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FCC STA Authorization Letter for Nighthawk testing.pdf

Program Letter for Nighthawk UAS Experimental Certificate

Registered Owner Name:	**Aircraft Builder:**
Applied Research Associates, Inc. (ARA)	Applied Research Associates, Inc.
Registered Owner Address:	**Year Manufactured:**
250 Beanville Rd	2013
Randolph, VT 05060	**Aircraft Serial Number:**
Aircraft Description:	AV-101
Nighthawk UAS (Analog Version)	**Aircraft Model Designation:**
Aircraft Registration:	Nighthawk IV
N489EA	**Engine Model:**
	AXi 2212/20 Gold Line – electric motor
	Propeller Model:
	Graupner CAM Folding Prop 20-11

1. Overview of Project. The applicant must provide a general explanation and overview of the project, indicating any past flight history or experience for consideration. The applicant must provide enough detail for the FAA to understand the program's purpose and need for an experimental certificate for a UAS or OPA, including the following:

a. Definition of the Experimental Purpose. Provide a definition of the experimental purpose(s) under which the aircraft is to be operated (14 CFR § 21.191, Experimental certificates).

The Nighthawk UAS activity is in support of engineering research and development for enhancements to operating capabilities, and verification of design changes implemented within the hardware or software for operating the Nighthawk. Several development activities are underway related to alternate payload modules, longer endurance batteries, enhanced wireless radio communication links, as well as refinement to the autopilot module that will be supported by experimental operations. As these configurations are available they will be reviewed with the FAA for inclusion under the experimental certificate approval. The initial configuration aligns with the production aircraft.

The Nighthawk UAS will also be used for crew training of personnel in the operation of the Nighthawk. This training will involve operation and checkout of personnel for currency requirements on operating the Nighthawk UAS as well as training additional personnel in the operation of the UAS while under the supervision of trained operators.

The Nighthawk UAS will also be used in support of market survey to perform demonstrations of capabilities for potential customers, to determine mission applicability, and to identify enhancement opportunities to meet potential customer needs.

b. Description of the Purpose/Scope of the Experimental Program. Provide a description of the purpose/scope of the experimental program for each experimental purpose sought (§ 21.193(b) and (d), Experimental certificates: general).

The scope of the experimental activity associated with the Nighthawk UAS is to perform operational verification checks associated with the UAS. These checks verify the proper operation of the UAS including integration and operation of the autopilot, communication system and payload interfaces. Specifically, the testing is geared toward verifying the following items:

- *Ability to properly load and execute a mission plan*
- *Ability to successfully launch the UAS*
- *Verify dynamic performance of installed GPS receiver to acquire and track satellites*
- *Verify the ability to establish and maintain a planned mobility path*
- *Verify communication data link performance*
- *Verify landing performance*
- *Determine performance of payloads (e.g., camera and video feedback)*
- *Observe proper flight characteristics during the test flight*

Flight test operations will utilize profiles similar to the production flight test needs to support initial verification flight test activities related to system enhancements.

c. Description of the Purpose/Scope of the Special Flight Permit Program. Provide the purpose of the flight. Include all information required by § 21.199(a), Issue of special flight permits.

N/A (this application is for an Experimental Certificate, not a Special Flight Permit)

2. Definition of Flight Areas. Provide a definition of the area(s) in which the experimental flights and, if applicable, production flight testing will be conducted. Indicate whether or not the same flight test area will be used for both purposes. Include the following:

a. The areas over which the flights are requested to be conducted and the address of base operation (§ 21.193(d)(3)).

The proposed areas of operation are defined by the operating areas shown in Section 2b. Main base of operations is on ARA leased property; this area will be used for both experimental and production flight testing. The address for the base of operations is: Applied Research Associates, Inc., 250 Beanville Road, Randolph, VT 05060.

Additionally, we have selected three alternate operating areas located in Texas, Virginia and Florida for the purpose of experimental flights. See Section 2b for a detailed description of these areas.

b. The proposed flight test area using latitude and longitude on an aeronautical chart or aerial photograph. For example, if the perimeter of the proposed flight test area is in the shape of a rectangle, the latitude and longitude of the corners must be stated. The distance of each leg of the perimeter must be stated.

Vermont Operating Area

The operating area for Nighthawk UAS operations (as shown in Figure 1 and Figure 2) is an area surrounding the ARA Randolph, VT facility. This operating area encompasses three potential launch points (see Figure 2), where the primary point will be the ARA facility. The area is bounded by a southern line from Lat(43°54'24"N) Lon(72°39'32"W) running easterly for approximately 1.8 nm to Lat(43°54'32"N) Lon(72°37'0"W); then running in a northerly direction for approximately 2 nm to Lat(43°56'35"N) Lon(72°37'26"W); then running in a southwesterly direction approximately 1.3 nm to Lat(43°55'48"N) Lon(72°38'54"W); then running in a southerly direction approximately 0.7 nm to Lat(43°55'8"N) Lon(72°38'48"W); then running in a westerly direction approximately 0.7 nm to Lat(43°54'55"N) Lon(72°39'49"W); returning in a southerly direction approximately 0.6 nm to the starting point at Lat(43°54'24"N) Lon(72°39'32"W). Within this area the primary operations area would be centered around our ARA facility, located at approximately Lat(43°54'47"N) Long(72°39'35"W).

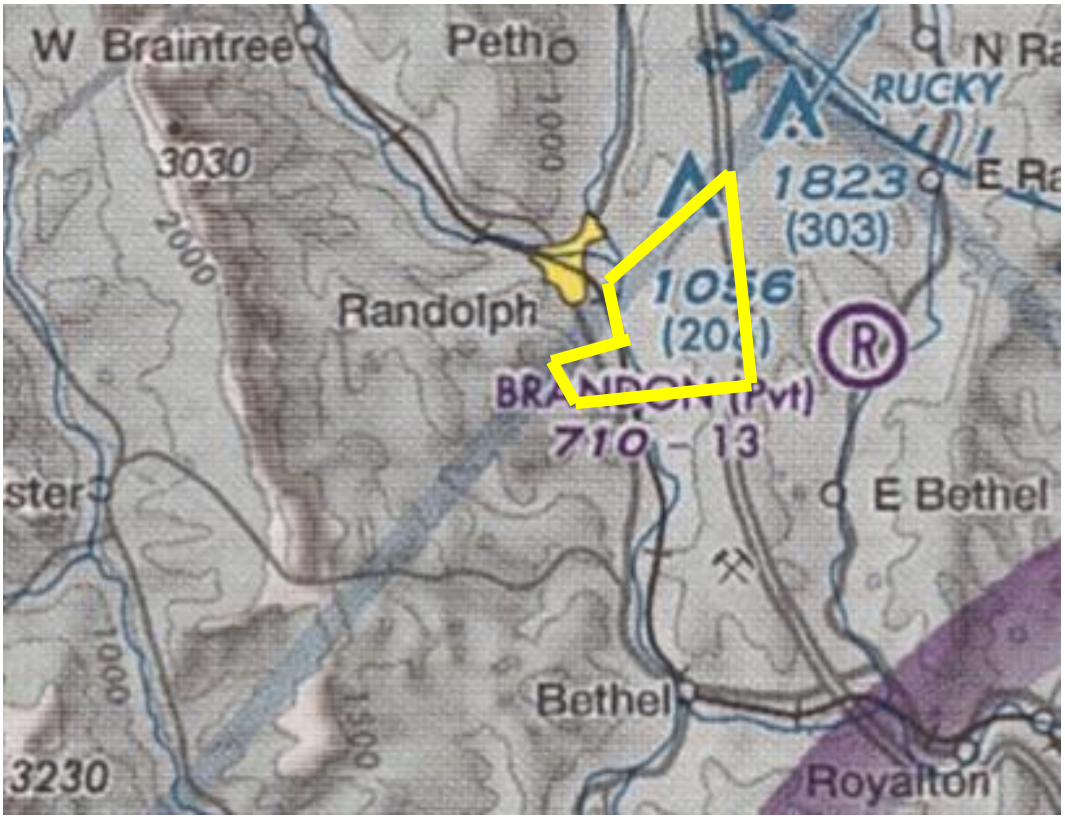


Figure 1. Map of operating area on FAA sectional map.

Vermont Operating Area

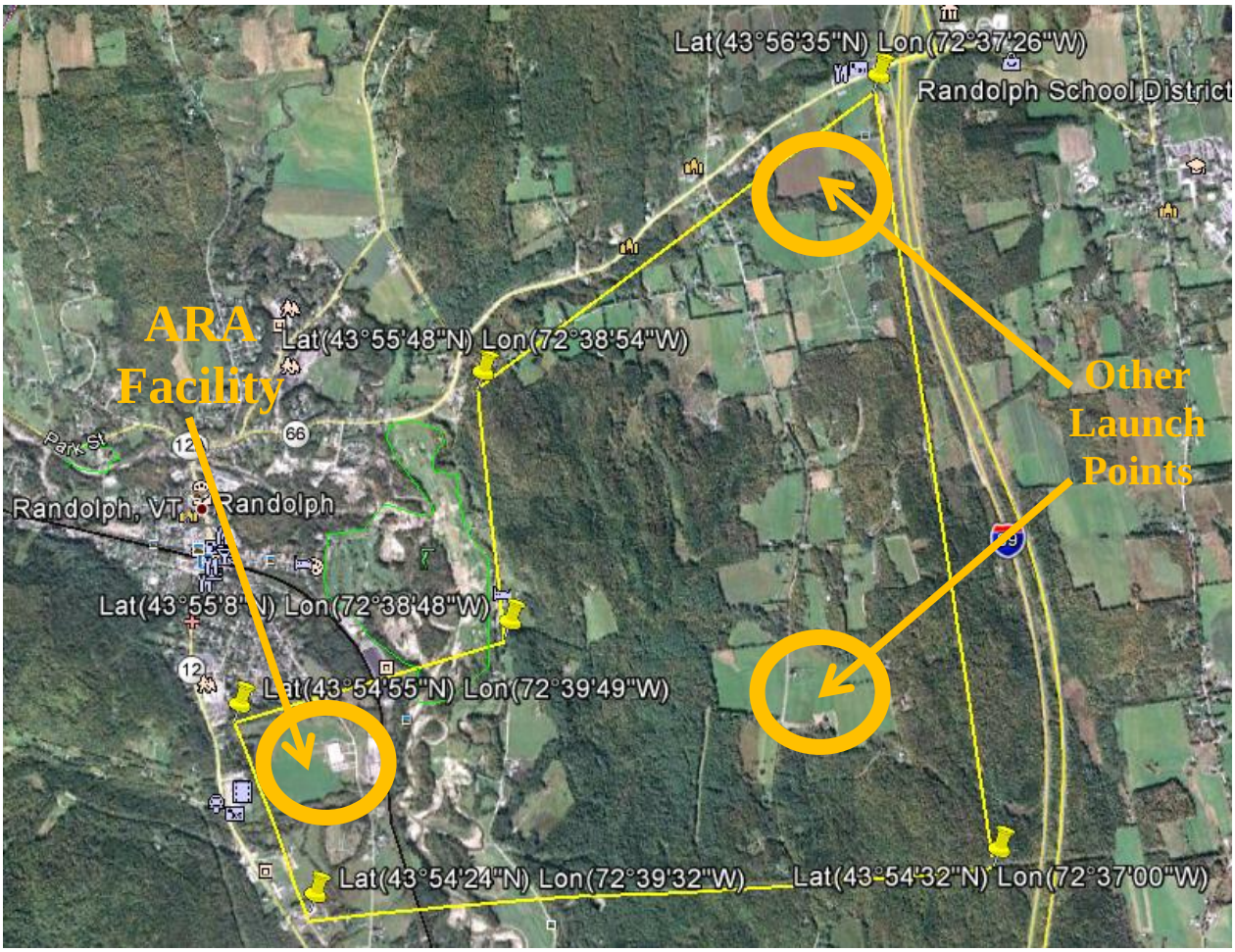


Figure 2. Map of operating area (from Google Earth), outlined in yellow, showing ARA's facility (primary launch point) and two other planned launch points within the operating area.

Florida Operating Area

The proposed Florida operating area for Nighthawk UAS operations is as follows: The northern border of the proposed operating area is established by a line starting at 30°14'25.00"N 85°31'50.00"W and moving easterly approximately 5.2 nautical miles to 30°14'25.00"N 85°255'0.00"W. From this point the eastern border is established by a southerly line approximately 2.7 nautical miles long to 30°11'45.00"N 85°25'50.00"W.From this point the southern border is established by a westerly line approximately 5.2 nautical miles long ending at 30°11'45.00"N 85°31'50.00"W. From here the western boundary line travels north approximately 2.7 nautical miles to the original starting point, 30°14'25.00"N 85°31'50.00"W. See Figure 3 and Figure 4 below. Requested operating altitude within the entire operating area would be up to a maximum of 500 ft AGL.

