11.5 Minimum Personnel Requirements ................................................................. 12
11.6 Personnel Responsibilities for Deployments ..................................................... 12
11.7 Personal Equipment .......................................................................................... 13
12. Emergency Procedures ...................................................................................... 13
   12.1 Emergency Loss of Signal Procedures ............................................................ 13
   12.2 Loss of Communications between Observer & PIC .......................................... 14
13. Pre-Flight/Post-Flight Actions ......................................................................... 15
   13.1 Inspections ...................................................................................................... 15
   13.2 Weather ........................................................................................................ 15
   13.3 Documentation ............................................................................................... 15
   13.4 Planning ......................................................................................................... 16
   13.5 Checklists ...................................................................................................... 16
   13.6 Maintenance .................................................................................................. 16
   13.7 Other ............................................................................................................ 16

APPENDIX 1 - BEAUFORT WIND SCALE
APPENDIX 2 - AREA AVIATION CONTACTS IMPACTING CAROLINE COUNTY
APPENDIX 3 - SAMPLE PRE-FLIGHT BRIEFING
APPENDIX 4 - CAROLINE SMALL SUAS CERTIFICATE OF REGISTRATION
APPENDIX 5 - AIRCRAFT SPECIFICATIONS (PHANTOM AND MATRICE)
APPENDIX 6 – CAROLINE FAA COA CERTIFICATE
APPENDIX 7 – SAMPLE LETTER TO HOMEOWNERS NEAR MISSIONS
APPENDIX 8 – CENDENCE REMOTE – CUSTOM SETTINGS CHART
APPENDIX 9 – TIME CONVERSION CHART
1. Preface

The following procedures are intended to promote safe, efficient and lawful operation of the CAROLINE COUNTY small, unmanned aircraft system (sUAS). Safety, above all else, is the primary concern in each and every operation, regardless of the nature of the mission.

2. Philosophy & Mission Statement

It shall be the mission of those personnel of CAROLINE COUNTY who are trained in the use of unmanned aircraft systems (sUAS), to use this resource to support emergency services missions associated with the Department of Fire – Rescue and Emergency Management under the guidelines outlined in the County’s Certificate of Waiver / Authorization (COA) as issued by the Federal Aviation Administration (FAA). Missions of this nature may include: firefighting incident situational awareness, search and rescue, Amber and Senior Alerts, training programs, damage assessment, and scene documentation. The County may also utilize its sUAS system in support of specific non-emergency government operations under the direction and control of licensed FAA Part 107 pilot. These missions may include: economic development photography and inspection of public buildings.

It shall be the intent of every Pilot in Command to make reasonable efforts to not invade a person’s reasonable expectation of privacy when operating the sUAS. When operating the sUAS, CAROLINE COUNTY operators abide by all FAA Regulations for flight and receive the proper authorization for flight.

3. Protection of Rights and Privacy

Pilots in Command and observers ensure the protection of private individuals’ civil rights and reasonable expectations of privacy before deploying the sUAS. Pilots in Command and observers ensure and are held accountable for ensuring that operations of the sUAS intrude to a minimal extent upon the private persons and businesses. To accomplish this primary goal, CAROLINE COUNTY observes the following:

A. CAROLINE COUNTY does not conduct random surveillance activities. The use of the sUAS is tightly controlled and regulated.

B. All authorized missions for CAROLINE COUNTY sUAS are for defined specific areas and missions. Missions may include:
   a. firefighting incident situational awareness
   b. search and rescue to include Amber and Senior Alerts
   c. damage assessment
   d. scene access / egress assessment
   e. scene documentation
   f. training programs
g. any emergency service needs deemed appropriate by the sUAS coordinator or his designee.

CAROLINE COUNTY sUAS operate strictly within the law and regulations. If in doubt, prior to operating the sUAS we ensure that the proper forms and applications are applied for and obtained. All operations are balanced with the need to accomplish the mission while maintaining public privacy and the freedom from intrusion.

UAS-recorded data will not be collected, disseminated or retained solely for the purpose of monitoring activities protected by the U.S. Constitution, such as the First Amendment’s protections of religion, speech, press, assembly, and redress of grievances [e.g. protests, demonstrations].

Collections, use dissemination, or retention of UAS-recorded data should not be based solely on individual characteristics (e.g., race, ethnicity, national origin, sexual orientation, gender identity, religion, age, or gender), which is a violation of the law.

4. Transparency

To promote transparency about the Caroline County sUAS programs, while not revealing information that could reasonability be expected to compromise law enforcement or national security, the team will attempt when possible to provide public notice regarding operations. An example of such a public notification document is included in Appendix 7. Notifications may be made “door-to-door” or through the County’s CarolineAlert notification system (text/email/voice).

The team will make available to the public, on an annual basis, a summary of the programs sUAS operations during the previous year. This will include a brief description of types of missions flown.

Information about the County’s program as well as changes that would significantly affect privacy, civil rights, or civil liberties will be made available to the public.

5. Data Retention

5.1 Retention

Information collected using sUAS shall not be retained for more than 180 days unless retention of the information is determined to be necessary to an authorized mission of the retaining agency, or is required to be retained for a longer period by any other applicable law or regulation.
Data (photo and video) will be stored on secure local County servers.


The Caroline Sheriff’s Office will be the custodian of any sUAS photography/video that may be utilized in any criminal investigation.

### 5.2 Data Privacy to Off Site Servers

Caroline’s DJI UAS aircraft utilize systems that transmit mission data via the internet to their company’s servers (some outside of the United States). Should the mission parameters be of a nature that any off-site data would reveal information that could reasonably be expected to compromise law enforcement or national security, the Pilot in Command will enable “DJI Privacy Mode” on the flight system. Privacy mode (referred to by DJI as Local Data Mode [LDM]) is enabled in the DJI Pilot app.

### 6. Definitions

A. **UNMANNED AIRCRAFT SYSTEM (sUAS):** The preferred industry definition of aircraft designed to navigate in the air without an on-board pilot. The authorization to use sUAS is regulated by the Federal Aviation Administration (FAA).

B. **CIVIL AIRCRAFT:** all aircraft except a public aircraft.

C. **LANDING AREA:** a place on land or water, including an airport or intermediate landing field, used, or intended to be used, for the takeoff and landing of aircraft, even when facilities are not provided for sheltering, servicing, or repairing aircraft, or for receiving or discharging passengers or cargo.

D. **COA:** is an authorization issued by the Air Traffic Organization to a public operator for a specific UA activity. After a complete application is submitted, FAA conducts a comprehensive operational and technical review. If necessary, provisions or limitations may be imposed as part of the approval to ensure the UA can operate safely with other airspace users. In most cases, FAA will provide a formal response within 60 days from the time a completed application is submitted.)

E. **PILOT IN COMMAND (PIC):** The person who has final authority and responsibility for the operation and safety of flight, has been designated as pilot in command before or during the flight, and holds the appropriate category, class, and type rating, if appropriate, for the conduct of the flight. The pilot in command position may rotate duties as necessary with equally qualified pilots. The individual designated as PIC may change during flight. All Pilots in Command will be required
to be certified by the Federal Aviation Administration (FAA) under 14 CFR Part 107 and possess a Remote Pilot Airman Certificate.

F. **VISUAL LINE-OF-SIGHT:** A method of control and collision avoidance that refers to the pilot or observer directly viewing the unmanned aircraft with human eyesight. Corrective lenses (spectacles or contact lenses) may be used by the pilot or visual observer.

G. **OBSERVER:** A trained person who assists the unmanned aircraft pilot in the duties associated with collision avoidance. This includes, but is not limited to, avoidance of other traffic, clouds, obstructions and terrain.

H. **PUBLIC AIRCRAFT:** An aircraft operated by a public user which is intrinsically governmental in nature (i.e. federal, state, and local agencies). Examples of public entities in Caroline County are the Caroline County Department of Fire – Rescue and Emergency Management, Sheriff’s Office, other local, state, and federal government agencies; and state universities. Refer to 14 CFR 1.1, General Definitions, for a complete definition of a public aircraft.

**7. Administration**

**7.1 Operations Manual**

1. The policies and procedures contained in this manual are issued by CAROLINE COUNTY.

2. This manual is not intended to be all-inclusive, but as a supplement to other County guidelines, Commonwealth of Virginia laws, Federal Aviation Administration regulations, pre-flight safety checklists, aircraft manufacturers' approved flight manual, etc.

3. This manual has been written to address sUAS operations as they existed when it was drafted. Equipment, personnel, environment (internal and external), etc., change over time. The management of change involves a systematic approach to monitoring organizational change and is a critical part of the risk management process. Given this, it is essential that this manual be continually updated as necessary. The entire manual must be reviewed, at a minimum, annually to assure it is up to date. Any changes to the manual will be communicated as currently dictated by policy.

4. A copy of the manual (electronic and/or paper) is issued to every person having sUAS responsibilities.

**7.2 Organization**

1. The sUAS unit is comprised of those personnel approved by CAROLINE COUNTY. It includes operators, observers and others deemed necessary as part of the sUAS crew.
2. Assignment to the sUAS flight crew is accomplished following careful selection and training by CAROLINE COUNTY.

