and off the system using a physical switch	*Power supply for the regulator should automatically be chosen when the swtich is flipped. USB power has priority over the battery.*	Test	Any		D
1.1.11	The system shall be able to power down peripherals (sensors, indicators, radios, etc.) when entering a sleep mode	*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*	Test		*We can measure the power draw by supplying 5V throught the test pads and monitoring current draw in the different modes*	UR
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*	Test	Any		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		Test	Any		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	*Different color codes for system states - error codes for failure modes*	Test	Any		D

1.2	Sensors					
1.2.1	The system shall utilize an IMU with at least 6 DOF		Inspection	AT/GT/MT		TIP
1.2.2	If the IMU has only a gyroscope and accelerometer, the system shall integrate another sensor to determine heading	*In GPS-enabled environments, the GPS sensor will suffice. Otherwise, a 3DOF magnetometer will need to be added*	Inspection	MT		A
1.2.3	Accelerometer shall be capable of measuring accelerations up to ±24g		Inspection			A
1.2.4	Accelerometer shall have a sensor resolution of at least 12 bits at ±8g sample range		Inspection			A
1.2.5	Gyroscope shall be capable of measuring rotation rates of up to 2000 deg/sec		Inspection			A
1.2.6	Gyroscope shall have a sensor resolution of at least 12 bits at ±500 deg/sec sample range		Inspection			A
1.2.7	Magnetometer shall be capable of measuring magnetic fields up to ±8G		Inspection			A
1.2.8	Magnetometer shall have a sensor resolution of at least 12 bits at ±2G sample range		Inspection			A
1.2.9	When in realistic conditions, the GPS shall report position data with an accuracy of at least ±3m		Analysis			A
1.2.10	The GPS shall be capable of reporting NMEA-encoded data at least every 1 Hz		Demonstration	GPST		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		Demonstration	AT/GT/MT		A
1.2.12	The sample rate of the sensors shall be configurable by the users through the configuration file	*1, 2, 4, 8, 16, 32, 64 Hz options*	Demonstration	AT/GT/MT		A
1.3	Units					
1.3.1	Unless otherwise specified, internal processing units shall be metric (SI)		Inspection			D
1.3.2	Unless otherwise specified, measurements shall be reported in metric (SI) units		Inspection			D
1.3.3	Unless otherwise specified, internal timing shall be done with millisecond-precision	*Arduino millis()*	Inspection			D
1.3.4	Unless otherwise specified, internal timestamping shall be done with POSIX epoch	*Seconds since January 1, 1970 @ 00:00 UTC*	Inspection			D
1.3.5	Unless otherwise specified, reported timestamps shall be in ISO8601 format with millisecond precision	*YYYY-MM-DDTHH:mm:SS.sss*	Inspection			D
1.3.7	Unless otherwise specified, reported timestamps shall be in the Universal Time Coordinated		Inspection			D
1.3.8	The user shall be able to override the timestamp format using the configuration file		Demonstration			UR
1.3.9	The user shall be able to override the recorded timezone using the configuration file		Demonstration			UR
1.3.10	Whenever possible the internal RTC shall be synchronized with external time sources like NTP and/or GPS					

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		Demonstration			D
2	Mechanical					
2.1	Physical dimensions					
2.1.1	The system shall fit within a 3"x3"x1" box		Inspection			D
2.1.2	The system shall not weight more than 500 grams		Inspection			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		Test			A
2.2.2	The enclosure shall not allow any dust to enter it		Test			A
2.2.3	The enclosure shall be sealed using a replaceable gasket or o-ring		Inspection			D
2.2.4	The enclosure shall not exceed the physical dimensions specified in Requirement 2.1.1		Inspection			A
2.2.5	The enclosure shall be able to be bolted, screwed, or ziptied to a surface with at least 2 points of contact		Inspection			A
2.2.6	The enclosure shall have external markings indicating the system's measurement axes and sensor location		Inspection			A
2.2.7	The enclosure shall be made of a non-RF blocking material, unless an external antenna is available		Inspection			A
2.2.8	The enclosure shall be made of a material resistant to continuous submersion in salt water (>25 ppt NaCl)		Test			A
2.2.9	The enclosure shall be made of a material that can withstand constant exposure to sunlight (UV radiation)		Test			A
2.2.10	The enclosure shall be capable of withstanding multiple drops without compromising its integrity		Test			A
2.2.11	The enclosure shall have multiple points on which to mount the instrumentation board		Inspection			A
3	Electrical					
3.1	Power					
3.1.1	The system shall operate off a 1S (3.7V nom.) lithium polymer battery		Inspection			D
3.1.2	The system shall use appropriate onboard voltage busses, as necessary		Inspection			D
3.1.3	The system shall not exceed the current draw of the battery		Test	PWT		A
3.1.4	The system shall be optionally powered from a USB or other external source		Demonstration			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		Analysis			D
3.1.6	The system shall not have multiple power sources being used at once		Analysis	PWT		A

3.1.7	In accordance with Requirement 3.1.6, the system shall draw power from the external voltage source, before the battery		Analysis	PWT		A
3.1.8	The system shall use low quiescent-current regulators, where feasible		Analysis	PWT		A
3.1.9	The system shall provide a battery backup voltage to the GPS module, if supported		Inspection			A
3.1.10	The system shall provide a battery backup voltage to the RTC, if supported		Inspection			R
3.1.11	The system shall be able to recharge the battery when plugged into USB power		Demonstration			D
3.2	Mechanical Connections					
3.2.1	Where possible, the system shall be assembled using lead-free solder that passes ASTM standards		Inspection			A
3.2.2	Components shall be soldered to the PCB following IPC J-STD-001 standards for electrical soldering	*More information: https://www.protoexpress.com/blog/ipc-j-std-001-standard-soldering-requirements/*	Inspection			A
3.2.3	When possible, components shall be placed on a single side of the PCB					
3.2.4	Any PCB designs will be made in accordance with the IPC-2221B standard	*More information: https://www.protoexpress.com/blog/ipc-2221-circuit-board-design/*	Inspection			A
3.2.5	Any board-to-board or board-to-cable connections shall use keyed receptacles that prevent connector reversal		Inspection			A
3.2.6	Any board-to-board or board-to-cable connections shall use components that are rated for automotive use		Inspection			A
3.2.7	Any board-to-antenna connectors shall use locking, friction-fit connectors with appropriate strain relief	*This is meant to ensure that the antenna connectors do not dislodge during use*	Inspection			A