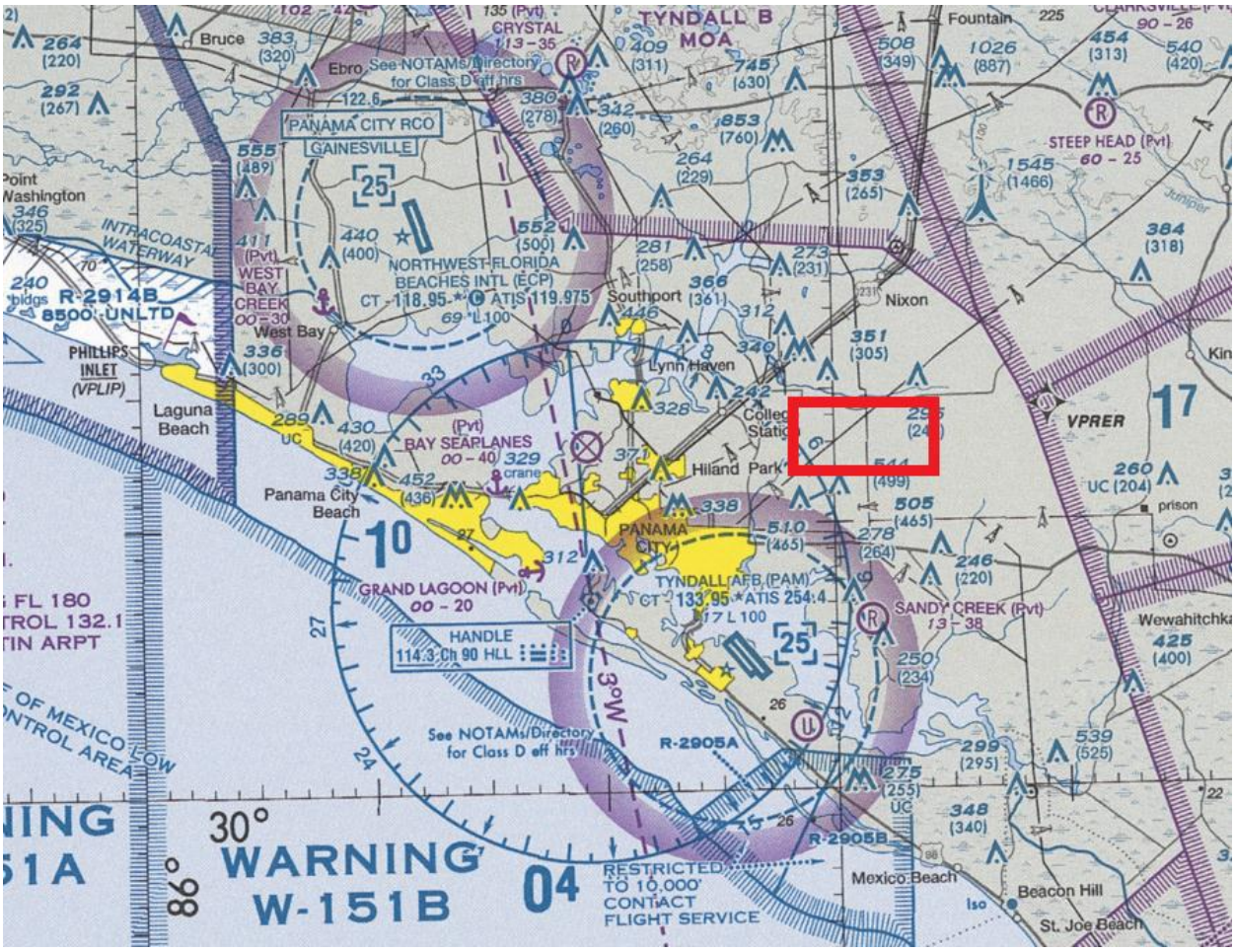


Figure 3. Map of proposed Florida operating area on FAA VFR sectional map.

Florida Operating Area

3/25/20143/25/2014

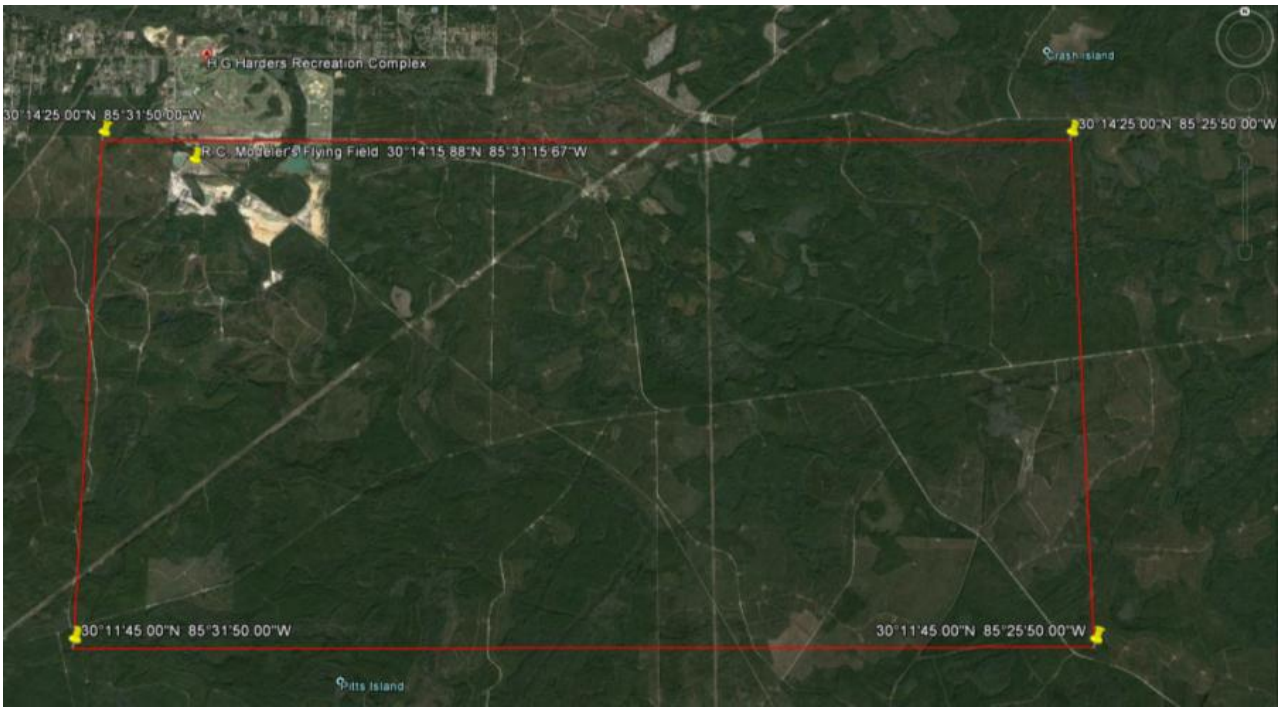


Figure 4. Map of proposed Florida operating area (from Google Earth), outlined in black. Primary takeoff and landing point highlighted by the aircraft icon.

Virginia Operating Area

The proposed Virginia operating area for Nighthawk UAS operations is as follows. The northern border of the proposed operating area is established by a line starting at 36°52'30.00N 76°59'0.00W and moving easterly approximately 6.5 nautical miles to 36°52'30.00N 76°50'60.00"W. From this point the eastern border is established by a southerly line approximately 4 nautical miles long to 36°48'30.00N 76°50'60.00"W. From this point the southern border is established by a westerly line approximately 6.5 nautical miles long ending at 36°48'30.00"N 76°59'0.00W. From here the western boundary line travels north approximately 4 nautical miles to the original starting point, 36°52'30.00N 76°59'0.00W. See Figure 5 and Figure 6 below. Requested operating altitude within the entire operating area would be up to a maximum of 1000 ft AGL.

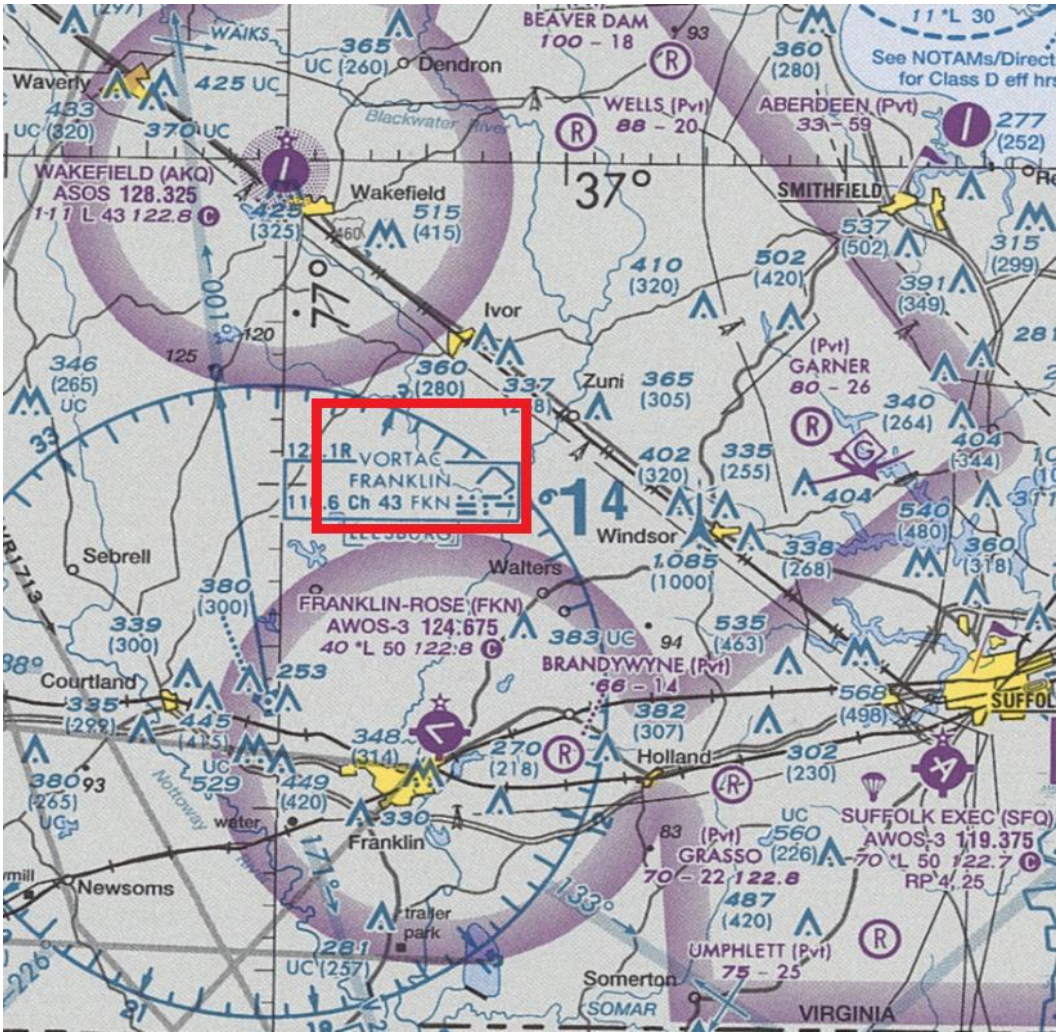


Figure 5. Map of proposed Virginia operating area on FAA VFR sectional map.

Virginia Operating Area

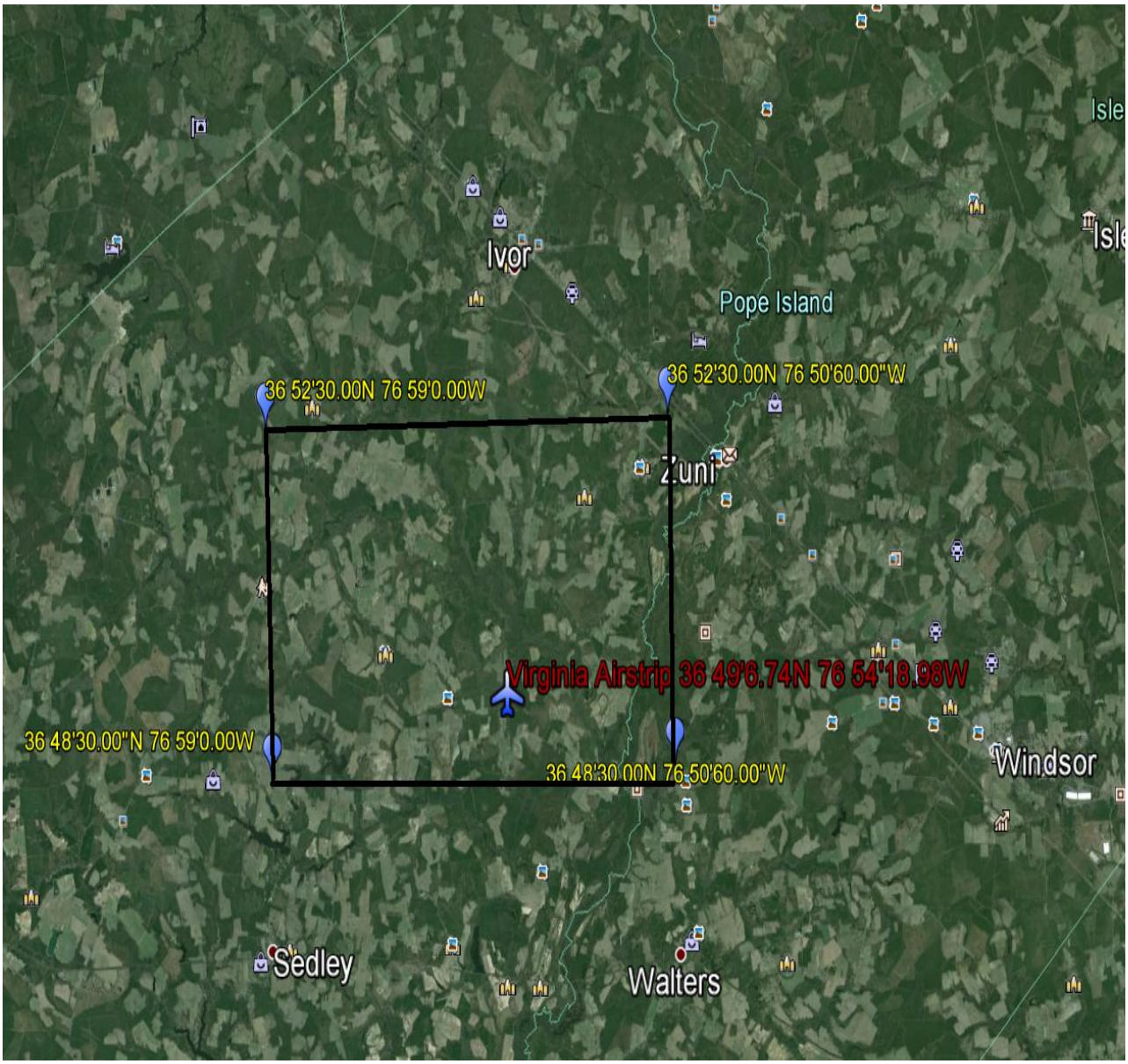


Figure 6. Map of proposed Virginia operating area (from Google Earth), outlined in black. Primary takeoff and landing point highlighted by the aircraft icon.