7.3 Personnel

1. Pilot-in-command (PIC):
   a. Responsible for the overall direction and performance of the UAS unit and exercises command and control over it.
   b. The PIC will check the sUAS before and after missions to ensure the UAS is airworthy.

2. UAS Coordinator:
   a. Maintaining all training, flight records for each operator and observer.
   b. Maintain all service/maintenance records for the sUAS and equipment.
   c. Maintain contact with the FAA and regulations as they change.

3. Operators:
   a. An operator's primary duty is the safe and effective operation of the sUAS in accordance with the manufacturer's approved flight manual, FAA regulations and CAROLINE COUNTY policy and procedures.
   b. Operators may be temporarily removed from flight status at any time by the UAS Coordinator for reasons including performance, proficiency, physical condition, etc. Should this become necessary, the operator will be notified verbally and in writing of the reason, further action to be taken and expected duration of such removal.
   c. The UAS Coordinator will maintain a file for each operator which will include copies of training records, flight incidents, etc. This file is reviewed in accordance with current CAROLINE COUNTY policy and procedures.

4. Observers:
   a. Observers must have been provided with sufficient training to communicate clearly to the operator any turning instructions required to stay clear of conflicting traffic and obstacles.
   b. An observer's primary duty is to operate the sUAS's equipment including cameras, thermal imaging camera, radio communications with other crew members and property owners as well as be an observer for anything that may affect the operator's primary duty.
   c. The UAS Coordinator maintains a file for each observer, which includes copies of training records, UAV incidents, etc.

7.4 Storage / Facilities

1. sUAS operations are housed and maintained by the Caroline County Department of Fire – Rescue and Emergency Management. sUAS equipment will be located behind a secured door, gate or by other means to ensure the security of the equipment.
2. Only the sUAS flight crew and designated individuals will have access to secured sUAS location(s).
3. Personnel must not leave sUAS equipment unsecured.
4. All personnel are equally responsible for maintaining the storage location in a neat, clean and orderly fashion.

7.5 Scheduling

1. To facilitate the broad use of the sUAS, it shall be made available to all sUAS flight crew members.
2. To maintain a level of proficiency with the sUAS, operators are required, as part of their acceptance into the sUAS flight crew, to attend all required training. Training is coordinated through the sUAS flight crew and announced in advance for scheduling purposes.

7.6 Miscellaneous

1. Inquiries from the news media must be forwarded to the CAROLINE COUNTY Administrator or Fire – EMS Chief (or their designee). Operators/Observers shall follow currently established County policy regarding interactions and inquiries from the media.
2. Requests for support from third-parties will be responded to by the sUAS coordinator. Should the request involve an immediate threat to life, or property, the operator is authorized to accept or decline the request. Proper policy and procedure, as well as FAA regulations must be followed when accepting mutual aid support for the sUAS.
3. Complaints or inquiries regarding sUAS operations must be referred to the sUAS coordinator.

8. Audits / Oversight

The Fire – EMS Chief, or his designee, will provide oversight of the team operations and appoint an UAS Team Coordinator. This oversight will include audits or assessments of safety policies, regulations, and practices.

9. Safety

9.1 Safety Policy

1. CAROLINE COUNTY is committed to having a safe and healthy workplace, including:
a. The ongoing pursuit of an accident free workplace, including no harm to people, no damage to equipment, the environment and property.
b. A culture of open reporting of all safety hazards in which management will not initiate disciplinary action against any personnel who, in good faith, disclose a hazard or safety occurrence due to unintentional conduct.
c. Support for safety training and awareness programs.
d. Conducting regular audits of safety policies, procedures and practices.
e. Monitoring the sUAS community to ensure best safety practices are incorporated into the organization.

2. It is the duty of every member within the sUAS flight crew to contribute to the goal of continued safe operations. This contribution comes in many forms and includes always operating in the safest manner practicable and never taking unnecessary risks. Any safety hazard, whether procedural, operational, or maintenance related must be identified as soon as possible after, if not before, an incident occurs. Any suggestions in the interest of safety should be made to the sUAS Coordinator.

3. If any member observes, or has knowledge of an unsafe or dangerous act committed by another member, the sUAS coordinator is to be notified immediately so that corrective action may be taken.

9.2 Operational Hazard and Occurrence Report (OHOR) and Investigations

1. Occurrences are unplanned safety related events, including accidents and incidents that could impact safety. A hazard is something that has the potential to cause harm. The systematic identification and control of all major hazards is foundational to safety.

2. The OHOR concept provides a mechanism to report hazards and occurrences, real and perceived, to those responsible for sUAS operations.

3. There is no specific format for the OHOR as the information provided is what is important, not the format and should be used without hesitation to report any anticipated, current, or experienced safety hazard, or occurrence. Further, the OHOR can be submitted anonymously, and to whatever level in the chain of command, to get the matter proper attention, without fear of reprisal.

4. Written memorandums fully explaining the problem will be given to the sUAS coordinator for investigation.

5. Every hazard and/or occurrence is investigated, with the results and corrective action taken communicated to all members. The investigation will be conducted by the sUAS coordinator or any other member of the County who has the technical skill necessary to do it. The services of an independent subject matter expert may be necessary in some cases to assure a thorough and complete investigation.

6. Hazards requiring immediate attention will be brought to the attention of the sUAS coordinator, verbally, without delay.
7. **ALL MEMBERS ARE AUTHORIZED TO TAKE ACTION TO CORRECT A HAZARD** if in that member's opinion delay will result in accident or injury. The sUAS coordinator will be notified immediately in such situations.

9.3 Safety Officer - Operator/Observer/Coordinator

1. In regards to safety, all members of the sUAS flight crew are responsible for the following:
   a. Ensuring all flight operations personnel understand applicable regulatory requirements, standards and organizational safety policies and procedures.
   b. Observe and control safety systems by monitoring all operations.
   c. Review standards and the practices of County personnel as they impact operational safety.
   d. Communicate all reported safety related problems and the corrective action taken. If there were any in-flight problems (or learned experiences), the proper procedures for handling that problem should be discussed.
   e. Copy and circulate pertinent safety information.
   f. Copy and circulate emergency safety bulletins.
   g. Place any electronic copies of safety information or bulletins in a conspicuous location for all employees to access.
   h. It is emphasized again that safety is the responsibility of ALL members of the sUAS unit.

9.4 Safety Training

1. All members shall receive training in the following subjects prior to operating the sUAS as a released PIC:
   a. County policy
   b. sUAS member's role in safety
   c. Emergency procedures

9.5 Medical Factors

1. Operator and Observers shall only deploy the sUAS when rested and emotionally prepared for the tasks at hand.
2. Physical illness, exhaustion, emotional problems, etc., seriously impair judgment, memory and alertness. The safest rule is not to act as an operator or observer when suffering from any of the above. Members are expected to "stand down" when these problems could reasonably be expected to affect their ability to perform flight duties.
3. A self-assessment of physical condition shall be made by all members during pre-flight activities.
4. Performance can be seriously hampered by prescription and over-the-counter drugs. The sUAS Coordinator must be advised anytime such drugs are being taken. If it is determined that the medication being taken could hamper an operator or observer, that member shall be prohibited from the deployment or exercise.

5. No member shall act as an operator or observer within eight hours after consumption of any alcoholic beverage, while under the influence of alcohol, or while having an alcohol concentration of 0.04 (FAR 91.17)

10. Training

10.1 Objective

1. The key to continued safe operations is by maintaining a professional level of competency. The first step in this process is establishing minimum qualifications for selecting members, and the second step involves training those personnel.

10.2 Instructors

1. Duties of instructing new members shall fall upon those who have the most flight time and knowledge of sUAS operations. Instructors are designated by those within the unit and approved by the sUAS Coordinator.

10.3 Training Plans

1. The approved training plan is developed by the sUAS coordinator.
2. All deployments or exercises are documented and count toward a member's training.
3. It is the member's responsibility to verify their training file contains all pertinent information.

10.4 Initial Training

1. Observers and Operators must have completed sufficient training to communicate to the pilot any instructions required to remain clear of conflicting traffic.
2. All Remote Pilots in Command will be required to be certified by the Federal Aviation Administration (FAA) under 14 CFR Part 107 and possess a Remote Pilot Airman Certificate.
3. In conjunction with fulfilling all training requirements for operator/observer duties, the new member must also become familiar with sUAS operations, the aircraft and its equipment.
4. Any new member who fails to successfully complete the initial training may be denied as a member of the sUAS flight crew.
5. Before a member can fly as an operator, they must complete a period of flight training with the sUAS instructors to show proficiency of the flight training exercise and the airframe (typically an 8 hour day). This must be accomplished to show their ability and knowledge of the sUAS.

10.5 Recurrent Training

1. All members within the unit shall maintain proficiency in their operator/observer abilities.
2. Recurrent training is not limited to actual operating/observer skills but includes knowledge of all pertinent sUAS/aviation matters.
3. Failure to prove proficiency can result in removal from sUAS responsibilities.

10.6 Miscellaneous

1. Depending on the nature of the training request, all efforts are made to accommodate the hours of training so as little impact is made to staffing levels.
2. All requests for training shall be approved through the member's chain of command and the UAS Coordinator and documented as required.
3. Members are encouraged to attend, and forward information on FAA sponsored safety seminars.

11. General Operating Procedures

11.1 Request for sUAS Support

1. Requests for sUAS support shall be made through the Caroline Emergency Communications Center or the sUAS coordinator who has the most current list of Pilot in Commands and observers to contact.
2. Requests for sUAS support can be made at any time during the day or night. Caroline’s ECC has access to a specific sUAS team group in the Caroline Alert system. This system may be used to alert team members as needed.

11.2 Call-out Procedure

1. The Caroline Emergency Communications Center will screen all initial requests to use a sUAS.
2. The Emergency Communications Center will notify the sUAS Coordinator (or their designee), who will vet the mission.
3. The sUAS coordinator will then contact the PIC to request the deployment of the sUAS.
4. The sUAS Coordinator will also contact the sUAS flight crew who will screen the request using the following factors:
   a. Is the proposed use of sUAS within the capabilities of the sUAS equipment and personnel to perform?
   b. Does the proposed use of the sUAS fall within the FAA and department policies and regulations for sUAS usage?
   c. Can the sUAS be deployed safely given current weather conditions?
   d. If the sUAS deployment requires a warrant, has one been requested and approved?
   e. Are sufficient trained and qualified personnel available to safely operate the sUAS?

5. The sUAS flight crew will either accept or decline the request for sUAS support. If the request is denied, the sUAS flight crew will provide a reason for declining the support request to the sUAS Coordinator who will provide the requestor this information along with the reason for declining. If the sUAS Coordinator accepts the support request, they will contact a Pilot in Command who will be provided all available mission information.

6. The Pilot in Command will contact a certified observer from the list of available trained observers. The Pilot in Command is responsible for transporting the sUAS and all required equipment to the scene. Upon arriving at the requested location the Pilot in Command will contact the requestor to check in and receive a briefing on the mission requested. The Pilot in Command will make an on scene determination of the ability of the sUAS to perform the requested mission safely and within County and FAA policies and procedures.

7. If the Pilot in Command determines that the use of the sUAS would violate County policy or directives then the Pilot in Command will inform the requestor of the potential conflict along with recommendations for modifying the requested mission to conform to policies and procedures. As this is a change from the original approved mission the Pilot in Command will contact the sUAS coordinator for direction on how to proceed. As soon as possible after the completion of the mission, the Pilot in Command will make a full report of the circumstances and their concern through the sUAS coordinator.

8. The Pilot in Command will have sole discretion for declaring a safety issue or a violation of FAA rules. If the Pilot in Command determines that a requested mission would violate FAA rules or endanger persons or property, then the Pilot in Command will respectfully inform the requestor of the reasons for refusing to operate the sUAS and contact the sUAS coordinator immediately. The sUAS will not be flown in this circumstance and the authority of the Pilot in Command is absolute.

9. If the Pilot in Command determines that the requested mission will potentially damage the sUAS or its associated equipment the Pilot in Command will inform the requestor of their concerns. The Pilot in Command will fully document and send a report to the sUAS coordinator.
11.3 Deployment Priorities

1. The sUAS shall not be used for the purpose of random surveillance.
2. If multiple requests for sUAS support are received simultaneously, they shall be prioritized.
3. In general terms, requests for sUAS support are prioritized as:
   a. Life Safety
   b. Incident Stabilization
   c. Property Conservation
   d. Non-Emergency Departmental Missions

11.4 Flight Boundaries

1. Although there may be requests for sUAS support in restricted airspace, FAA regulations for sUAS restrict sUAS deployment inside restricted airspace.
2. At no time shall sUAS support be granted inside restricted airspace without first obtaining permission from an FAA authorized administrator and approval by local authorities.
3. Maximum altitude shall not be more than 400’ AGL or, when within 400’ radius of an obstacle, 400’ above the uppermost point of the obstacle.
   *IAW 14 CFR Part 107 or Public Agency Certificate of Authorization(s)
4. The operator will ensure that only authorized persons will be allowed within the designated distance of the flight operation, and this area may be reduced depending on the safety determination.

11.5 Minimum Personnel Requirements

1. Due to the nature of the mission, the minimum personnel required on ALL missions will be an operator and observer. Under no circumstances will an operator attempt to complete a deployment alone.
2. Although training is not considered a mission, an observer shall be used.

11.6 Personnel Responsibilities for Deployments

1. Operator
   a. The operator is directly responsible for, and is the final authority over the actual operation of the sUAS.
   b. Operators have absolute authority to reject a flight based on personnel safety or violation of FAA regulations. No member of CAROLINE COUNTY, regardless of status, shall order an operator to make a flight when, in the opinion of the operator, it poses a risk to personnel or is in violation of FAA regulations.
c. Operators are responsible for compliance with this manual, County policy and procedure and FAA regulations.
d. The operator’s main duty during the deployment of the sUAS is to operate the sUAS safely while accomplishing the goals of the deployment.
e. Operators shall see-and-avoid any obstacle that will lessen safety during the mission.
f. Operators shall be responsive to the requests of the observer in order to accomplish the deployment.
g. Operators shall be responsible for documentation for mission training and updating of flight books.

2. Observer
   a. Observers shall see-and-avoid any obstacle that will lessen safety during the mission.
   b. Observers are responsible for the operational aspect of the deployment.
   c. Observers shall operate any attachments to the sUAS, allowing the operator to maintain complete focus on the operation of the sUAS.
   d. Observers shall remain alert for suspicious persons or activities on the ground and coordinate response by other sUAS flight crew members.
   e. Observers shall assist the operator in the main objective of safe operations of the sUAS.
   f. Observers shall be responsible for documentation for mission training and updating of flight books.

11.7 Personal Equipment

1. Although there is no specific uniform for the sUAS unit or required for proper operation of the sUAS, the operator/observer should take necessary measures to deploy in a professional matter, wear Hi-Visible vests when appropriate, and take into consideration that all deployments are subject to media requests.
2. Operators/Observers will take into consideration the current weather conditions when planning to deploy, and wear appropriate clothing to deploy comfortably.
3. There are no documented issues with the use of the radio or cellular phones during the deployment of the sUAS, but the operator/observer should at all times take into consideration safe operation of the sUAS when using a radio or another device.

12. Emergency Procedures

12.1 Emergency Loss of Signal Procedures

General - Caroline’s sUAS will be configured for Failsafe Operations in the event of a “loss of signal. In this operations, the aircraft will initiate a Return to Home (RTH) process after
recording a loss of signal for three seconds. Before launch, operators should verify that the Failsafe RTH feature is enabled and adjust the RTH attitude as necessary. Operators should refer to the manufacturer’s aircraft users guide for additional information.

**Emergency Procedures**

1. Personnel flying the sUAS will be trained that in any emergency situation, the safety of persons on the ground and in the air is number one. The following are emergency procedures and each will be documented with an emergency checklist for crew to review.

2. **Fire**: sUAS will be flown away from people and property until a safe landing location can be found. A fire extinguisher and first aid kit will be located at the mission site.

3. **Loss of Link**: Onboard system will execute lost link protocol by either landing immediately or returning to launch point and land.

4. **Loss of Line of Sight**: In the event that both crewmembers lose sight of the aircraft, the pilot will initiate a Go-Home on the remote control. The Go-Home protocol is identical to the Loss of Link protocol. Once visual contact with the aircraft is re-established the pilot will take-back the aircraft using the remote control.

5. **Loss of Propulsion**: During a propulsion failure, sUAS coordinated flight cannot be maintained effectively. An announcement will be made to all personnel on scene advising them of the emergency. If the aircraft fails to successfully land at a predetermined location, a recovery operation will be initiated.

6. In the unlikely event of an emergency involving the aircraft and person(s) on the ground, the flight crew (PIC and Observer) shall maintain a list of applicable numbers (EMS, Dispatch) for emergency contact.

12.2 **Loss of Communications between Observer & PIC**

The PIC and Observer will be co-located during operations and communications will be through direct communication. However, if the observer and the PIC are co-located where verbal communication is not possible, the following communication tools will be utilized:

- Hand held radio
- Voice actuated headsets
- Cellular phone
- Hand Signals (may be used solely or in conjunction with the communication equipment)
- If communication is lost and cannot be re-established the sUAS will immediately land.
13. Pre-Flight/Post-Flight Actions

13.1 Inspections

1. Operators/Observers are both responsible for a thorough preflight inspection of the sUAS.
2. Before and after each deployment (whether a mission or training), the operator and observer shall conduct a thorough inspection of the sUAS in accordance with the instructions contained in the manufacture's user's manual.
3. Any issues found that will put in jeopardy the safe operation of the sUAS shall be documented and resolved immediately prior to flight.
4. It has been recognized that the use of a checklist is a significant method to combat sUAS accidents. A Caroline specific pre-flight checklist is contained with each sUAS Base Station and is utilized prior to each flight.
5. Any issues / discrepancies with physical equipment that cannot be resolved on-site, and which have an impact on safety or the mission, will override the deployment. These issues will be resolved before flight.