Texas Operating Area

The proposed Texas operating area for Nighthawk UAS operations is as follows. The northern border of the proposed operating area is established by a line starting at 31°17'22.00"N 103°16'41.30"W and moving easterly approximately 4.5 nautical miles to 31°17'22.00"N

103°11'31.45"W. From this point the eastern border is established by a southerly line approximately 3.1 nautical miles long to 31°14'15.30"N 103°11'31.45"W. From this point the southern border is established by a westerly line approximately 4.5 nautical miles long ending at 31°14'15.30"N 103°16'41.30"W. From here the western boundary line travels north approximately 3.1 nautical miles to the original starting point, at 31°17'22.00"N 103°16'41.30"W. See Figure 7 and Figure 8 below. Requested operating altitude within the entire operating area would be up to a maximum of 1000 ft AGL.

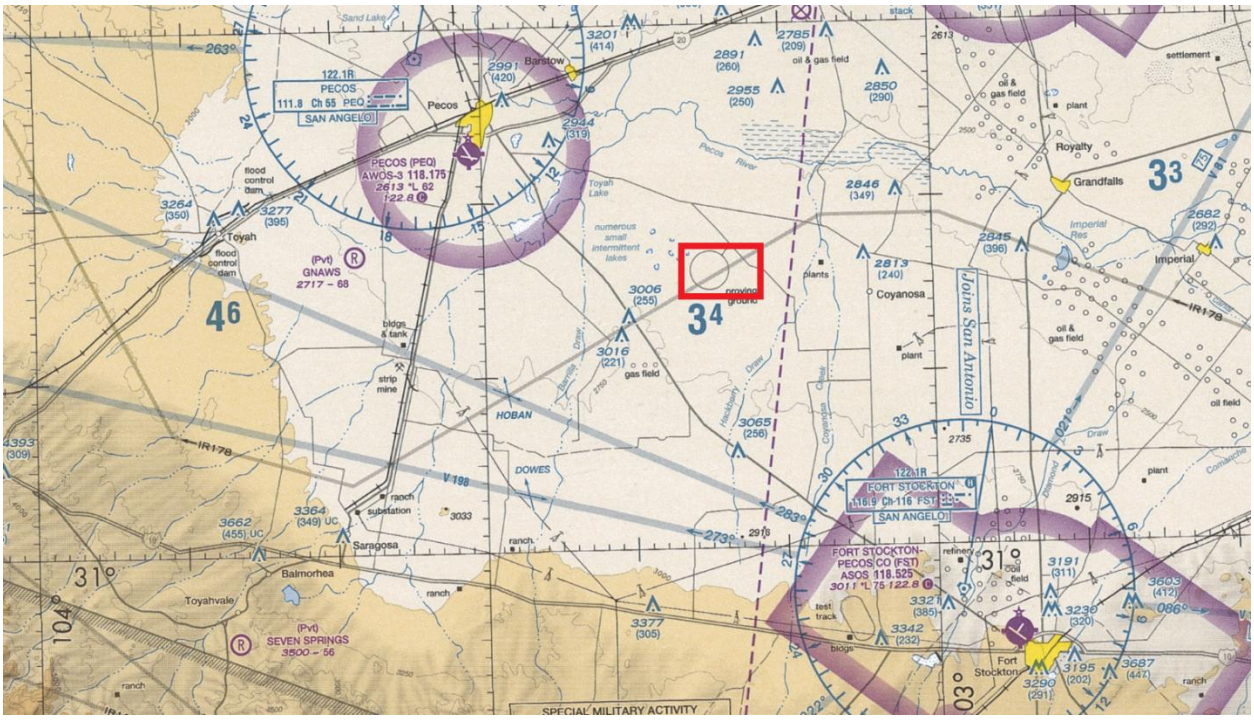


Figure 7. Map of proposed Texas operating area on FAA VFR sectional map.

Texas Operating Area

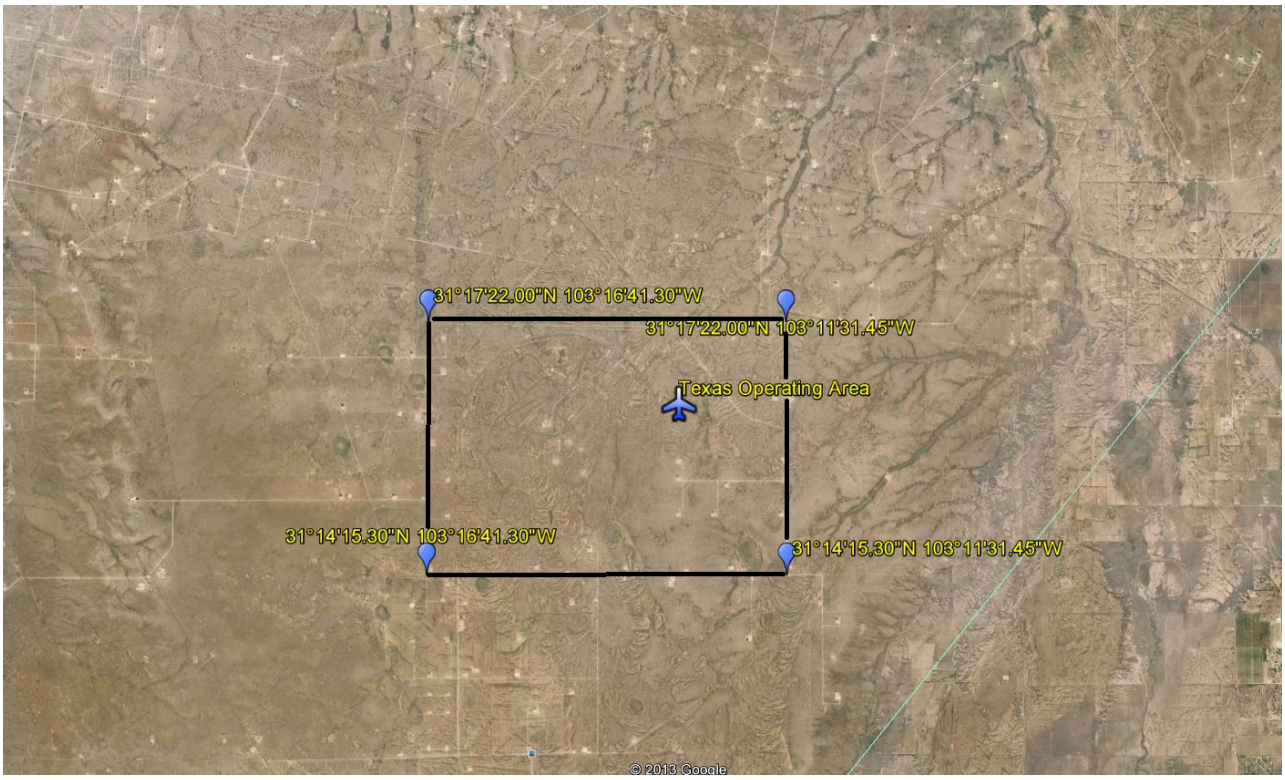


Figure 8. Map of proposed operating area (from Google Earth), outlined in black. Primary takeoff and landing point highlighted by the aircraft icon.

c. Airspeed and altitude operating parameters, number of flight hours, number of flights, and program duration for each test flight area.

The Nighthawk UAS has a maximum airspeed of 40-45 knots, and cruise airspeed of 22-28 knots. Operating altitude within the entire operating area will be less than 1,000 ft AGL. The maximum flight endurance of the Nighthawk is approximately 70 minutes. Experimental flights will vary in duration but typically would not exceed 60 minutes. The quantity and frequency of experimental flights will be dependent on the nature of testing being done and will be coordinated with any production flight test activity.

d. Class of airspace to be used.

Class G.

e. Whether minimum fuel requirements of 14 CFR § 91.151, Fuel requirements for flight in VFR conditions, will be met.

The Nighthawk is an electrically driven UAS based on an installed battery; minimum fuel is not applicable.

f. Whether flight testing will include payload testing. If so, briefly describe the payload and its operation.

Flight testing may involve the verification of installed payload modules for the Nighthawk. The data stream for these modules is included in the data telemetry stream associated with UAS control and monitoring. The payloads for Nighthawk are electro-optical or infra-red sensor units that provide video feedback to the ground station. The ground station has the ability to steer the Nighthawk to maintain video on an area of interest. Two different payload modules are currently available, with potential for future payloads to be part of the experimental test configuration.

g. Considerations that need to be taken into account regarding payloads.

Nighthawk payloads are installed in an integral module for the UAS. The UAS provides power and data link support for transmitting data from the payload to the ground station.

h. Whether the aircraft will perform any aerobatic maneuvers as defined by § 91.303.

Aerobatic maneuvers are not part of the planned testing for the Nighthawk UAS.

i. Flight rules and weather conditions, for example, VFR and visual meteorological conditions (VMC).

Nighthawk flight testing will be conducted under VFR and VMC conditions, and will maintain line-of-sight (LOS) communication and operation of the UAS.

3. Aircraft Configuration. Attach three-view drawings or three-view dimensioned photographs of the aircraft (see § 21.193(b)(4)). Describe any ground support equipment (power carts, air carts, towing equipment, etc) required for aircraft operations. Include a description of aircraft/system performance characteristics including the following:

a. Wing span. *26.0 in*

b. Length. *24.8 in*

c. Powerplant. *AXi 2212/20 Gold Line Electric DC Brushless Motor*

d. Maximum gross takeoff weight. *2.4 lbs*

e. Fuel capacity. *N/A*

f. Payload capacity. 0.*5 lbs*

g. Maximum altitude. *37,000 ft MSL*

h. Endurance. *70 minutes maximum*

i. Maximum airspeed. *45 knots*

j. Control/data frequencies.

The Nighthawk dual-radio with analog video link configuration uses separate data up/downlink and video downlink frequencies. For up/downlink data transmittal, a frequency band with a center channel of 380 MHz and a span of 6 MHz is used. A variant of this particular communications package also supports up/downlink data transmittal at a center channel frequency of 410 MHz. Video downlink transmissions offer 10 channel selections with a center channel frequency of 1.785 GHz.

The single-radio digital data link configuration uses only one up/downlink frequency band for both data and video. There are several channels for operation of this radio link in the following frequency ranges: 2.2997-2.3133 GHz and 2.3497-2.3632 GHz.

k. Guidance and navigation control.

Nighthawk UAS incorporates an advanced autopilot system with integrated GPS, which provides precise navigation, station keeping and easy aircraft re-tasking. The autopilot and embedded navigation system, complemented with the intuitive, easy-to-operate and lightweight Ground Control Station (GCS), allow operators with limited flight experience to easily plan and execute missions. The Nighthawk UAS contains a GPS receiver module, three-axis accelerometers, three-axis magnetometers, and three-axis rate gyros to support guidance and navigation control. Altitude and airspeed are provided by a pitot static sensor system. The aircraft relies on its advanced autopilot for both the pre-programmed and real-time changes to its flight path. In the event of lost link with the aircraft, the aircraft will fly a pre-programmed flight path and recovery route while attempts to re-establish link are made. If link is not re-established, the aircraft will recover autonomously in accordance with its programmed lost link procedures at a preselected lost link landing site.

Nighthawk UAS Description

The Nighthawk weighs 2 pounds, with an airframe made of carbon fiber molded for enhanced durability. It is capable of carrying a half-pound payload, with a cruise speed of 22-28 knots, and a typical operational altitude of 200-500 ft AGL. Nighthawk (shown in Figure 3) is powered by a quiet electric motor and can remain airborne for up to 70 minutes. Upon recovery, the rechargeable battery or modular plug and play imagers can quickly be swapped out and the aircraft can be re-launched within five minutes. The Nighthawk UAS disassembles into four components (fuselage, wing, payload, tail), but can be transported in a tube while fully assembled. The system is completely man-portable, offers modular multi-mission imaging sensors, and can be operated by one person, though a two-person team is optimum. The Nighthawk can be hand-launched

and, aided by GPS, can be guided to an accurate recovery via a skid-landing on the ground. The Nighthawk UAS provides a live video feed thru an RF link to the portable Ground Control Station (GCS). The GCS consists of four primary components: fully-ruggedized laptop computer, a 12 volt battery (same as aircraft battery), integrated Communications Box (Comms Box) with cables, and antennas. Figure 4 shows three-view schematic drawings for the Nighthawk UAS.