13.2 Weather

1. Before each deployment the operator/observer will ensure that he/she gathers enough information to make themselves familiar with the weather situation existing throughout the area of deployment. The operator shall utilize FAA approved weather resources to obtain the latest and most current weather conditions.
2. An anemometer should be utilized in order to better estimate the wind speed and determine if it is within the capabilities of the airframe being flown.
3. Operators/Observers should use the Beaufort Scale when making deployment decisions in regards to wind conditions.
4. The weather conditions reported for the operation shall be recorded in the pre-flight checklist.
5. The operator shall ensure that the flight will occur within FAA VFR weather requirements.

13.3 Documentation

1. Inspection and weather will be documented prior to flight within the log book.
2. After each flight, the operator will complete a statement documenting the sUAS operations.
13.4 Planning

1. The operator/observer shall familiarize themselves with all available information concerning the deployment including, but not limited to, the weather conditions, hazards, description of the incident, deployment goals, etc.
2. Operators will ensure that the location for take-off and emergency landing is adequate for a safe deployment.
   a. The take-off/landing area should be clearly marked and identifiable with short cones.
   b. At least one emergency landing area should be identified per deployment.
3. Operators will ensure that they are aware of their surroundings in the event that an emergency landing is necessary. This includes the ability to recover the sUAS.

13.5 Checklists

1. Operators shall utilize pre-flight checklists to ensure the highest level of safety for deployment.
2. Prior to flight, the flight log shall be initiated.

13.6 Maintenance

1. Although there are few parts on the sUAS that need servicing, it is necessary that the manufacturer's maintenance schedule is followed and properly documented.
2. Any issues that arise during maintenance that cannot be resolved by routine methods shall be forwarded to the manufacturer for further technical support.

13.7 Other

1. Operators/Observers will ensure that no items are attached to the sUAS prior to flight that are not required for safe operation and to complete the mission goal.
Beaufort Wind Scale

DJI Phantom 4 maximum wind velocity for flight:
20m/s or 22 mph or 19.4 knots or Beaufort #5.
Appendix 2

Area Aviation Contacts Impacting Caroline County

Fort AP Hill
Aviation Unit
804-633-8272 or 804-633-8713

Note – Aviation Unit is staffed when training is active. If unit is unmanned, contact AP Hill Range Control unit at 804-633-8157 or 804-633-8224

Monitor – 126.200 MHz

Woodford Airpark (Private) (20VA)
Bull Church Rd
Woodford, VA 22580
804-448-0982
Monitor – UNICOM - 122.800 MHz

Shannon (EZF) Airport
3380 Shannon Airport Circle
Fredericksburg, VA 22408
540-373-4431
540-979-4431
Monitor – CTAF/UNICOM – 122.800 MHz
Appendix 3
Sample Pre-Flight Briefing

A discussion led by the PIC prior to aircraft launch which shall include but not be limited to:

☐ Review of mission goals and methods to achieve goals, including handoff procedures. Review of current and forecasted weather conditions and weather limitations on mission.

☐ Review of current Notice to Airmen (NoTAMs) and Temporary Flight Restrictions (TFRs) that have been issued for the proposed flight area.

☐ Identification of mission limitations and safety issues such as battery charge, GPS strength, and potential for radio interference.

☐ Review of proposed flight area, including maximum ceiling and floor.

☐ Review of communication procedures between PIC, Observer, and other ground support personnel.

☐ Review of emergency/contingency procedures including aircraft system failure, flight termination, divert, and lost link procedures.

☐ Review of required video or digital images.

☐ Identify radio frequencies / channels to be used.

☐ Execution of a pre-flight check following the approved checklist.
Appendix 4
Caroline Small sUAS Certificate of Registration

Figure 1 - Phantom 4

Figure 2 - Matrice 210

Figure 3 - Mavic 2 Enterprise Zoom
## Appendix 5

### Aircraft Specifications

**Phantom 4**

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aircraft</strong></td>
<td></td>
</tr>
<tr>
<td>Weight (Battery &amp; Propellers Included)</td>
<td>1380 g</td>
</tr>
<tr>
<td>Max Ascent Speed</td>
<td>6 m/s (Sport mode)</td>
</tr>
<tr>
<td>Max Descent Speed</td>
<td>4 m/s (Sport mode)</td>
</tr>
<tr>
<td>Max Speed</td>
<td>20 m/s (Sport mode)</td>
</tr>
<tr>
<td>Max Service Ceiling Above Sea Level</td>
<td>19685 feet (6000 m)</td>
</tr>
<tr>
<td>Max Flight Time</td>
<td>Approx. 28 minutes</td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>32°F to 104°F (0°C to 40°C)</td>
</tr>
<tr>
<td>Satellite Systems</td>
<td>GPS/GLONASS</td>
</tr>
<tr>
<td>Gimbal</td>
<td></td>
</tr>
<tr>
<td>Controllable Range</td>
<td>Pitch: -90° to +30°</td>
</tr>
<tr>
<td><strong>Obstacle Sensing System</strong></td>
<td></td>
</tr>
<tr>
<td>Obstacle Sensory Range</td>
<td>2 - 49 feet (0.7 - 15 m)</td>
</tr>
<tr>
<td>Operating Environment</td>
<td>Surface with clear pattern and adequate lighting (lux &gt; 15)</td>
</tr>
<tr>
<td><strong>Vision Positioning System</strong></td>
<td></td>
</tr>
<tr>
<td>Velocity Range</td>
<td>≤10 m/s (2 m above ground)</td>
</tr>
<tr>
<td>Altitude Range</td>
<td>0 - 33 feet (0 - 10 m)</td>
</tr>
<tr>
<td>Operating Range</td>
<td>0 - 33 feet (0 - 10 m)</td>
</tr>
<tr>
<td>Operating Environment</td>
<td>Surfaces with a clear pattern and adequate lighting (lux &gt; 15)</td>
</tr>
<tr>
<td><strong>Camera</strong></td>
<td></td>
</tr>
<tr>
<td>Sensor</td>
<td>1/2.3” Effective pixels: 12 M</td>
</tr>
<tr>
<td>Lens</td>
<td>FOV (Field Of View) 94°, 20 mm (35 mm format equivalent) f/2.8 focus at ∞</td>
</tr>
<tr>
<td>ISO Range</td>
<td>100-3200 (video) 100-1600 (photo)</td>
</tr>
<tr>
<td>Electronic Shutter Speed</td>
<td>8 s to 1/8000 s</td>
</tr>
<tr>
<td>Max Image Size</td>
<td>4000 x 3000</td>
</tr>
<tr>
<td></td>
<td>Single shot</td>
</tr>
<tr>
<td></td>
<td>Auto shooting: 3/5/7 frames</td>
</tr>
<tr>
<td></td>
<td>Auto Exposure Bracketing (AEB):</td>
</tr>
<tr>
<td></td>
<td>3/6 Bracketed frames at 0.7 EV Bias</td>
</tr>
<tr>
<td></td>
<td>Time-lapse</td>
</tr>
<tr>
<td></td>
<td>HDR</td>
</tr>
<tr>
<td><strong>Still Photography Modes</strong></td>
<td></td>
</tr>
<tr>
<td>UHD: 4096 x 2160 (4K)</td>
<td>24 / 25p</td>
</tr>
<tr>
<td>3840 x 2160 (4K)</td>
<td>24 / 25 / 30p</td>
</tr>
<tr>
<td>2704 x 1520 (2.7K)</td>
<td>24 / 25 / 30p</td>
</tr>
<tr>
<td>FHD: 1920 x 1080</td>
<td>24 / 25 / 30 / 48 / 50 / 60 / 120p</td>
</tr>
<tr>
<td>HD: 1280 x 720</td>
<td>24 / 25 / 30 / 48 / 50 / 60p</td>
</tr>
<tr>
<td><strong>Video Recording Modes</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Max. Bitrate Of Video Storage</strong></td>
<td>60 Mbps</td>
</tr>
</tbody>
</table>

21
## Supported File Systems

<table>
<thead>
<tr>
<th>Supported File Systems</th>
<th>FAT32 (≤ 32 GB); exFAT (&gt; 32 GB)</th>
</tr>
</thead>
</table>

## Photo

- JPEG, DNG (RAW)

## Video

- MP4 / MOV (MPEG – 4 AVC / H.264)

## Supported SD Cards

- Micro SD, Max capacity: 64GB. Class 10 or UHS-1 rating required

## Operating Temperature

- 32°F to 104°F (0°C to 40°C)

### Remote Controller

<table>
<thead>
<tr>
<th>Operating Frequency</th>
<th>2.400 GHz to 2.483 GHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Transmission Distance</td>
<td>FCC Compliant: 3.1 mi (5 km); CE Compliant: 2.2 mi (3.5 km) (Unobstructed, free of interference)</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>32°F to 104°F (0°C to 40°C)</td>
</tr>
<tr>
<td>Battery</td>
<td>6000 mAh LiPo 23</td>
</tr>
<tr>
<td>Mobile Device Holder</td>
<td>Tablets and smartphones</td>
</tr>
<tr>
<td>Transmitter Power (EIRP)</td>
<td>FCC: 23 dBm; CE: 17 dBm</td>
</tr>
<tr>
<td>Operating Voltage</td>
<td>7.4V @ 1.2A</td>
</tr>
<tr>
<td>Charger</td>
<td></td>
</tr>
<tr>
<td>Voltage</td>
<td>17.4 V</td>
</tr>
<tr>
<td>Rated Power</td>
<td>100 W</td>
</tr>
<tr>
<td>Intelligent Flight Battery (PH4 - 5350 mAh -15.2 V)</td>
<td></td>
</tr>
<tr>
<td>Capacity</td>
<td>5350 mAh</td>
</tr>
<tr>
<td>Voltage</td>
<td>15.2 V</td>
</tr>
<tr>
<td>Battery Type</td>
<td>LiPo 4S</td>
</tr>
<tr>
<td>Energy</td>
<td>81.3 Wh</td>
</tr>
<tr>
<td>Net Weight</td>
<td>462 g</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>14°F to 104°F (−10°C to 40°C)</td>
</tr>
<tr>
<td>Max. Charging Power</td>
<td>100 W</td>
</tr>
</tbody>
</table>
# M210 SPECIFICATIONS

## AIRCRAFT

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>M210</td>
</tr>
<tr>
<td>Package Dimensions</td>
<td>31.1×15.4×11.4 inch (790×390×290mm)</td>
</tr>
<tr>
<td>Dimensions (unfolded)</td>
<td>34.9×34.6×14.9 inch (887×880×378 mm)</td>
</tr>
<tr>
<td>Dimensions (folded)</td>
<td>28.2×8.7×9.3 inch (716×220×236 mm)</td>
</tr>
<tr>
<td>Folding Method</td>
<td>Folded Inward</td>
</tr>
<tr>
<td>Diagonal Wheelbase</td>
<td>25.3 inch (643 mm)</td>
</tr>
<tr>
<td>Number of Batteries</td>
<td>2</td>
</tr>
<tr>
<td>Weight (TB50)</td>
<td>Approx. 3.84kg (with two standard batteries)</td>
</tr>
<tr>
<td>Weight (TB55)</td>
<td>Approx. 4.57kg (with two standard batteries)</td>
</tr>
<tr>
<td>Max Takeoff Weight</td>
<td>6.14KG</td>
</tr>
<tr>
<td>Max Payload (2 TB50)</td>
<td>Approx. 2.3kg (with two standard batteries)</td>
</tr>
<tr>
<td>Max Payload (2 TB55)</td>
<td>Approx. 1.57kg (with two standard batteries)</td>
</tr>
<tr>
<td>Hovering Accuracy (during safe flights)</td>
<td>Vertical: ±0.5, Downward Vision System enabled: ±0.1</td>
</tr>
<tr>
<td>Max Angular Velocity</td>
<td>Pitch: 300°/s; Yaw: 150°/s</td>
</tr>
<tr>
<td>Max Pitch Angle (Dual Downward Gimbals)</td>
<td>P Mode: 25° (Forward Vision System enabled: 25°); A Mode: 25°; S Mode: 30°</td>
</tr>
<tr>
<td>Max Pitch Angle (Single Upward/Downward Gimbal)</td>
<td>P Mode: 30° (Forward Vision System enabled: 25°); A Mode: 30°; S Mode: 35°</td>
</tr>
<tr>
<td>Max Ascent Speed</td>
<td>16.4 ft/s (5 m/s)</td>
</tr>
<tr>
<td>Max Descent Speed</td>
<td>Vertical: 9.8 ft/s (3 m/s)</td>
</tr>
<tr>
<td>Max Speed (Dual Downward Gimbals)</td>
<td>S Mode: 40.3mph (64.8kph)</td>
</tr>
<tr>
<td>Max Speed (Single Upward/Downward Gimbals)</td>
<td>P Mode: 38mph (61.2kph); A Mode: 38mph (61.2kph)</td>
</tr>
<tr>
<td>Max Service Ceiling Above Sea Level</td>
<td>1.86 miles (3000 m)</td>
</tr>
<tr>
<td>Max Wind Resistance</td>
<td>39.4 ft/s (12 m/s)</td>
</tr>
<tr>
<td>Max Flight Time (No Payload, with TB50)</td>
<td>27min</td>
</tr>
<tr>
<td>Max Flight Time (No Payload, with TB55)</td>
<td>38min</td>
</tr>
<tr>
<td>Max Flight Time (Full Payload, with TB50)</td>
<td>13min</td>
</tr>
<tr>
<td>Max Flight Time (Full Payload, with TB55)</td>
<td>24min</td>
</tr>
<tr>
<td>Motor Model</td>
<td>DJI 3515</td>
</tr>
<tr>
<td>Propeller Model</td>
<td>1760S</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-4° to 113°F (-20° to 45° C)</td>
</tr>
<tr>
<td>IP Rating</td>
<td>IP43</td>
</tr>
</tbody>
</table>

## GIMBAL INSTALLATION
Unmanned Aircraft Systems Operations Manual

Downward Gimbal Mount Supported
Upward Gimbal Mount Supported
Downward Dual Gimbal Supported

CHARGER

Model IN2C180
Voltage 26.1 V
Rated Power 180 W

FORWARD VISION SYSTEM

Obstacle Sensing Range 2.3-98.4 feet (0.7-30 m)
FOV Horizontal 60°, Vertical 54°
Operating Environment Surfaces with clear patterns and adequate lighting (> 15 lux)

DOWNWARD VISION SYSTEM

Velocity Range <32.8 ft/s (10 m/s) at height of 6.56 feet (2 m)
Altitude Range <32.8 feet (10 m)
Operating Range <32.8 feet (10 m)
Operating Environment Surfaces with clear patterns and adequate lighting (> 15 lux)
Ultrasonic Sensor Operating Range 0.33-16.4 feet (10-500 cm)
Ultrasonic Sensor Operating Environment Non-absorbing material, rigid surface (thick indoor carpeting will reduce performance)

GIMBALS

Zenmuse X4S
Zenmuse X5S
Zenmuse Z30
Compatible Gimbals Zenmuse XT
Zenmuse XT2
SLANTRANGE 3PX
Senterra AGX710

BATTERY

Model TB50
Capacity 4280 mAh
Voltage 22.8V
Battery Type LiPo 6S
Energy 97.58 Wh
Net Weight Approx. 520 g
Operating Temperature -20°C to 45°C
Storage Temperature Less than 3 months: -4° to 113° F (-20° to 45° C)
More than 3 months: 72° to 82° F (22° to 28° C)
Charging Temperature 41° to 104° F (5° to 40° C)
Max Charging Power 180 W
### Unmanned Aircraft Systems Operations Manual

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model</strong></td>
<td>TB55</td>
</tr>
<tr>
<td><strong>Capacity</strong></td>
<td>7660 mAh</td>
</tr>
<tr>
<td><strong>Voltage</strong></td>
<td>22.8V</td>
</tr>
<tr>
<td><strong>Battery Type</strong></td>
<td>LiPo 6S</td>
</tr>
<tr>
<td><strong>Energy</strong></td>
<td>176.93Wh</td>
</tr>
<tr>
<td><strong>Net Weight</strong></td>
<td>Approx. 885 g</td>
</tr>
<tr>
<td><strong>Operating Temperature</strong></td>
<td>-4° to 113° F (-20° to 45° C)</td>
</tr>
<tr>
<td><strong>Storage Temperature</strong></td>
<td>Less than 3 months: -20° C to 45° C</td>
</tr>
<tr>
<td></td>
<td>More than 3 months: 22° C to 28° C</td>
</tr>
<tr>
<td><strong>Charging Temperature</strong></td>
<td>41° to 104° F (5° to 40° C)</td>
</tr>
<tr>
<td><strong>Max Charging Power</strong></td>
<td>180 W</td>
</tr>
</tbody>
</table>

**DJI GO 4 APP**

- **Name**: DJI GO 4
- **Mobile Device System Requirements**: iOS 9.0 or later, Android 4.4.0 or later
- **Supported Mobile Devices**: iOS: iPhone 5s, iPhone SE, iPhone 6, iPhone 6 Plus, iPhone 6s, iPhone 6s Plus, iPhone 7, iPhone 7 Plus, iPad Air, iPad Air Wi-Fi + Cellular, iPad mini 2, iPad mini 2 Wi-Fi + Cellular, iPad Air 2, iPad Air 2 Wi-Fi + Cellular, iPad mini 3, iPad mini 3 Wi-Fi + Cellular, iPad mini 4 and iPad mini 4 Wi-Fi + Cellular. This app is optimized for iPhone 7, iPhone 7 Plus. Android: Samsung tabs 705c, Samsung S6, Samsung S5, Samsung NOTE4, Samsung NOTE3, Google Nexus 6p, Nexus 9, Google Nexus 7 II, Ascend Mate7, Huawei P8 Max, Huawei Mate 8, LG V20, Nubia Z7 mini, Sony Xperia Z3, MI 3, MI PAD, Smartisan T1.

*Support for additional devices available as testing and development continues.