Figure 3. Pictures of ARA's Nighthawk UAS.

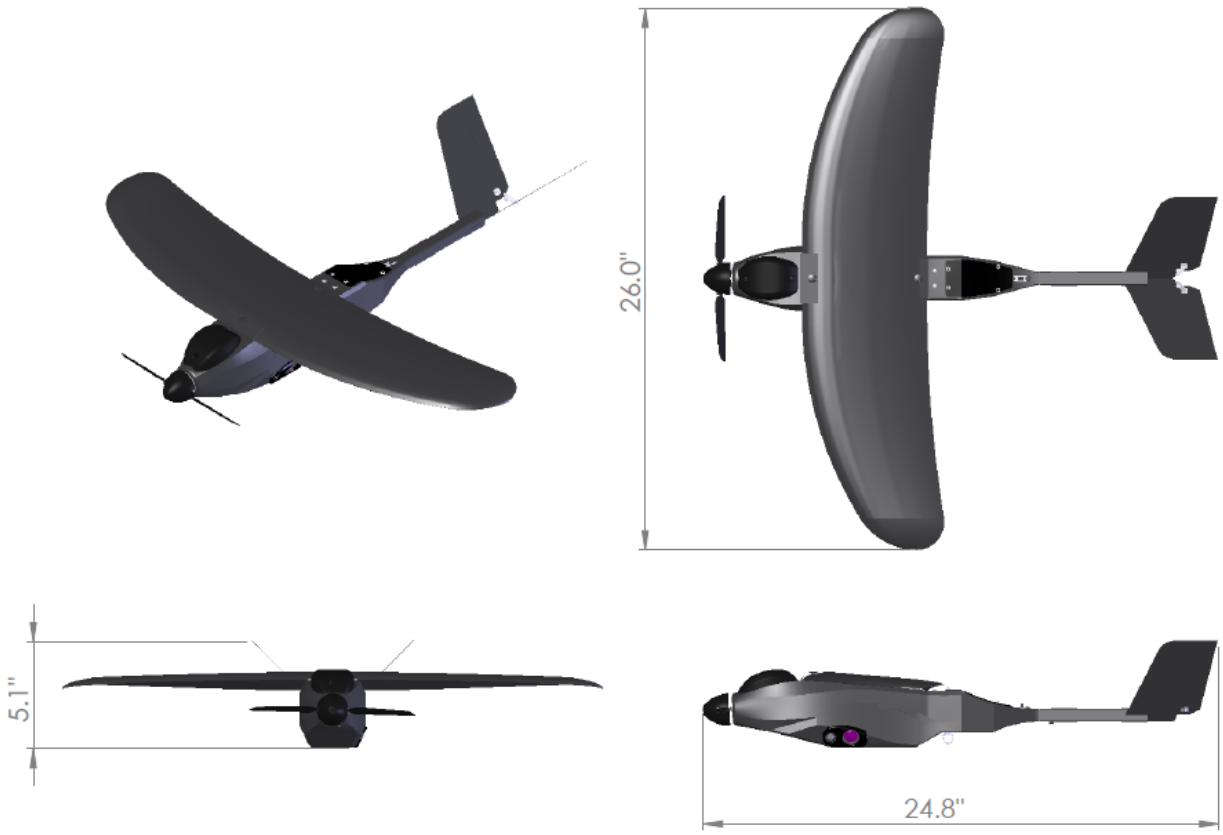


Figure 4. Schematic drawing of ARA's Nighthawk UAS showing overall dimensions.

4. Inspection and Maintenance (14 CFR part 91 – General Operating and Flight Rules, Subpart E – Maintenance, Preventive Maintenance, and Alterations).

a. Description of the Program. Describe the inspection and maintenance program that will be used to maintain the aircraft and related systems, including ground stations and/or other support systems.

The Nighthawk UAS system shall be inspected prior to each flight by completion of a pre-flight inspection. Any discrepancies noted at that time shall be repaired or corrected prior to flight. The Nighthawk UAS system will also be subject to an annual inspection. This annual inspection is similar in scope and detail to that of 14 CFR part 43 appendix D and has been submitted as part of the Safety Checklist. Please reference that document for details.

b. Required Documentation. Provide a copy of the flight manual, if applicable; current weight and balance report; and equipment list.

The Nighthawk Operations and Maintenance Manuals have been developed, and will be updated and verified as part of our R&D testing. Current weights range from approximately 1.8 to 2.0 pounds, depending on configuration. Center of gravity is held

to between 2.0 and 2.125 inches (via ballast if necessary) behind center wing leading edge until CG limits are experimentally determined.

5. Pilot Qualification (14 CFR 61.3, Requirement for certificates, ratings, and authorizations, and 14 CFR 61.5, Certificates and ratings issued under this part).

a. Pilot Qualifications. Describe the qualifications for each pilot.

All pilots need to have completed ARA training regarding operation of the Nighthawk UAS and crew resource management training. In addition, all pilots will have successfully completed private pilot ground school and an associated written exam, and will obtain a Class 2 medical certificate. For flights above 400 ft AGL, pilots will have a current Private Pilot's License.

b. Pilot Certifications. Pilots must be qualified/certificated in the appropriate category of aircraft, that is, rotorcraft, powered lift, and airplane.

ARA's primary Nighthawk UAS pilot holds a current private pilot license. ARA's primary Nighthawk UAS pilot will provide training for additional pilots who will be allowed to fly the Nighthawk under this experimental certificate in the designated area. Pilot training will include specific training regarding operation of the Nighthawk (as noted in item "c" below) and crew resource management training. In addition, all pilots will successfully complete private pilot ground school and an associated written exam. For flights above 400 ft AGL, pilots will have a current Private Pilot's License.

c. Pilot Training. Describe the internal training program to qualify pilots.

All pilots complete an ARA training program to support operating and testing of the Nighthawk UAS. This training includes the following:

- *Overview, System Setup and Teardown, Major Component Details*
- *System Operation, Software & Mission Planning*
- *Demonstration Flights*
- *Simulated Mission Instruction, Launch Procedures*
- *Field Setup*
- *Launch (Throwing) Practice*
- *Student Flights under supervision*
- *Altitude Mode operation*

Students demonstrate proficiency in the following elements as part of the training for flight certification conducted by ARA:

- *Preflight Checks – ensures users can operationally set up and check the UAS for airworthiness*
- *Launch Wizard – users can properly prepare the UAS for flight and launch*
- *GCS Preparation - users can properly use mapping and imagery for unknown areas and zone overlays*
- *Proper Mission Planning – ensure correct software execution, ensure safe flight plans are prepared, situational awareness is maintained for the flying area, identify proper launch and recovery areas*
- *Ability to edit a mission in flight – proficiency in re-tasking demonstrated*

- *Recovery Proficiency – demonstrates competency to land the UAS within specified landing zone*
- *Properly Operate Payload – demonstrates understanding capability of different modes and usage, recording payload imagery*
- *Unplanned Event Correction – handling of contingencies*
- *Range Awareness – understanding the operational concept for operating in the test range (aviate, navigate, communicate)*

Pilots will also be trained in the operation within the defined airspace for the UAS test activity, including the following:

- *Rules and responsibilities for operating near other aircraft (91.111)*
- *Right-of-Way Rules (91.113)*
- *VFR Weather Minimums (91.155)*

d. Supplemental Pilots. Describe whether supplemental pilots will be used for the operation. Describe how supplemental pilots will be used. Describe the company's internal training program for supplemental pilots. Describe company procedures and requirements for maintaining currency and conducting a flight review for supplemental pilots.

Supplemental pilots may be assigned to a flight to assist the PIC but are not required. Supplemental pilots need to have completed ARA training regarding operation of the Nighthawk UAS and crew resource management training. In addition, supplemental pilots will have successfully completed private pilot ground school and an associated written exam, and will obtain a Class 2 medical certificate.

e. Qualifications and Training of Observers. Describe the qualifications and training of observers. Observer training is required for observers to communicate to the pilot any instructions required to remain clear of conflicting traffic. Acceptable observer training as a minimum must include, but is not limited to, knowledge about the following—

(1) The rules and responsibilities described in §§ 91.111 (Operating near other aircraft), 91.113 (Right-of-way rules: Except water operations), and 91.155 (Basic VFR weather minimums);

(2) Air traffic and radio communications, including the use of approved ATC/pilot phraseology; and

(3) Appropriate sections of the *Aeronautical Information Manual*.

Observers are trained to perform their function and training includes understanding applicable aviation regulations related to see and avoid, clear of clouds and right of way rules. The primary purpose of the observers is to identify when local aviation may approach the Nighthawk flight area. Once identified, the observer will inform the pilot who will take appropriate action.

Observers are trained to understand operation of the Nighthawk and be fully briefed by the pilot prior to launch. Observers will complete ARA's crew resource management training. Observers will have a current Class 2 medical certificate.

6. **Aircraft Registration and Identification Marking (14 CFR part 45).** All UAS and OPA are required to be registered and identified with the registration number. Aircraft must be marked in accordance with part 45 or alternative marking approval issued by AIR-200.

   The Nighthawk UAS will be registered and marked with its US registration number, in accordance with part 45 or as agreed to with AIR-200.

7. **ATC Transponder and Altitude Reporting System Equipment and Use (§ 91.215**). Describe the aircraft altitude reporting system.

   Nighthawk does not include a Transponder and Altitude Reporting System.

8. **Method for See-and-Avoid (§ 91.113).** Describe in what manner, or by what means, the requirement to see-and-avoid other aircraft will be met. Describe the expected performance of the chase plane.

   The operation of the Nighthawk UAS will be within sight of the ground observer to support monitoring the aircraft for other aircraft that may be in the area. As a small, slow-moving UAS operating at low altitudes, Nighthawk does not utilize a chase aircraft to support see-and-avoid.

9. **Safety Risk Management.** Provide a safety checklist that identifies and analyzes the hazards of UAS or OPA operations described in the program letter. (See a sample safety checklist in appendix D to this order.) Additional information is available by contacting the FAA Aviation Safety Inspector.

   Refer to the Nighthawk UAS Safety Checklist.

10. **System Configuration.** Provide a description of the ground and airborne equipment used to allow direct or indirect control of the UAS or OPA.

    As described in Section 3k, the Nighthawk airborne platform incorporates an advanced autopilot system with integrated GPS, which provides precise navigation, station keeping and easy aircraft re-tasking. The autopilot and embedded navigation system, complemented with the intuitive, easy-to-operate and lightweight Ground Control Station (GCS), allow operators to easily control the aircraft as well as plan and execute missions. The Nighthawk UAS contains a GPS receiver module, three-axis accelerometers, three-axis magnetometers, and three-axis rate gyros to support guidance and navigation control. Altitude and airspeed are provided by a pitot static sensor system. The portable GCS consists of four primary components: fully-ruggedized laptop computer, a 12 volt battery, integrated Communications Box (Comms Box) with cables, and antennas.

    A pneumatic tube launcher can be used as an alternative launching method to the commonly used hand-launch method. The tube launcher consists of: 1) a tube in which the UAS with folded wings is inserted; 2) a launching mechanism, inside the tube, to provide pneumatic thrust to launch the UAS; 3) a control pendant to provide a means to trigger the launch; and 4) a rod, inserted into the bucktooth on the nose of the UAS, that is propelled by pneumatic force used to pull the UAS out of the tube. For tube launches, the propeller of the UAS remains off until it is powered up at 100% thrust as soon as it experiences the acceleration of launch.

11. System Safety—Flight Termination and Lost Link. Describe/explain the expectation of aircraft flight if fuel is starved. Describe/explain aircraft lost link and emergency recovery procedures. Provide an explanation of the flight termination system in detail.

Low Battery Power: *The Nighthawk motor is battery powered. Battery power is monitored by the system and provides the operator alerts as the battery becomes depleted. When the battery voltage dips below a threshold value, the aircraft begins navigating to a preprogrammed recovery point. If the aircraft is not landed by the operator before the battery reaches a critical value, the aircraft lands automatically via a slow descending spiral maneuver.*

Loss of Communication in Flight: *Indications of lost or intermittent communications are identified by audible and written warnings through the GCS. Other indicators of weak uplink include reduced number of bars in the Received Signal Strength Indicator (RSSI) and a change of color of the RSSI from green to yellow to red, as indicated on the GCS. Sustained loss of signal will activate the Loss of Signal Mission, as described next.*

Loss of Signal Mission: *The Loss of Signal Mission is to return to and orbit the launch point. If there is a sustained loss of communication for greater than five minutes, the Nighthawk UAS will proceed to the primary mission landing pattern and land. Restoration of communications at any time will not impact the UAS failsafe return to home mission until otherwise instructed. The UAS will not deviate from the Loss of Signal Mission until re-tasked by the user.*

Flight Termination: *The Nighthawk UAS does not include a flight termination system. The user can command the flight to terminate at any point by commanding an immediate landing.*

12. Command and Control. Provide a description of the system and/or procedures for command and control of the UAS or OPA.