**UPWARD INFRARED SENSOR**

- **Obstacle Sensing Range**: 0-16.4 feet (0-5 m)
- **FOV**: ±5°
- **Operating Environment**: Large, diffuse and reflective obstacles (reflectivity >10%)

**CENDENCE**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>GL800A</td>
</tr>
<tr>
<td><strong>Operating Frequency</strong></td>
<td>2.400-2.483 GHz; 5.725-5.825 GHz</td>
</tr>
<tr>
<td></td>
<td>2.4 GHz: 4.3 miles (7 km, FCC); 2.2 miles (3.5 km, CE); 2.5 miles (4 km, SRRC)</td>
</tr>
<tr>
<td></td>
<td>5.8 GHz: 4.3 miles (7 km, FCC); 1.2 miles (2 km, CE); 3.1 miles (5 km, SRRC)</td>
</tr>
<tr>
<td><strong>EIRP</strong></td>
<td>2.4 GHz: 26 dBm (FCC); 17 dBm (CE); 20 dBm (SRRC)</td>
</tr>
<tr>
<td></td>
<td>5.8 GHz: 28 dBm (FCC); 14 dBm (CE); 20 dBm (SRRC)</td>
</tr>
<tr>
<td><strong>Power Supply</strong></td>
<td>Extended Intelligent Battery (Model: WB37-4920mAh-7.6V)</td>
</tr>
<tr>
<td><strong>Intelligent Battery</strong></td>
<td>4923 mAh LiPo</td>
</tr>
<tr>
<td><strong>Charging</strong></td>
<td>DJI charger</td>
</tr>
<tr>
<td><strong>Output Power</strong></td>
<td>20 W (supplying power to DJI CS550 monitor)</td>
</tr>
<tr>
<td></td>
<td>12 W (without supplying power to monitor)</td>
</tr>
<tr>
<td><strong>Video Output Ports</strong></td>
<td>USB, HDMI, SDI</td>
</tr>
<tr>
<td>Feature</td>
<td>Specification</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>USB Supply Power</td>
<td>iOS: 1 A, 5.2 V (Max); Android: 1.5 A, 5.2 V (Max)</td>
</tr>
<tr>
<td>Dual User Capability</td>
<td>Master-and-Slave connection</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-4 ° to 104 °F (-20 ° to 40 °C)</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>Less than 3 months: -4 ° to 113 °F (-20 ° to 45 °C)</td>
</tr>
<tr>
<td></td>
<td>More than 3 months: 72 ° to 82 °F (22 ° to 28 °C)</td>
</tr>
<tr>
<td>Charging Temperature</td>
<td>32 ° to 104 °F (0 ° to 40 °C)</td>
</tr>
<tr>
<td>Charging Time</td>
<td>About 2 hours and 24 minutes (using a 180 W charger)</td>
</tr>
<tr>
<td>Supply Power Time</td>
<td>About 4 hours (only Master remote controller function enabled and without supplying power to monitor)</td>
</tr>
<tr>
<td>Weight</td>
<td>1041 g</td>
</tr>
</tbody>
</table>
Zenmuse Z30 Specifications

GENERAL

Name Zenmuse Z30
Dimensions 152×137×61 mm
Weight 556 g

CAMERA

Sensor CMOS, 1/2.8"
Effective Pixels: 2.13 M
30x Optical Zoom
F1.6 (Wide) - F4.7 (Tele)
Zoom Movement Speed:
- Optical Wide – Optical Tele: 4.6 sec
- Optical Wide – Digital Tele: 6.4 sec
- Digital Wide – Digital Tele : 1.8 sec
Focus Movement Time:
∞ - near: 1.1 sec
FOV 63.7°(Wide) - 2.3°(Tele)
Digital Zoom 6x
Min. Working Distance 10 mm - 1200 mm
Photo Formats JPEG
Video Formats MOV, MP4
Working Modes Capture, Record, Playback
Still Photography ModesSingle shot, Burst shooting: 3/5 frames, Interval (2/3/4/7/10/15/20/30 sec)
Exposure Mode Exposure Mode Auto, Manual, Shutter priority, Aperture priority
Exposure Compensation ±2.3 (1/3 increments)
Metering Mode Center-weighted metering, Spot metering (Area option 12x8)
AE Lock Supported
Electronic Shutter Speed 1/30 – 1/6000 s
White Balance Auto, Sunny, Cloudy, Incandescent, Custom (2000K - 10000K)
Video Captions Supported
TapZoom Supported
TapZoom Range 1-5
Defog Supported
One Key to 1x Image Supported
Anti-flicker 50 Hz, 60 Hz
PAL/NTSC Supported
Supported SD Cards MicroSD (SD / SDHC / SDXC)
Max. Capacity: 64 GB, Class 10 or UHS-1
Supported File Systems exFAT (≤ 32 GB)

GIMBAL

Angular Vibration Range ±0.01°
Mount Detachable
Controllable Range Pitch : +40° to -90°, Yaw: ±320°
Mechanical Range Pitch : +50° to -140°, Yaw: ±330°, Roll: +90° to -50°
Max Controllable Speed Pitch : 180°/s, Yaw: 180°/s
ENVIRONMENTAL

Operating Temperature 14° to 113° F (-10° to 45° C)
Non-Operating Temperature -4° to 140° F (-20° to 60° C)
Zenmuse XT2 Specifications

GENERAL

Name: Zenmuse XT2
Dimensions:
- With 25 mm lens: 123.7×112.6×127.1 mm
- With other lens: 118.02×111.6×125.5 mm

THERMAL CAMERA

Thermal Imager: Uncooled VOx Microbolometer
FPA/Digital Video Display Formats:
- 640×512
- 336×256
Digital Zoom:
- 640×512: 1x, 2x, 4x, 8x
- 336×256: 1x, 2x, 4x
Pixel Pitch: 17 μm
Spectral Band: 7.5-13.5 μm
Full Frame Rates: 30 Hz
Exportable Frame Rates: <9 Hz
Sensitivity (NEdT): <50 mk @ f/1.0
Scene Range (High Gain):
- 640×512: -25° to 135°C
- 336×256: -25° to 100°C
Scene Range (Low Gain): -40° to 550°C
File Storage: MicroSD card
Photo Format: JPEG, TIFF, R-JPEG
Video Format: 8 bit: MOV, MP4 14 bit: TIFF Sequence, SEQ

IMAGE PROCESSING & DISPLAY CONTROL

Image Optimization: Yes
Digital Detail Enhancement: Yes
Polarity Control (Black Hot/ White Hot): Yes

GIMBAL

Angular Vibration Range: ±0.01°
Mount: Detachable
Controllable Range:
- Tilt: +30° to -90°
- Pan: ±320°
- Tilt: +45° to -130°
Mechanical Range:
- Pan: ±330°
- Roll: -90° to +60°
Max Controllable Speed:
- Tilt: 90°/s
- Pan: 90°/s

VISUAL CAMERA

Sensor: 1/1.7” CMOS
- Effective Pixels: 12 M
- Prime lens
Lens:
- Focus at 8 mm
- FOV 57.12°×42.44°
Digital Zoom:
- 1x, 2x, 4x, 8x
Unmanned Aircraft Systems Operations Manual

Photo Formats: JPEG
Video Formats: MOV, MP4
Video Resolutions:
- 4K Ultra HD: 3840×2160 29.97p
- FHD: 1920×1080 29.97p
Working Modes: Capture, Record, Playback, Single Shot
Still Photography Modes:
- Burst Shooting (3/5 frames)
- Interval (2/3/4/7/10/15/20/30 sec)
Video Caption: Supported
Anti-flicker: Auto, 50 Hz, 60 Hz
MicroSD card:
- Max capacity: 128 GB, UHS-3 required
Storage:
- Recommended model: Sandisk Extreme 16/32 GB UHS-3 microSDHC
- Sandisk Extreme 64/128 GB UHS-3 microSDXC
Supported File System:
- FAT 32 (≤32GB), exFAT (>32GB)

IMAGE PROCESSING & DISPLAY CONTROL

Color & Monochrome Palettes (LUT): Yes

MODELS – LENS AND RESOLUTION OPTIONS

Thermal Lens Models:
- 9 mm, 13 mm, 19 mm, 25 mm

640×512 FoV, iFoV:
- N/A, f/1.25 45°×37° 1.308 mr, f/1.25 32°×26° 0.895 mr, f/1.1 25°×20° 0.680 mr

336×256 FoV, iFoV:
- f/1.25 35°×27° 1.889 mr, f/1.25 25°×19° 1.308 mr, f/1.25 17°×13° 0.895 mr, N/A

Min Focus Distance:
- 3.2 cm, 7.6 cm, 15.3 cm, 30 cm

Hyperfocal Distance:
- 2.1 m, 4.4 m, 9.5 m, 21 m

Hyperfocal Depth of Field:
- 1.1 m, 2.2 m, 4.8 m, 11 m

Notes:
The SD card, which is located near the lens, is used to store TIFF Sequence and SEQ infrared RAW video only. The other format footage will be stored in the other SD card.
*It is recommended to use ImageJ to play the TIFF Sequence video and Flir Tools to play SEQ video.
# DJI Mavic 2 Enterprise Zoom Specifications

## AIRCRAFT

<table>
<thead>
<tr>
<th>Specification</th>
<th>Zoom Edition: 905 g</th>
<th>Dual Edition: 899 g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Takeoff Weight (Without Accessories)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Folded</td>
<td>214×91×84 mm</td>
<td></td>
</tr>
<tr>
<td>Unfolded</td>
<td>322×242×84 mm</td>
<td></td>
</tr>
<tr>
<td>Dimensions (L×W×H)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unfolded+Spotlight</td>
<td>322×242×114 mm</td>
<td></td>
</tr>
<tr>
<td>Unfolded+Beacon</td>
<td>322×242×101 mm</td>
<td></td>
</tr>
<tr>
<td>Unfolded+Speaker</td>
<td>322×242×140 mm</td>
<td></td>
</tr>
<tr>
<td>Diagonal Length</td>
<td>354 mm</td>
<td></td>
</tr>
<tr>
<td>Max Ascent Speed</td>
<td>5 m/s (S-mode[^1])</td>
<td></td>
</tr>
<tr>
<td>Max Descent Speed</td>
<td>3 m/s (P-mode)</td>
<td></td>
</tr>
<tr>
<td>Max Speed (near sea level, no wind)</td>
<td>72 kph (S-mode, without wind)</td>
<td>50 kph (P-mode, without wind)</td>
</tr>
<tr>
<td>Max Service Ceiling Above Sea Level</td>
<td>6000 m</td>
<td></td>
</tr>
<tr>
<td>Max Flight Time (no wind)</td>
<td>31 min (at a consistent speed of 25 kph)</td>
<td>29 min</td>
</tr>
<tr>
<td></td>
<td>27 min (with beacon turned on)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>28 min (with beacon turned off)</td>
<td></td>
</tr>
<tr>
<td>Max Hovering Time (no wind)</td>
<td>22 min (with spotlight turned on)</td>
<td>26 min (with spotlight turned off)</td>
</tr>
<tr>
<td></td>
<td>25 min (with speaker turned on)</td>
<td>26 min (with speaker turned off)</td>
</tr>
<tr>
<td>Max Wind Speed Resistance</td>
<td>29–38 kph</td>
<td></td>
</tr>
<tr>
<td>Max Tilt Angle</td>
<td>35° (S-mode, with remote controller)</td>
<td>25° (P-mode)</td>
</tr>
<tr>
<td></td>
<td>200°/s (S-Mode)</td>
<td></td>
</tr>
<tr>
<td>Max Angular Velocity</td>
<td>100°/s (P-Mode)</td>
<td>200°/s (S-Mode)</td>
</tr>
<tr>
<td></td>
<td>100°/s (P-Mode)</td>
<td></td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>-10°C to 40°C</td>
<td></td>
</tr>
<tr>
<td>GNSS</td>
<td>GPS+GLONASS</td>
<td></td>
</tr>
<tr>
<td>Hovering Accuracy Range</td>
<td>±0.1 m (with Vision Positioning)</td>
<td>±0.5 m (with GPS Positioning)</td>
</tr>
<tr>
<td></td>
<td>Horizontal: ±0.3m (with Vision Positioning)</td>
<td>±1.5 m (with GPS Positioning)</td>
</tr>
<tr>
<td></td>
<td>2.400 - 2.4835 GHz</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.725 - 5.850 GHz</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.400 - 2.4835 GHz</td>
<td></td>
</tr>
<tr>
<td>Transmission Power (EIRP)</td>
<td>FCC : ≤26 dBm</td>
<td></td>
</tr>
</tbody>
</table>

[^1]: Requires remote controller
Unmanned Aircraft Systems Operations Manual

CE : ≤20 dBm
SRRC : ≤20 dBm
MIC : ≤20 dBm 5.725-5.850 GHz
FCC : ≤26 dBm
CE : ≤14 dBm
SRRC : ≤26 dBm

Internal Storage
24 GB

GIMBAL

Mechanical Range
Tilt: -135 – +45°
Pan: -100 – +100°
Controllable Range
Pan: -75 – +75°
Stabilization
3-axis (tilt, roll, pan)
Max Control Speed (tilt) 120°/s
Angular Vibration Range±0.005°

SENSING SYSTEM

Sensing System
Omnidirectional Obstacle Sensing [3]
Precision Measurement Range: 0.5 - 20 m
Detectable Range: 20 - 40 m
Forward
Effective Sensing Speed: ≤ 14m/s
FOV: Horizontal: 40°, Vertical: 70°
Precision Measurement Range: 0.5 - 16 m
Detectable Range: 16 - 32 m
Backward
Effective Sensing Speed: ≤ 12m/s
FOV: Horizontal: 60°, Vertical: 77°
Upward
Precision Measurement Range: 0.1 - 8 m
Precision Measurement Range: 0.5 - 11 m
Downward
Detectable Range: 11 - 22 m
Sides
Effective Sensing Speed: ≤ 8m/s
FOV: Horizontal: 80°, Vertical: 65°
Operating Environment(walls, trees, people, etc.)
Forward, Backward and Sides:
Surface with clear pattern and adequate lighting (lux > 15)
Upward:
Detects diffuse reflective surfaces (>20%)
Downward:
Surface with clear pattern and adequate lighting (lux > 15)
Detects diffuse reflective surfaces (>20%)
(REMotes, trees, people, etc.)

REMOTE CONTROLLER

Operating Frequency
2.400 - 2.483 GHz; 5.725 - 5.850 GHz
## Unmanned Aircraft Systems Operations Manual

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Transmission Distance (Unobstructed, free of interference)</td>
<td>2.400 - 2.483 GHz; 5.725 - 5.850 GHz</td>
</tr>
<tr>
<td>FCC:</td>
<td>8000 m</td>
</tr>
<tr>
<td>CE:</td>
<td>5000 m</td>
</tr>
<tr>
<td>SRRC:</td>
<td>5000 m</td>
</tr>
<tr>
<td>MIC:</td>
<td>5000 m</td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>0°C to 40°C</td>
</tr>
<tr>
<td>2.4 - 2.4835 GHz</td>
<td></td>
</tr>
<tr>
<td>FCC:</td>
<td>≤26 dBm</td>
</tr>
<tr>
<td>CE:</td>
<td>≤20 dBm</td>
</tr>
<tr>
<td>SRRC:</td>
<td>≤20 dBm</td>
</tr>
<tr>
<td>Transmitter Power (EIRP)</td>
<td>dBm MIC: ≤20 dBm</td>
</tr>
<tr>
<td>5.725 - 5.850 GHz</td>
<td></td>
</tr>
<tr>
<td>FCC:</td>
<td>≤26 dBm</td>
</tr>
<tr>
<td>CE:</td>
<td>≤14 dBm</td>
</tr>
<tr>
<td>SRRC:</td>
<td>≤26 dBm</td>
</tr>
<tr>
<td>Battery</td>
<td>3950 mAh</td>
</tr>
<tr>
<td>Charging Time</td>
<td>2 hours 15 min</td>
</tr>
<tr>
<td>Operating Current/Voltage</td>
<td>1800 mA – 3.83V</td>
</tr>
<tr>
<td>Mobile Device Holder</td>
<td>Thickness Supported: 6.5-8.5 mm, Max length: 160 mm</td>
</tr>
<tr>
<td>RC Size</td>
<td>Folded: 145x80x48 mm (LxWxH)</td>
</tr>
<tr>
<td>Unfolded: 190x115x100 mm (LxWxH)</td>
<td></td>
</tr>
<tr>
<td>Supported USB port types</td>
<td>Lightning, Micro USB (Type-B), USB Type-C™</td>
</tr>
</tbody>
</table>

## M2ED VISUAL CAMERA

- **Sensor**: 1/2.3” CMOS; Effective pixels: 12M
- **FOV**: approx. 85°
- **35 mm format equivalent**: 24 mm
- **Aperture**: f/2.8
- **Focus**: 0.5 m to ∞
- **ISO Range**:
  - Video: 100-3200 (auto)
  - Photo: 100-1600 (auto)
- **Max Image Size**: 4056×3040 (4:3); 4056×2280 (16:9)
- **Single shot**
- **Still Photography Modes**:
  - Burst shooting: 3/5/7 frames
  - Interval (2/3/5/7/10/15/20/30/60 s)
  - 4K Ultra HD: 3840×2160 30p
- **Video Recording Modes**:
  - 2.7K: 2688×1512 30p
  - FHD: 1920×1080 30p
- **Max Video Bitrate**: 100 Mbps
- **Photo**:
  - JPEG
- **Video Format**:
  - MP4, MOV (MPEG-4 AVC/H.264)

## M2E CAMERA

- **Sensor**: 1/2.3” CMOS
- **Effective pixels**: 12 Megapixels
Unmanned Aircraft Systems Operations Manual

Lens
FOV: 82.6°(24 mm) ; 47.8°(48 mm)
Format equivalent: 24-48 mm
Aperture: f/2.8(24 mm)-f/3.8(48 mm)
Auto focus at: 0.5 - ∞