As described in Section 3k, the Nighthawk UAS utilizes a fully autonomous flight system, incorporating an advanced autopilot system with integrated GPS, which provides precise navigation, station keeping and easy aircraft re-tasking. The autopilot and embedded navigation system integrate with the intuitive and easy-to-operate lightweight GCS that allows operators with limited flight experience to plan and execute missions. During autonomous missions, the pilot maintains oversight of the Nighthawk UAS and can take over direct control through the GCS at any point in time.

Prior to launching the Nighthawk UAS, the planned operational mission is loaded to the UAS via data link communications. Following launch the UAS will execute the planned mission unless the ground station operator / pilot uploads a new mission, or takes direct control of the UAS operation through input control commands. An extremely useful mission override is the "Loiter Here Now" command. By simply selecting this override and clicking on a location on the map, the UAS will divert immediately to that commanded point and begin to orbit at the default altitude. The original autonomous mission can be reactivated at any time with "Cancel Override" or GOTO a primary mission waypoint.

13. Control Stations. Provide a description of the ground/airborne stations used to control the UAS or OPA.

The Nighthawk UAS implements an intuitive, easy-to-operate, lightweight Ground Control Station (GCS). The GCS consists of four primary components: fully-ruggedized laptop computer, a 12 volt battery (same as aircraft battery), integrated Communications Box (Comms Box) with cables, and antennas. The GCS laptop provides a main control screen to

support the operation and monitoring of the Nighthawk UAS. This screen supports a map overlay of terrain data, depicts mission route plan information, and provides the UAS operator situational awareness of the UAS condition and flight state. The control screen also provides user controls to allow the operator to provide command inputs to the UAS to change altitude, airspeed, and heading. The GCS application on the laptop computer utilizes a graphical user interface (GUI) that includes mission planning, UAS monitors, telemetry calculations, and 2-way communication with the aircraft.

14. Control Frequencies. Provide a description/listing of the frequencies used to control the UAS or OPA.

The Nighthawk dual-radio with analog video link configuration uses separate data up/downlink and video downlink frequencies. For up/downlink data transmittal, a frequency band with a center channel of 380 MHz and a span of 6 MHz is used. A variant of this particular communications package also supports up/downlink data transmittal at a center channel frequency of 410 MHz. Video downlink transmissions offer 10 channel selections with a center channel frequency of 1.785 GHz.

The single-radio digital data link configuration uses only one up/downlink frequency band for both data and video. There are several channels for operation of this radio link in the following frequency ranges: 2.2997-2.3133 GHz and 2.3497-2.3632 GHz.

Nighthawk

Aerial Surveillance Simplified

The 4th generation Nighthawk is a hand or tube launched Micro UAV that uses GPS and built-in autopilot to provide situational awareness in almost any environment. The 1.9 lb. Nighthawk delivers a range of more than 10km and flight time of more than 60 minutes.

Nighthawk carries forward and side looking EO cameras and can carry a side looking thermal imager in a removable pod providing real-time situational awareness and targeting information to the operator. Nighthawk rolls and stores into a 6" tube with no assembly required prior to use.

"Point & click" waypoint navigation makes operation extremely user friendly.

Gain aerial "eyes on" with Nighthawk in these environs:

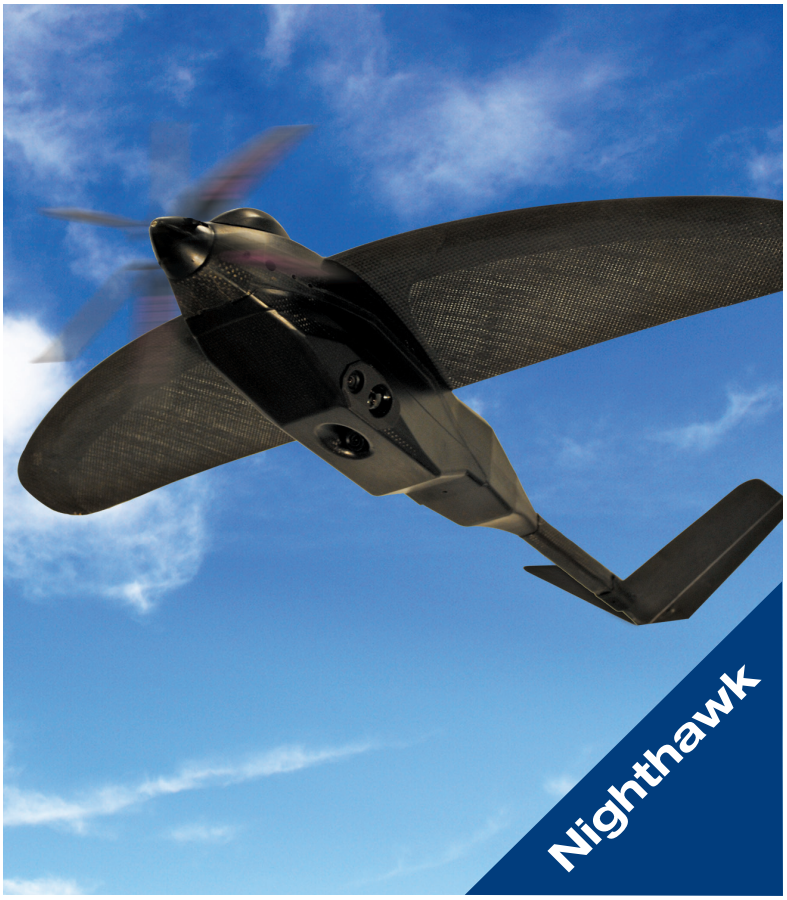
- Military Bases
- Detention Centers
- Nuclear Facilities
- Government Installations
- Border Regions
- Industrial Farms
- Roadless Terrain

"Nighthawk rolls and stores into a 6" tube with no assembly required prior to use."

The tube launch system can be mounted on a building or placed in the launcher of a combat vehicle, allowing for its use without exposing any personnel to harm.

Man-packable and deploys fast

A tube launch system delivers automatic "fly to cue"



ARA

forcepro@ara.com | 800.639.6315 | www.ara.com

Nighthawk | Product Specifications

WHY NIGHTHAWK?

The mobile and affordable option for aerial reconnaissance, the Nighthawk is a force multiplier that is well suited to solve a variety of battlefield and fixed site security challenges. Able to integrate with existing security systems and with added capabilities like automatic tube launching from vehicles or fixed installations, Nighthawk offers a more complete security solution than typical small airborne systems with unequaled ease of use.

10+ km range

OPTIONS

Depending on your application you may choose to purchase more than one plane, our COTS laptop computer system, assault pack, or durable waterproof pelican case for transport. Remote video terminal, thermal imaging and various spare and repair kits are also available.

Quickly from tube storage to flight

DIMENSIONS

1.9 pounds
26” wingspan

PERFORMANCE

60 +/- minutes of runtime
10+ kilometer range
25-40 mph cruising speed
11,000 foot operating ceiling
Built-in failsale modes
Lithium polymer battery
Electro-optical camera and thermal imager

Autopilot or assisted flight modes

REVIEWS

“Nighthawk performed the best at the Micro-UAS trial at URBEX..” – MAJOR MATT MOORE, ROYAL ARTILLERY VIA SHEPHARD NEWS

DEPLOYMENTS

Hundreds of TACMAV (2nd generation Nighthawk) systems deployed in combat.

ARA
forcepro@ara.com | 800.639.6315 | www.ara.com

APPLICATION FOR EQUIPMENT FREQUENCY ALLOCATION

CLASSIFICATION	DATE	FORM APPROVED OMB No. 0704-0188
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DOD GENERAL INFORMATION

TO	FROM

1. APPLICATION TITLE

2. SYSTEM NOMENCLATURE

3. STAGE OF ALLOCATION *(X one)* ☐ a. STAGE 1 CONCEPTUAL ☐ b. STAGE 2 EXPERIMENTAL ☐ c. STAGE 3 DEVELOPMENTAL ☐ d. STAGE 4 OPERATIONAL

4. FREQUENCY REQUIREMENTS
   a. FREQUENCY(IES)
   b. EMISSION DESIGNATOR(S)

5. TARGET STARTING DATE FOR SUBSEQUENT STAGES

a. STAGE 2	b. STAGE 3	c. STAGE 4

6. EXTENT OF USE

7. GEOGRAPHICAL AREA FOR
   a. STAGE 2
   b. STAGE 3
   c. STAGE 4

8. NUMBER OF UNITS

a. STAGE 2	b. STAGE 3	c. STAGE 4

9. NUMBER OF UNITS OPERATING SIMULTANEOUSLY IN THE SAME ENVIRONMENT

10 OTHER J/F 12 APPLICATION NUMBER(S) TO BE	11. IS THERE ANY OPERATIONAL REQUIREMENT AS DESCRIBED IN THE INSTRUCTIONS FOR PARAGRAPH 11?
☐ a. SUPERSEDED J/F 12/ ☐ b. RELATED J/F 12/	☐ a. YES X b. NO ☐ c. NAvail

12. NAMES AND TELEPHONE NUMBERS

a. PROGRAM MANAGER	(1) COMMERCIAL	(2) AUTOVON
b. PROJECT ENGINEER	(1) COMMERCIAL	(2) AUTOVON

13. REMARKS

DOWNGRADING INSTRUCTIONS	CLASSIFICATION	
N/A	UNCLASSIFIED	

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TRANSMITTER EQUIPMENT CHARACTERISTICS

1. NOMENCLATURE, MANUFACTURER'S MODEL NO. IPnDDL2300	**2. MANUFACTURER'S NAME** Microhard Systems Inc.
3. TRANSMITTER INSTALLATION	**4. TRANSMITTER TYPE** COFDM
5. TUNING RANGE 2.304GHz to 2.359GHz	**6. METHOD OF TUNING** Synthesis PLL
7. RF CHANNELING CAPABILITY 1MHz step (4MHz and 8MHz Channels)	**8. EMISSION DESIGNATOR(S)** 5M7D1DEF 11M1D1DEF
9. FREQUENCY TOLERANCE 2 ppm	
10. FILTER EMPLOYED *(X one)* X a. YES ☐ b. NO	
11. SPREAD SPECTRUM *(X one)* ☐ a. YES X b. NO	**12. EMISSION BANDWIDTH** *(X and complete as applicable)* ☐ CALCULATED X MEASURED
13. MAXIMUM BIT RATE 18Mbps (RAW)	**a. -3 dB** 4.0MHz / 8MHz (Half / Full BW) **b. -20 dB** 4.3MHz / 8.48MHz
14. MODULATION TECHNIQUES AND CODING COFDM (QPSK/16QAM)	**c. -40 db** 5.2MHz / 9.7MHz **d. -60 dB** 14.5MHz / 25.0MHz **e. OC-BW** 4.2MHz / 8.38MHz
	15. MAXIMUM MODULATION FREQUENCY N/A
16. PRE-EMPHASIS *(X one)* ☐ a. YES X b. NO	**17. DEVIATION RATIO** N/A
	18. PULSE CHARACTERISTICS N/A
19. POWER	**a. RATE**
a. MEAN up to 1 Watt (optional higher power available 2W)	**b. WIDTH**
b. PEP up to 1Watt	**c. RISE TIME**
20. OUTPUT DEVICE InGaP HBT	**d. FALL TIME** **e. COMP RATIO**
	21. HARMONIC LEVEL
22. SPURIOUS LEVEL -60 dBc	**a. 2nd** -55 dBc
23. FCC TYPE ACCEPTANCE NO. N/A	**b. 3rd** -60 dBc **c. OTHER**

24. REMARKS

BOX 19. 2W order Option available for Government Users "-2W"

Microhard Systems Inc.
#150 Country Hills Landing
Calgary, AB, Canada
T3K 5P3
Phone: (403) 248-0028
Fax: (403) 248-2762
Attn: Hany Shenouda

CLASSIFICATION UNCLASSIFIED	

CLASSIFICATION	PAGE
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RECEIVER EQUIPMENT CHARACTERISTICS

1. NOMENCLATURE, MANUFACTURER'S MODEL NO. IPnDDL2300	**2. MANUFACTURER'S NAME** **Microhard Systems Inc.**
3. RECEIVER INSTALLATION	**4. RECEIVER TYPE** Zero IF receiver
5. TUNING RANGE 2.304GHz to 2.359GHz	**6. METHOD OF TUNING** Synthesis PLL
7. RF CHANNELING CAPABILITY 1MHz step (4MHz and 8MHz Channels)	**8. EMISSION DESIGNATOR(S)** **5M7D1DEF** **11M1D1DEF**
9. FREQUENCY TOLERANCE 2 ppm	

10. IF SELECTIVITY	**1st**	**2nd**	**3rd**
a. -3 dB	+/- 4 MHz +/- 7MHz		
b. -20 dB	+/- 10MHz +/- 12MHz		
c. -60 dB	+/-21MHz +/- 26MHz (40dB)		

11. RF SELECTIVITY (X and complete as applicable)

☐ **CALCULATED** **X MEASURED**

a. -3 dB	75MHz
b. -20 dB	120 MHz
c. -60 dB	180 MHz

12. IF FREQUENCY	**d. Preselection Type** SAW Bandpass Filter
a. 1st **Zero IF Reciever**	**13. MAXIMUM POST DETECTION FREQUENCY** N/A
b. 2nd	**14. MINIMUM POST DETECTION FREQUENCY** N/A
c. 3rd	**16. MAXIMUM BIT RATE** 18Mbps