ISO Range
Video:
100-3200

Shutter Speed
8-1/8000s
Still Image Size
4000×3000
Still Photography Modes
Burst shooting: 3/5/7 frames
Auto Exposure Bracketing (AEB): 3/5 bracketed frames at 0.7 EV Bias
Interval (JPEG: 2/3/5/7/10/15/20/30/60s RAW:5/7/10/15/20/30/60s)

Video Resolution
4K: 3840×2160 24/25/30p
2.7K: 2720×1530 24/25/30/48/50/60p
FHD: 1920×1080 24/25/30/48/50/60/120p

Max Video Bitrate
100 Mbps

Color Mode
D-Cinelike

Supported File System
FAT32(≤ 32 GB ) ; exFAT(> 32 GB)

Photo Format
JPEG , DNG (RAW)

Video Format
MP4 / MOV (MPEG-4 AVC/H.264)

CHARGER
Input
100-240V , 50-60Hz , 1.8A
Output
Main: 17.6V − 3.41A or 17.0V−3.53
USB: 5 V − 2 A
Voltage
17.6±0.1V
Rated Power
60W

INTELLIGENT FLIGHT BATTERY
Capacity
3850 mAh
Voltage
15.4 V
Max Charging Voltage
17.6 V
Battery Type
LiPo
Energy
59.29 Wh
Net Weight
297 g
Charging Temperature
5°C - 40°C
Operating Temperature Range
-10°C to 40°C
Heating Methods
Manual Heating ; Auto Heating
Heating Temperature
-20°C to 6°C
Heating duration:
500s (Max)
Heating Power
55W (Max)
Charging Time
90 min
Max Charging Power  80W

APP / LIVE VIEW

Video Transmission System OcuSync 2.0
Mobile App  DJI PILOT
Live View Quality  Remote Controller:
Max Live View Bitrate  40 Mbps
Latency  120 - 130 ms
Required Operating System 10.0 or later Android 5.0 or later

SUPPORTED SD CARDS

Supported SD Cards  Micro SD™ Supporting Micro SD with capacity up to 128 GB and R/W speed up to UHS-I Speed Grade 3

M2E SPOTLIGHT

Dimensions  68x60x41 mm
Port Type  USB Micro-B
Operating Range  30 m
Power  Max 26W
Illuminance  FOV 17°, Max: 11 lux @ 30 m Straight

M2E BEACON

Dimensions  68x40x27.8 mm
Port Type  USB Micro-B
Power  Avg. 1.6W
Controllable Range  5000 m
Light intensity  Min Angle: 55 cd;
Light intensity: 157 cd

M2E SPEAKER

Dimensions  68x55x65 mm
Port Type  USB Micro-B
Power  Max 10W
Decibel  100 db @ 1 meter distance
Bitrate  16 kbps

FOOTNOTES

[2] Due to real-time digital enhancements, the photo and video size of the thermal data is
larger than the sensor’s native resolution.

[3] Omnidirectional Obstacle Sensing includes left/right, up/down, and forward/backward obstacle sensing. Sensing for left/right directions is only available in ActiveTrack or Tripod Mode. Omnidirectional Obstacle Sensing does not fully cover the circumference of a 360-degree arc. And left and right obstacle sensing system only works in specific modes and environments. DJI warranty does not cover any loss caused by crashing when flying left or right, even when ActiveTrack or Tripod mode is activated. Please be aware of your surroundings and App notifications when operating the Mavic 2 to ensure safety. These specs have been determined through tests conducted with the latest firmware. Firmware updates can enhance performance, so updating to the latest firmware is highly recommended.”

[4] These specs have been determined through tests conducted with the latest firmware. Firmware updates can enhance performance, so updating to the latest firmware is highly recommended.”
Appendix 6
Caroline County FAA COA

Caroline County was issued a Certificate of Waiver or Authorization (COA) on July 18, 2017 from the FAA.

This certificate, 2017-ESA-122, is effective from July 18, 2017 through July 17, 2019.

It is on file, along with any addendums, at the Department of Fire – Rescue and Emergency Management.
County of Caroline
Department of Fire–Rescue & Emergency Management

Appendix 7

DATE

Dear ________ Rd Resident:

Caroline County has developed an unmanned aerial vehicle (UAV) [drone] program to assist emergency services with search and rescue, damage assessment, and other emergency activities. The __________ has granted our agency access to their property to conduct a training exercise this __________ over __________. During this exercise we will simulate __________ and testing our UAV operators’ ability to __________. Weather permitting our training drill will take place starting at TIME and should last a couple of hours.

We are reaching out to nearby residents to advise them of this activity so they will not be alarmed if they see a higher volume of emergency vehicles in the vicinity of the __________. Additionally, I do not want residents to be alarmed if they see or hear the drone flying over the area. The drone is relatively quiet, however, if you are outside it may sound like a distant swarm of bees. The Department is very mindful of your privacy and will work to keep overflights of your property to a minimum.

Thank you for your understanding as we hone our training skills with this new technology. Please feel free to call us at 804-633-9831 if you have any questions or concerns.

Sincerely,

Mark C. Garnett
Deputy Fire – EMS Chief

233 West Broadus Ave. • Bowling Green, VA 22427
Phone: 804-633-9831 • Fax: 804-633-9832
Appendix 8 – Cendence Remote – Custom Settings Chart
## Chart To Convert Minutes To Tenths Of An Hour

<table>
<thead>
<tr>
<th>Minutes to be reported</th>
<th>Tenth of Hour reported</th>
<th>Minutes to be reported</th>
<th>Tenth of Hour reported</th>
<th>Minutes to be reported</th>
<th>Tenth of Hour reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 min.</td>
<td>0.0</td>
<td>21 min.</td>
<td>0.4</td>
<td>41 min.</td>
<td>0.7</td>
</tr>
<tr>
<td>2 min.</td>
<td>0.0</td>
<td>22 min.</td>
<td>0.4</td>
<td>42 min.</td>
<td>0.7</td>
</tr>
<tr>
<td>3 min.</td>
<td>0.1</td>
<td>23 min.</td>
<td>0.4</td>
<td>43 min.</td>
<td>0.7</td>
</tr>
<tr>
<td>4 min.</td>
<td>0.1</td>
<td>24 min.</td>
<td>0.4</td>
<td>44 min.</td>
<td>0.7</td>
</tr>
<tr>
<td>5 min.</td>
<td>0.1</td>
<td>25 min.</td>
<td>0.4</td>
<td>45 min.</td>
<td>0.8</td>
</tr>
<tr>
<td>6 min.</td>
<td>0.1</td>
<td>26 min.</td>
<td>0.4</td>
<td>46 min.</td>
<td>0.8</td>
</tr>
<tr>
<td>7 min.</td>
<td>0.1</td>
<td>27 min.</td>
<td>0.5</td>
<td>47 min.</td>
<td>0.8</td>
</tr>
<tr>
<td>8 min.</td>
<td>0.1</td>
<td>28 min.</td>
<td>0.5</td>
<td>48 min.</td>
<td>0.8</td>
</tr>
<tr>
<td>9 min.</td>
<td>0.2</td>
<td>29 min.</td>
<td>0.5</td>
<td>49 min.</td>
<td>0.8</td>
</tr>
<tr>
<td>10 min.</td>
<td>0.2</td>
<td>30 min.</td>
<td>0.5</td>
<td>50 min.</td>
<td>0.8</td>
</tr>
<tr>
<td>11 min.</td>
<td>0.2</td>
<td>31 min.</td>
<td>0.5</td>
<td>51 min.</td>
<td>0.9</td>
</tr>
<tr>
<td>12 min.</td>
<td>0.2</td>
<td>32 min.</td>
<td>0.5</td>
<td>52 min.</td>
<td>0.9</td>
</tr>
<tr>
<td>13 min.</td>
<td>0.2</td>
<td>33 min.</td>
<td>0.6</td>
<td>53 min.</td>
<td>0.9</td>
</tr>
<tr>
<td>14 min.</td>
<td>0.2</td>
<td>34 min.</td>
<td>0.6</td>
<td>54 min.</td>
<td>0.9</td>
</tr>
<tr>
<td>15 min.</td>
<td>0.3</td>
<td>35 min.</td>
<td>0.6</td>
<td>55 min.</td>
<td>0.9</td>
</tr>
<tr>
<td>16 min.</td>
<td>0.3</td>
<td>36 min.</td>
<td>0.6</td>
<td>56 min.</td>
<td>0.9</td>
</tr>
<tr>
<td>17 min.</td>
<td>0.3</td>
<td>37 min.</td>
<td>0.6</td>
<td>57 min.</td>
<td>1.0</td>
</tr>
<tr>
<td>18 min.</td>
<td>0.3</td>
<td>38 min.</td>
<td>0.6</td>
<td>58 min.</td>
<td>1.0</td>
</tr>
<tr>
<td>19 min.</td>
<td>0.3</td>
<td>39 min.</td>
<td>0.7</td>
<td>59 min.</td>
<td>1.0</td>
</tr>
<tr>
<td>20 min.</td>
<td>0.3</td>
<td>40 min.</td>
<td>0.7</td>
<td>60 min.</td>
<td>1.0</td>
</tr>
</tbody>
</table>