15. OSCILLATOR TUNED	**1st**	**2nd**	**3rd**
a. ABOVE TUNED FREQUENCY			
b. BELOW TUNED FREQUENCY			
c. EITHER ABOVE OR BELOW THE FREQUENCY			

17. SENSITIVITY	
a. SENSITIVITY **-97 dBm @ 6Mbps**	
b. CRITERIA **<10% Packet Error Rate**	
c. NOISE FIG ≈ 3 dB	
d. NOISE TEMP N/A	

18. DE-EMPHASIS *(X one)* ☐ **a. YES** **X b. NO**	**20. SPURIOUS REJECTION** **> 70 dBc (Out of Band)**
19. IMAGE REJECTION **N/A**	

21. REMARKS

Microhard Systems Inc.
#150 Country Hills Landing
Calgary, AB, Canada
T3K 5P3
Phone: (403) 248-0028
Fax: (403) 248-2762
Attn: Hany Shenouda

CLASSIFICATION UNCLASSIFIED	PAGE of Pages

ANTENNA EQUIPMENT CHARACTERISTICS

1.
☐ a. TRANSMITTING ☐ b. RECEIVING ☐ c. TRANSMITTING AND RECEIVING

2. NOMENCLATURE, MANUFACTURER'S MODEL NO.	3. MANUFACTURER'S NAME
4. FREQUENCY RANGE	5. TYPE
6. POLARIZATION	7. SCAN CHARACTERISTICS
	a. TYPE
8. GAIN	b. VERTICAL SCAN
a. MAIN BEAM	(1) Max Elev
b. 1st MAJOR SIDE LOBE	(2) Min Elev
	(3) Scan Rate
9. BEAMWIDTH	c. HORIZONTAL SCAN
a. HORIZONTAL	(1) Sector Scanned
b. VERTICAL	(2) Scan Rate
	d. SECTOR BLANKING *(X one)* ☐ (1) YES ☐ (2) NO

10. REMARKS

CLASSIFICATION UNCLASSIFIED	

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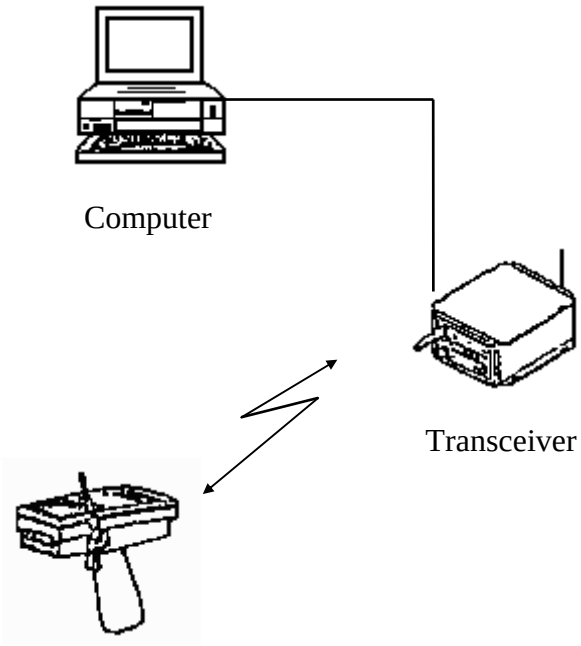
SAMPLE LINE DIAGRAM



This entire system is configured to operate within warehouse buildings. Some internal antennae may be necessary to allow uninterrupted communication between the bar code scanners and the base station within the building. The base station transceiver will be networked to directly to the server. Data will be transferred via RF between bar code scanners and the base station. The server will also be networked to other Family Housing terminals.

APPLICATION FOR SPECTRUM REVIEW	CLASSIFICATION: UNCLASSIFIED	PAGE of Pages

NTIA GENERAL INFORMATION

1. APPLICATION TITLE

2. SYSTEM NOMENCLATURE

3. STAGE OF ALLOCATION *(X one)*

☐ a. STAGE 1 CONCEPTUAL ☐ b. STAGE 2 EXPERIMENTAL ☐ c. STAGE 3 DEVELOPMENTAL ☐ d. STAGE 4 OPERATIONAL

4. FREQUENCY REQUIREMENTS

a. FREQUENCY(IES)

b. EMISSION DESIGNATOR(S)

5. PURPOSE OF SYSTEM, OPERATIONAL AND SYSTEM CONCEPTS (WARTIME USE) *(X one)* ☐ a. YES ☐ b. NO

6. INFORMATION TRANSFER REQUIREMENTS

7. ESTIMATED INITIAL COST OF THE SYSTEM

8. TARGET DATE FOR

a. APPLICATION APPROVAL	b. SYSTEM ACTIVATION	c. SYSTEM TERMINATION

9. SYSTEM RELATIONSHIP AND ESSENTIALITY

10. REPLACEMENT INFORMATION

11. RELATED ANALYSIS AND/OR TEST DATA

12. NUMBER OF MOBILE UNITS

13. GEOGRAPHICAL AREA FOR

a. STAGE 2

b. STAGE 3

c. STAGE 4

14. LINE DIAGRAM See page(s)	15. SPACE SYSTEMS See page(s)
16. TYPE OF SERVICE(S) FOR STAGE 4	17. STATION CLASS(ES) FOR STAGE 4

18. REMARKS

DOWNGRADING INSTRUCTIONS	CLASSIFICATION	
N/A	UNCLASSIFIED	

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APPLICATION FOR FOREIGN SPECTRUM SUPPORT	CLASSIFICATION: UNCLASSIFIED	PAGE of Pages

FOREIGN COORDINATION GENERAL INFORMATION

1. APPLICATION TITLE

2. SYSTEM NOMENCLATURE

3. STAGE OF ALLOCATION *(X one)*

☐ a. STAGE 1 CONCEPTUAL ☐ b. STAGE 2 EXPERIMENTAL ☐ c. STAGE 3 DEVELOPMENTAL ☐ d. STAGE 4 OPERATIONAL

4. FREQUENCY REQUIREMENTS

a. FREQUENCY(IES)

b. EMISSION DESIGNATOR(S)

5. PROPOSED OPERATING LOCATIONS OUTSIDE US&P

6. PURPOSE OF SYSTEM, OPERATIONAL AND SYSTEM CONCEPTS

7. INFORMATION TRANSFER REQUIREMENTS

8. NUMBER OF UNITS OPERATING SIMULTANEOUSLY IN THE SAME ENVIRONMENT

9. REPLACEMENT INFORMATION

10. LINE DIAGRAM See page(s)	11. SPACE SYSTEMS See page(s)

12. PROJECTED OPERATIONAL DEPLOYMENT DATE

13. REMARKS

DOWNGRADING INSTRUCTIONS	CLASSIFICATION	
N/A	UNCLASSIFIED	

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TRANSMITTER EQUIPMENT CHARACTERISTICS

1. NOMENCLATURE, MANUFACTURER'S MODEL NO.
(U) VNTXL-2A/SC232/DP/F/S

2. MANUFACTURER'S NAME
(U) L-3 Southern California Microwave

3. TRANSMITTER INSTALLATION
(U) Aircraft

4. TRANSMITTER TYPE
(U) FM Video and data

5. TUNING RANGE
(U) 1710 MHz - 1850 MHz

6. METHOD OF TUNING
(U) Synthesizer

7. RF CHANNELING CAPABILITY:
(U) see remarks

8. EMISSION DESIGNATOR
(U) 18M5F9W (U) (U)

9. FREQUENCY TOLERANCE:
(U) 20 ppm

10. FILTER EMPLOYED

(U) ☒ a. YES ☐ b. NO

11. SPREAD SPECTRUM

(U) ☐ a. YES ☒ b. NO

12. EMISSION BANDWIDTH
☐ CALCULATED ☒ MEASURED

13. MAXIMUM BIT RATE
(U) 20k bps

a. -3 dB (U) 2.4 MHz (U) (U)

b. -20 dB (U) 14.8 MHz (U) (U)

14. MODULATION TECHNIQUES AND CODING
(U) FM analog video with FM data subcarrier at 7.5 MHz. (See Remarks)

c. -40 dB (U) 26.0 MHz (U) (U)

d. -60 dB (U) 38.0 MHz (U) (U)

e. OC-BW (U) 14.0 MHz (U) (U)

15. MAXIMUM MODULATION FREQUENCY
7.575 MHz

16. PRE-EMPHASIS
(U) ☒ a. YES ☐ b. NO

17. DEVIATION RATIO
(U) 1.0

18. PULSE CHARACTERISTICS: N/A

19. POWER

a. MEAN (U) 2 W (U) (U)

b. PEP (U) (U) (U)

a. RATE (U) NA (U) (U)

b. WIDTH (U) NA (U) (U)

c. RISE TIME (U) NA (U) (U)

d. FALL TIME (U) NA (U) (U)

e. COMP RATIO (U) NA (U) (U)

20. OUTPUT DEVICE
(U) Soild State Transistor

21. HARMONIC LEVEL

22. SPURIOUS LEVEL
(U) -80 dBC

a. 2nd (U) -60 dBC

b. 3rd (U) -80 dBC

23. FCC TYPE ACCEPTANCE NO.
(U) N/A

c. OTHER (U) -80 dBC

24. REMARKS (U)

7. "1710 MHz, 10kHz increments, 4 frequencies will be software selected: 1710,1760,1790,and 1839 MHz."
8. The necessary bandwidth figure with the emission designator was calculated based upon NTIA Annex J (Bn = 2M + 2DK), K=1.0, M=7.575, D=1.6 MHz (visual) + .075 MHz (data subcarrier)= 1.675 MHz. So Bn = 2(7.575) + 2(1. 675) (1) = 18.5 MHz.
10. Internal 7-pole Chebychev low pass filter between the output device and the antenna connector. Approximately 0.5 dB insertion loss with 30 dB attenuation at two times the transmit frequency.l
13. The maximum-bit rate shown is for the digital FM data sub-carrier.
14. There will be one FM data subcarrier at 7.5 MHz offset from the carrier frequency. It is wholly separated from the video stream.
15. Maximum modulation frequency value includes the data sub-carrier.

APPLICATION FOR EQUIPMENT FREQUENCY ALLOCATION

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DOD GENERAL INFORMATION

TO	FROM

1. APPLICATION TITLE

2. SYSTEM NOMENCLATURE

3. STAGE OF ALLOCATION (X one) ☐ a. STAGE 1 CONCEPTUAL ☐ b. STAGE 2 EXPERIMENTAL ☐ c. STAGE 3 DEVELOPMENTAL ☐ d. STAGE 4 OPERATIONAL

4. FREQUENCY REQUIREMENTS
   a. FREQUENCY(IES)
   b. EMISSION DESIGNATOR(S)

5. TARGET STARTING DATE FOR SUBSEQUENT STAGES

a. STAGE 2	b. STAGE 3	c. STAGE 4

6. EXTENT OF USE

7. GEOGRAPHICAL AREA FOR
   a. STAGE 2
   b. STAGE 3
   c. STAGE 4

8. NUMBER OF UNITS

a. STAGE 2	b. STAGE 3	c. STAGE 4

9. NUMBER OF UNITS OPERATING SIMULTANEOUSLY IN THE SAME ENVIRONMENT

10 OTHER J/F 12 APPLICATION NUMBER(S) TO BE	11. IS THERE ANY OPERATIONAL REQUIREMENT AS DESCRIBED IN THE INSTRUCTIONS FOR PARAGRAPH 11?
☐ a. SUPERSEDED J/F 12/ ☐ b. RELATED J/F 12/	☐ a. YES X b. NO ☐ c. NAvail

12. NAMES AND TELEPHONE NUMBERS

a. PROGRAM MANAGER	(1) COMMERCIAL	(2) AUTOVON
b. PROJECT ENGINEER	(1) COMMERCIAL	(2) AUTOVON

13. REMARKS

DOWNGRADING INSTRUCTIONS	CLASSIFICATION	
N/A	UNCLASSIFIED	

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TRANSMITTER EQUIPMENT CHARACTERISTICS

1. NOMENCLATURE, MANUFACTURER'S MODEL NO. n320F (Serial Version) IPn320F (Ethernet / USB Version)	**2. MANUFACTURER'S NAME** **Microhard Systems Inc.**
3. TRANSMITTER INSTALLATION	**4. TRANSMITTER TYPE** FM
5. TUNING RANGE 310MHz to 390 MHz (-F1 option 350 to 400MHz)	**6. METHOD OF TUNING** Synthesis PLL
7. RF CHANNELING CAPABILITY 250kHz or 280kHz @ 230.4kbps / 400kHz @ 345kbps	**8. EMISSION DESIGNATOR(S)** FM Modulated **280kF1D @ 230kbps** **480kF1D @ 345kbps**
9. FREQUENCY TOLERANCE 2.5 PPM	
10. FILTER EMPLOYED *(X one)* **X a. YES** ☐ **b. NO**	
11. SPREAD SPECTRUM *(X one)* **X a. YES** ☐ **b. NO**	**12. EMISSION BANDWIDTH** *(X and complete as applicable)* ☐ **CALCULATED** **X MEASURED**
13. MAXIMUM BIT RATE 230.4 kbps / 345 kbps –NT (option)	**a. -3 dB** 180 kHz (230kbps) 225kHz (345kbps) **b. -20 dB** 280 kHz (230kbps) 375kHz (345kbps)
14. MODULATION TECHNIQUES AND CODING **CPFSK**	**c. -40 db** 550 kHz (230kbps) 775kHz (345kbps) **d. -60 dB** 950 kHz (230kbps) 1.25MHz (345kbps) **e. OC-BW** 290 kHz (230kbps) 485kHz (345kbps)
	15. MAXIMUM MODULATION FREQUENCY 115.2 kHz
16. PRE-EMPHASIS *(X one)* ☐ **a. YES** **X b. NO**	**17. DEVIATION RATIO** 0.5 to 1
	18. PULSE CHARACTERISTICS **N/A (frequency modulated)**
19. POWER	**a. RATE**
a. MEAN up to 1 Watt (optional higher power available 2W)	**b. WIDTH**
b. PEP up to 1Watt	**c. RISE TIME**
20. OUTPUT DEVICE HBT	**d. FALL TIME** **e. COMP RATIO**
	21. HARMONIC LEVEL
22. SPURIOUS LEVEL **-60 dBc**	**a. 2nd** **-50 dBc**
23. FCC TYPE ACCEPTANCE NO. **N/A**	**b. 3rd** **-60 dBc** **c. OTHER**

24. REMARKS

BOX 19. 2W order Option available for Government Users "-2W"
Operates in Single frequency or on Hopping Table of 50 Frequencies

Microhard Systems Inc.
#17, 2135 – 32nd Avenue NE
Calgary, AB, Canada
T2E 6Z3
Phone: (403) 248-0028
Fax: (403) 248-2762
Attn: Hany Shenouda

CLASSIFICATION UNCLASSIFIED	

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RECEIVER EQUIPMENT CHARACTERISTICS

1. NOMENCLATURE, MANUFACTURER'S MODEL NO.
n320F (Serial Version) **IPn320F** (Ethernet / USB Version)

2. MANUFACTURER'S NAME
Microhard Systems Inc.

3. RECEIVER INSTALLATION

4. RECEIVER TYPE
Dual Conversion Superheterodyne

5. TUNING RANGE
310MHz to 390 MHz (-F1 option 350 to 400MHz)

6. METHOD OF TUNING
Synthesis PLL

7. RF CHANNELING CAPABILITY
250kHz or 280kHz @ 230.4kbps / 400kHz @ 345kbps

8. EMISSION DESIGNATOR(S)
FM Modulated

Receiver

9. FREQUENCY TOLERANCE
2.5 PPM

10. IF SELECTIVITY	1st	2nd	3rd
a. -3 dB	500 kHz	280kHz / 500kHz	
b. -20 dB	750kHz	740 kHz / 850 kHz	
c. -60 dB	1.3MHz	1600 kHz / 2000 kHz	

11. RF SELECTIVITY (X and complete as applicable)
☐ CALCULATED X MEASURED

a. -3 dB	100MHz
b. -20 dB	150MHz
c. -60 dB	>200 MHz

12. IF FREQUENCY

a. 1st 243.95MHz

b. 2nd 10.7MHz

c. 3rd

d. Preselection Type
LC Filter

13. MAXIMUM POST DETECTION FREQUENCY 120kHz @ 230.4kpbs 175 kHz @ 345kbps

14. MINIMUM POST DETECTION FREQUENCY N/A

16. MAXIMUM BIT RATE 230.4 kbps / 345kbps

15. OSCILLATOR TUNED	1st	2nd	3rd
a. ABOVE TUNED FREQUENCY	X	X	
b. BELOW TUNED FREQUENCY			
c. EITHER ABOVE OR BELOW THE FREQUENCY			

17. SENSITIVITY

a. SENSITIVITY -107 dBm

b. CRITERIA 10^{-4} BER

c. NOISE FIG ≈ 3.5 dB

d. NOISE TEMP N/A

18. DE-EMPHASIS *(X one)*
☐ a. YES X b. NO

19. IMAGE REJECTION
> 60 dBc

20. SPURIOUS REJECTION
> 60 dBc

21. REMARKS

Microhard Systems Inc.
Attn: Hany Shenouda

Item 10. IF Selectivity (230.4kbps / 345kbps)

Operates in Single frequency or on Hopping Table of 50 Frequencies

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ANTENNA EQUIPMENT CHARACTERISTICS

1.
☐ a. TRANSMITTING ☐ b. RECEIVING ☐ c. TRANSMITTING AND RECEIVING

2. NOMENCLATURE, MANUFACTURER'S MODEL NO.	3. MANUFACTURER'S NAME
4. FREQUENCY RANGE	5. TYPE
6. POLARIZATION	7. SCAN CHARACTERISTICS
	a. TYPE
8. GAIN	b. VERTICAL SCAN
a. MAIN BEAM	(1) Max Elev
b. 1st MAJOR SIDE LOBE	(2) Min Elev
	(3) Scan Rate
9. BEAMWIDTH	c. HORIZONTAL SCAN
a. HORIZONTAL	(1) Sector Scanned
b. VERTICAL	(2) Scan Rate
	d. SECTOR BLANKING *(X one)* ☐ (1) YES ☐ (2) NO

10. REMARKS

CLASSIFICATION UNCLASSIFIED	

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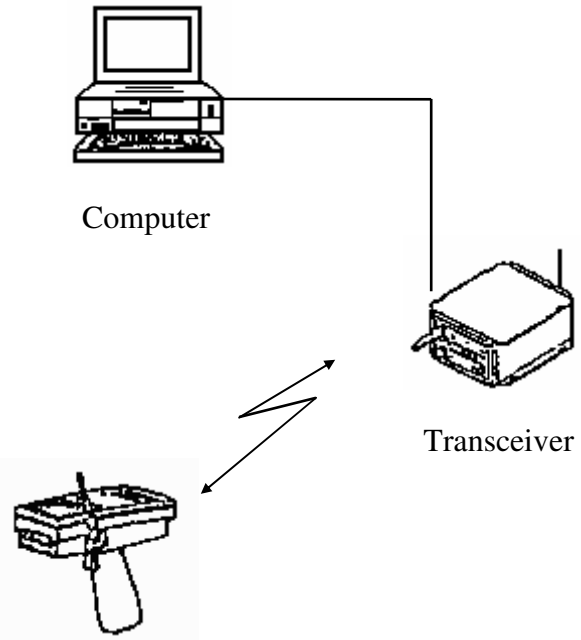
SAMPLE LINE DIAGRAM



This entire system is configured to operate within warehouse buildings. Some internal antennae may be necessary to allow uninterrupted communication between the bar code scanners and the base station within the building. The base station transceiver will be networked to directly to the server. Data will be transferred via RF between bar code scanners and the base station. The server will also be networked to other Family Housing terminals.

APPLICATION FOR SPECTRUM REVIEW	CLASSIFICATION: UNCLASSIFIED	PAGE of Pages

NTIA GENERAL INFORMATION

1. APPLICATION TITLE

2. SYSTEM NOMENCLATURE

3. STAGE OF ALLOCATION *(X one)*

☐ a. STAGE 1 CONCEPTUAL ☐ b. STAGE 2 EXPERIMENTAL ☐ c. STAGE 3 DEVELOPMENTAL ☐ d. STAGE 4 OPERATIONAL

4. FREQUENCY REQUIREMENTS

a. FREQUENCY(IES)

b. EMISSION DESIGNATOR(S)

5. PURPOSE OF SYSTEM, OPERATIONAL AND SYSTEM CONCEPTS (WARTIME USE) *(X one)* ☐ a. YES ☐ b. NO

6. INFORMATION TRANSFER REQUIREMENTS

7. ESTIMATED INITIAL COST OF THE SYSTEM

8. TARGET DATE FOR

a. APPLICATION APPROVAL	b. SYSTEM ACTIVATION	c. SYSTEM TERMINATION

9. SYSTEM RELATIONSHIP AND ESSENTIALITY

10. REPLACEMENT INFORMATION

11. RELATED ANALYSIS AND/OR TEST DATA

12. NUMBER OF MOBILE UNITS

13. GEOGRAPHICAL AREA FOR

a. STAGE 2

b. STAGE 3

c. STAGE 4

14. LINE DIAGRAM See page(s)	15. SPACE SYSTEMS See page(s)
16. TYPE OF SERVICE(S) FOR STAGE 4	17. STATION CLASS(ES) FOR STAGE 4

18. REMARKS

DOWNGRADING INSTRUCTIONS	CLASSIFICATION	
N/A	UNCLASSIFIED	

APPLICATION FOR FOREIGN SPECTRUM SUPPORT	CLASSIFICATION: UNCLASSIFIED	PAGE of Pages

FOREIGN COORDINATION GENERAL INFORMATION

1. APPLICATION TITLE

2. SYSTEM NOMENCLATURE

3. STAGE OF ALLOCATION *(X one)*

☐ a. STAGE 1 CONCEPTUAL ☐ b. STAGE 2 EXPERIMENTAL ☐ c. STAGE 3 DEVELOPMENTAL ☐ d. STAGE 4 OPERATIONAL

4. FREQUENCY REQUIREMENTS

a. FREQUENCY(IES)

b. EMISSION DESIGNATOR(S)

5. PROPOSED OPERATING LOCATIONS OUTSIDE US&P

6. PURPOSE OF SYSTEM, OPERATIONAL AND SYSTEM CONCEPTS

7. INFORMATION TRANSFER REQUIREMENTS

8. NUMBER OF UNITS OPERATING SIMULTANEOUSLY IN THE SAME ENVIRONMENT

9. REPLACEMENT INFORMATION

10. LINE DIAGRAM See page(s)	11. SPACE SYSTEMS See page(s)

12. PROJECTED OPERATIONAL DEPLOYMENT DATE

13. REMARKS

DOWNGRADING INSTRUCTIONS	CLASSIFICATION	
N/A	UNCLASSIFIED	

DD Form 1494, AUG 96

HyperLink Wireless 2.4 GHz 14 dBi Flat Patch Wireless LAN Antenna Model: HG2414P

Applications and Features

Applications:

- 2.4 GHz ISM Band
- IEEE 802.11b, 802.11g, 802.11n Wireless LAN
- Bluetooth®
- Public Wireless Hotspot
- WiFi
- Wireless Video Systems

Features:

- Superior performance
- Light weight
- Durable UV-stable, UL flame rated radome
- Low loss solid brass elements
- DC Short lightning protection
- 12 inch coax lead
- Can be installed for either vertical or horizontal polarization
- Optional mounting brackets available

Description

Directional Flat Patch Antenna

The HG2414P is a high performance directional flat patch WiFi antenna suitable for indoor and outdoor applications in the 2.4GHz ISM band, including IEEE 802.11b, 802.11g and 802.11n wireless LANs, Bluetooth®, and public wireless hotspots. This WiFi antenna is lightweight and features an aesthetic UV-stable, UL flame rated white plastic radome which can also be painted to match the room or building structure. The HG2414P can be installed for horizontal or vertical polarization. It can be wall or ceiling mounted, as well as mast-mounted using U-bolts.

Specifications

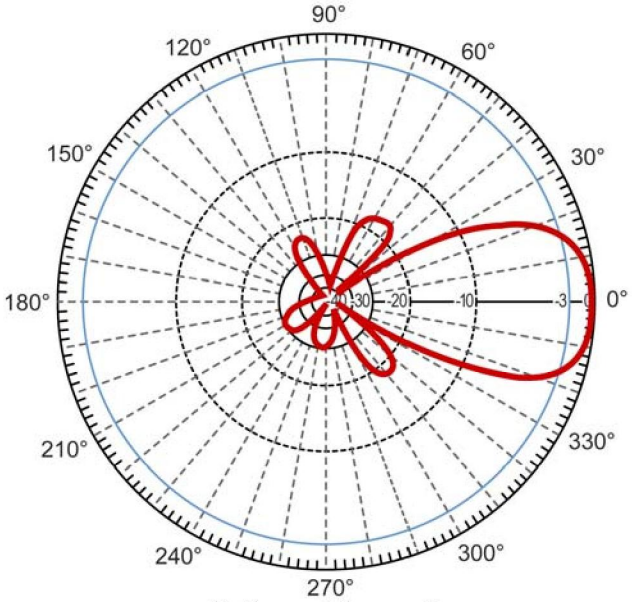
Electrical Specifications

Frequency	2400-2500 MHz
Gain	14 dBi
Horizontal Beam Width	30 degrees
Vertical Beam Width	30 degrees
Impedance	50 Ohm
Max. Input Power	25 Watts
VSWR	< 1.5:1 avg.
Lightning Protection	DC Short

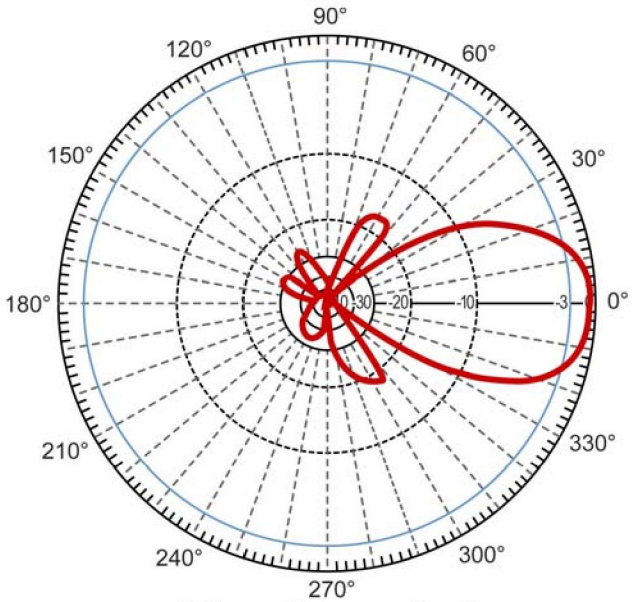
Mechanical Specifications

Weight	.95 lbs. (.43 Kg)
Dimensions	8.5 x 8.5 x 1 (inches) 216 x 216 x 26 (mm)
Radome Material	UV-inhibited Polymer
Flame Rating	UL 94HB
Mounting	Four ¼ in. (6.3 mm) Holes
Polarization	Horizontal or Vertical
Operating Temperature	-40° C to 85° C (-40° F to 185° F)
Wind Survival	>150 MPH (241 KPH)

RF Antenna Gain Patterns



Vertical



Horizontal

PROCERUS TECHNOLOGIES

PRT-DIP01

Procerus Dipole Antenna

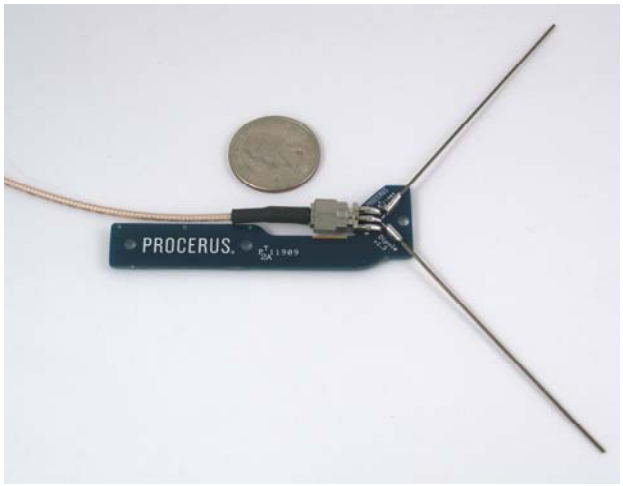


Figure 1 Procerus dipole antenna with SMA connector and mounting tab

FEATURES

- Light weight: 4 grams
- Small Size: 0.563" x 1.5" x 0.25"
- Available with SMA connector or with directly soldered coaxial cable (default) for weight and size savings
- Coax cable cut to custom length. Specify when ordering
- Rugged construction with ultra flexible memory wire poles. 105° angle.

APPLICATION

- 868 MHz, 900 MHz, UHF, 1.375 GHz, S-Band, C-Band, and L-Band wireless communications.

DESCRIPTION

Procerus Dipole wireless communications antennas are extremely light-weight, robust, and flexible and can be ordered for a wide variety of communication frequencies. Each antenna comes with a removable mounting tab for easy installation. In addition, each antenna is individually impedance matched to maximize communication range.

The space and weight saving nature of the Procerus Dipole wireless communications antennas makes them ideal for communications and video data transmission from onboard small and light-weight UAV platforms.

ABSOLUTE MAXIMUM RATINGS

Operating Temperature Range .....-55ºC to 100ºC
Storage Temperature Range.....-55ºC to 100ºC
Input RF Power**..... 5W
Humidity ..... 5% to 95%, no condensing

*** derate linearly to 2.5W at 100ºC*

Stresses above those listed under the Absolute Maximum Ratings may cause permanent damage to this device. This is a stress rating only; functional operation of this device at these or any other conditions above those indicated in the operational section of this specification are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability

PHYSICAL CHARACTERISTICS

Parameter	Conditions	Typ	Units
Dimensions		0.563" x 1.5" x 0.25"	Inches
Weight		4	Grams

TYPICAL APPLICATION

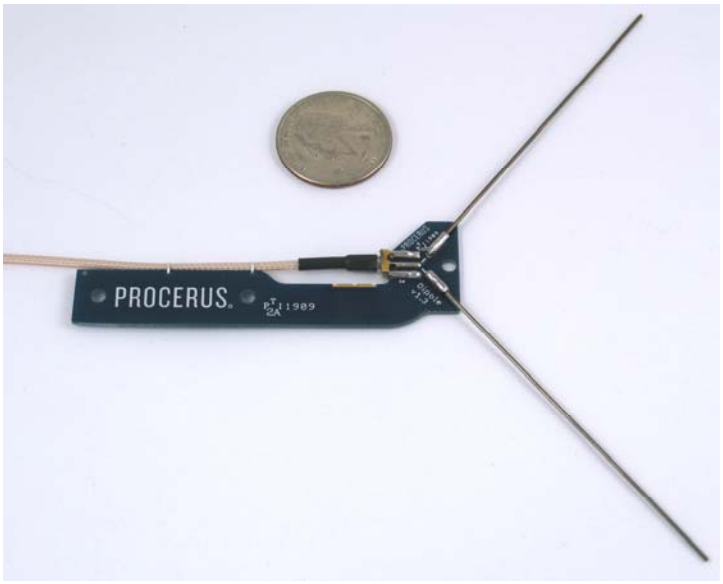


Figure 2 Procerus dipole antenna with mounting tab

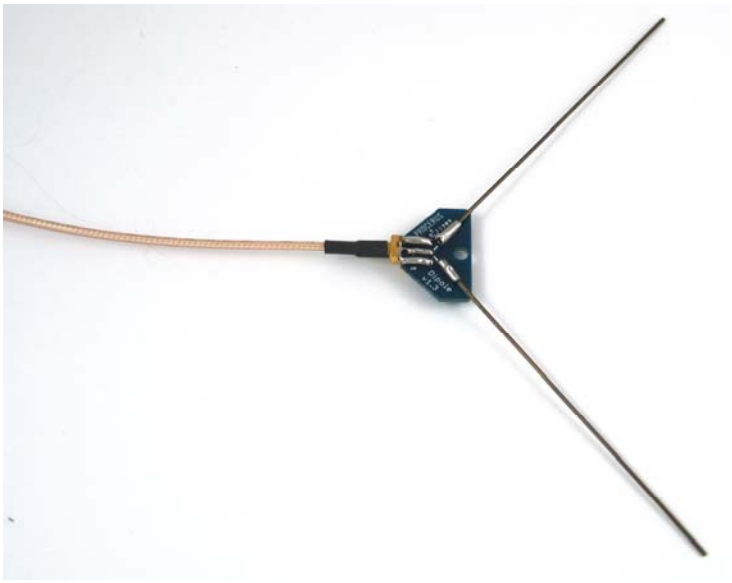


Figure 3 Procerus dipole antenna without mounting tab

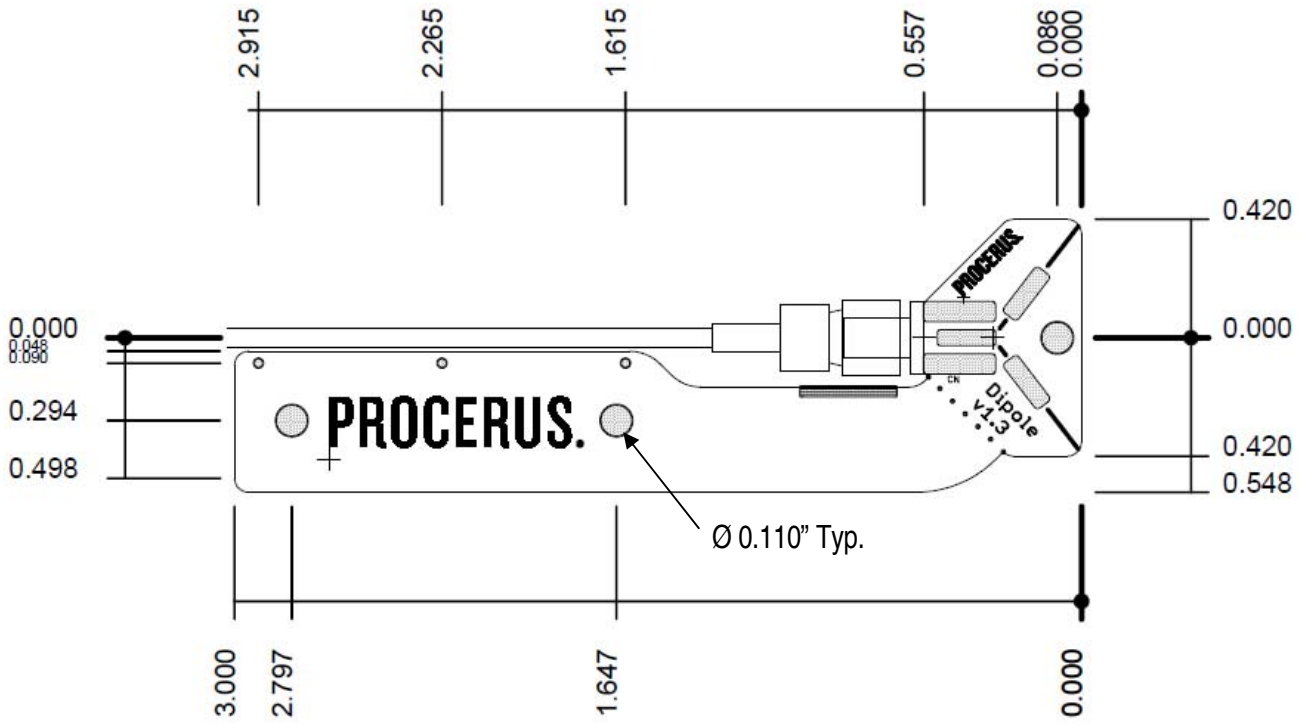


Figure 4 Drawing of Procerus dipole antenna (units in inches)

RELATED PARTS

The following table contains parts that may be used with the Servo Expansion Board. These parts can be purchased from Procerus Technologies or distributors like Digikey or Mouser.

Part Number	Manufacturer	Description	Comments
RMX-9010-1A	www.hdcom.com	Right Angle MMCX Crimp Plug A for RG-178/U	Coaxial Cable Connector

Steven Timian, 250 Beanville Road, Randolph, VT 05060,

United States of America
FEDERAL COMMUNICATIONS COMMISSION
EXPERIMENTAL
SPECIAL TEMPORARY AUTHORIZATION

EXPERIMENTAL	WG9XWM
(Nature of Service)	(Call Sign)
XT FX MO	0709-EX-ST-2013
(Class of Station)	(File Number)

NAME Applied Research Associates, Inc

This Special Temporary Authorization is granted upon the express condition that it may be terminated by the Commission at any time without advance notice or hearing if in its discretion the need for such action arises. Nothing contained herein shall be construed as a finding by the Commission that the authority herein granted is or will be in the public interest beyond the express terms hereof.

This Special Temporary Authorization shall not vest in the grantee any right to operate the station nor any right in the use of the frequencies designated in the authorization beyond the term hereof, nor in any other manner than authorized herein. Neither the authorization nor the right granted hereunder shall be assigned or otherwise transferred in violation of the Communications Act of 1934. This authorization is subject to the right of use of control the Government of the United States conferred by Section 706 of the Communications Act of 1934.

Special Temporary Authority is hereby granted to operate the apparatus described below:

Purpose Of Operation:
Test flights and demonstrations of the NightHawk Micro UAV.

Station Locations
(1) Randolph (ORANGE), VT - NL 43-54-48; WL 72-39-28; MOBILE: , within 4.5 km
(2) Randolph (ORANGE), VT - NL 43-54-48; WL 72-39-28; MOBILE: , within 4.5 km

Frequency Information

Randolph (ORANGE), VT - NL 43-54-48; WL 72-39-28; MOBILE: , within 4.5 km

Frequency	Station Class	Emission Designator	Authorized Power	Frequency Tolerance (+/-)
310-390 MHz	MO	280KF1D	1.531 W (ERP)	0.00025 %
2.2997-2.3133 GHz	MO	11M1D1D 5M70D1D	16 W (ERP)	0.0002 %
2.3497-2.3632 GHz	MO	5M70D1D	16 W (ERP)	0.0002 %

This authorization effective August 01, 2013 and
will expire 3:00 A.M. EST February 02, 2014

FEDERAL COMMUNICATIONS COMMISSION

Frequency Information

Randolph (ORANGE), VT - NL 43-54-48; WL 72-39-28; MOBILE: , within 4.5 km

Frequency	Station Class	Emission Designator	Authorized Power	Frequency Tolerance (+/-)
2.3497-2.3632 GHz	MO	11M1D1D	16 W (ERP)	0.0002 %

Randolph (ORANGE), VT - NL 43-54-48; WL 72-39-28; MOBILE: , within 4.5 km

Frequency	Station Class	Emission Designator	Authorized Power	Frequency Tolerance (+/-)
310-390 MHz	MO	280KF1D	1.531 W (ERP)	0.00025 %
1755-1850 MHz		18M5F9W	3.062 W (ERP)	0.002 %
2.2997-2.3133 GHz	MO	5M70D1D 11M1D1D	1.531 W (ERP)	0.0002 %
2.3497-2.3632 GHz	MO	5M70D1D 11M1D1D	1.531 W (ERP)	0.0002 %

Special Conditions:

(1) Operation in 1710-1755 MHz is denied and licensee should note that the 1755-1850 MHz band is being reviewed for transfer to the FCC.

(2) Licensee must notch out the ILS band 328.6 thru 335.4 MHz

(3) Licensee must notch out the following frequencies:
348.6 MHz +/- 10 kHz
353.8 MHz +/- 10 kHz
360.8 MHz +/- 10 kHz