

MEMORANDUM FOR RECORD

FROM: Joel R Walker, Aurora Flight Sciences

SUBJ: ANSWERS TO NATIONAL TELECOMMUNICATION AND INFORMATION AGENCY QUESTIONS
SENT VIA FCC EMAIL, DATE 02 NOV 2015

1. Answers in response to the following questions provided by the FCC on 02 NOV 2015, are provided in support of Federal coordination of STA application 1112-EX-ST-2015.

a. Number of "total" frequencies to be utilized is not clearly stated (identified).

The following table is provided to show the potential channels:

C-Band Data Link Frequencies (in MHz)	
Downlink	Uplink
4418.0	4717.5
4432.0	4724.5
4443.0	4732.0
4468.0	4739.5
4478.0	4747.0
4488.0	4762.0
4498.0	4784.5
4523.0	4799.5
4533.0	
4544.0	
4558.0	
4600.0	
4650.0	
4700.0	
4750.0	
4800.0	
4850.0	
4900.0	

Of these typically four total channels (two uplink, two downlink) are used simultaneously; however, during this testing up to eight total channels (four uplink, four downlink) maybe utilized simultaneously.

b. Separation criteria (paired/single channel) also not stated, possible misused, or incorrect emission designator.

The datalink manufacturer (ViaSat) and our team have done extensive testing with multiple configurations and "neighbor" channels with no issues noted. This platform has flown over 120 sorties and 170 hours during the last four years with no issues. This platform and associated RF

system has been approved by FAA and FCC respectively to operate in the Virginia/Maryland area and at the Griffiss Test site during this four year period. Additionally, this RF datalink system has been utilized by other platforms we have developed and on DoD ranges. This includes the Orion UAS which set the world endurance record on the NAS China Lake range. No interference issues were note during that 80+ hour flight or any of the buildup prior to it.

The following data is provided from the manufacturer, ViaSat, for the Enterlinks III system:

Frequency Tolerance (%)	0.0005
Emissions Designator	13M2G1D
Modulating Signal	Gaussian Shaped Minimum Shift keying (GMSK)

The center frequency of the standard EnerLinks product can be set to any multiple of 500 kHz in the band of interest. The carrier frequency is generated by a programmable synthesizer in the modem RF section and is configured by software.

The spectrum plot in figure 1 below should answer the question about how much bandwidth is used at 10 Mbps. It's clear from this picture that it's simplistic to talk about bandwidth in terms of a single value, but we do sometimes say that you can space adjacent channels with carriers separated by something like 1.1 times their bit rates.

The figures below show measured spectra at the PA output for 10 and 5 Mbps operation:

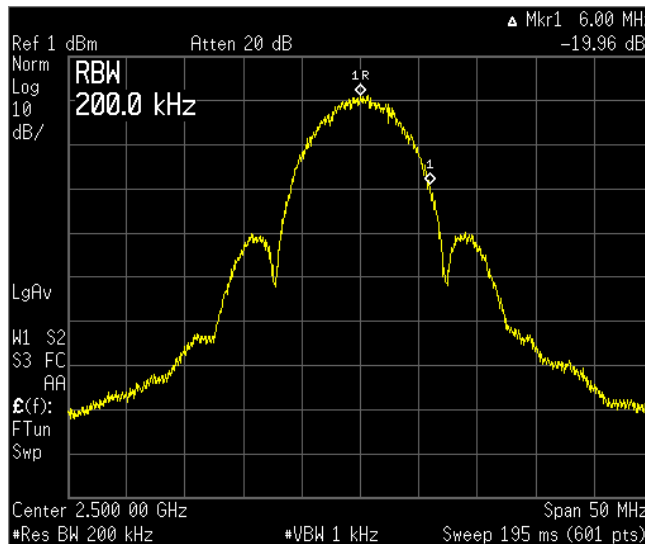


Figure 1 Spectrum measured at PA output at 10 Mbps

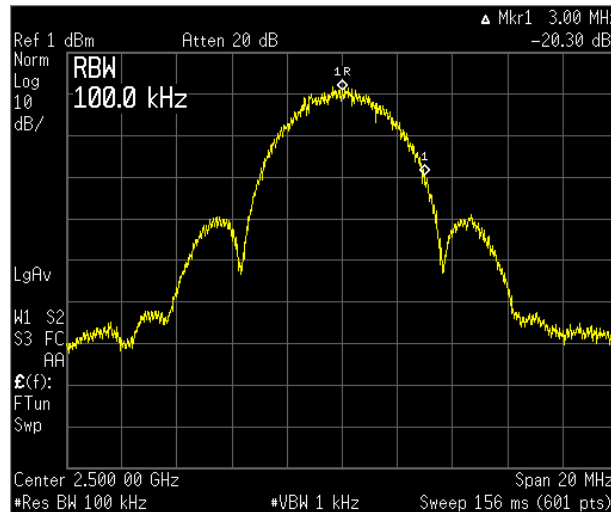


Figure 2 Spectrum measured at PA output at 5 Mbps

c. Questioning if this is being utilized for Command & Control (Video Links/Telemetry) of the UAS.

Yes, this datalink is utilized for these functions. We run two independent systems in a truly redundant fashion to provide this capability. This platform has flown over 120 sorties and 170 hours using this RF datalink system during the last four years with no issues. This platform and associated RF system has been approved by FAA and FCC respectively to operate in the Virginia/Maryland area and at the Griffiss Test site during this four year period. Additionally, this RF datalink system has been utilized by other platforms we have developed and on DoD ranges. This includes the Orion UAS which set the world endurance record on the NAS China Lake range. No interference issues were note during that 80+ hour flight or any of the buildup prior to it.

d. Radius of 30KM of airport at 25,000 ft. clearly is not radio horizon; this would be closer to 380KM at this altitude.

This information was provided in direct response to the FCC form asking for the transmitter location. In this case the transmitter will be located in the volume contained from surface to FL250 (25,000 ft MSL) and within 30 km of SpacePort (9NM9). This was not to answer the RF horizon of the transmitter. The base terrain at this location averages approximately 4,500 ft MSL. This would place our airborne transmitter at approximately 20,500 ft AGL. Based on this the estimated RF horizon at around 380 km is probably valid if not accounting for any terrain masking from the various mountain ranges in the area.

e. Has an approved COA from the FAA been processed (granted), reference S405 record notes.

Our platform, as a civil aircraft and not public use aircraft, operates under FAA Order 8130.34C, Airworthiness Certification of Unmanned Aircraft Systems and Optionally Piloted Aircraft. We have been granted special airworthiness certificates in the experimental category and have been operating our aircraft under this certification for the last five years and the last four years with the FCC licensed RF datalink system that we are requesting frequency allocation and utilization for at SpacePort (9NM9). We currently have FAA Operating Limitations authorizing us to fly in the Optionally Piloted Aircraft (OPA) configuration at multiple working areas in the US. We have

recently been granted the SpacePort (9NM9) area in this authorization. The FAA may issue a CoA for this mode of operation however FAA Order 8130.34 does not require this as the Operating Limitations provided under this order are functionally equivalent. We have applied for and are in the process with the FAA (AIR-100 and MIDO) to obtain our Optionally Piloted Aircraft/ Unmanned Aircraft System (OPA/UAS) special airworthiness certificates in the experimental category. SpacePort (9NM9) is one of the locations where UAS operation will be conducted. The FAA may issue a civil CoA in addition to the Operating Limitations for UAS operation; however, this has not been required yet as the working areas in the Operating Limitations are equivalent to a CoA for civil aircraft under the FAA Order 8130.34 process.

Flights in the OPA configuration will be conducted at SpacePort as a build up to UAS flights. All of these operations are to be flown utilizing this RF link system under this STA. These flights will be flown in the National Airspace (NAS) under this FAA airworthiness certification and operating limitations. We are also coordinating with White Sands Missile Range (WSMR) for authority to operate in Restricted airspace (R-5111) that they are the cognizant and scheduling authority for. Airspace and frequency utilization will be coordinated and scheduled through WSMR for all OPA and UAS flights. This will include operations solely in the NAS outside the Restricted airspace to ensure no conflicts exist with WSMR operation.

Additionally, the U.S. Department of Commerce, National Telecommunications and Information Administration (NTIA) Manual of Regulations and Procedures for Federal Radio Frequency Management, May 2014 Revision of the May 2013 Edition, provides the following guidance for UAS and S405:

8.3.33 Coordination of Frequency Assignments for Unmanned Aircraft Systems (UAS)
Federal agencies who have obtained a frequency assignment for UAS operations outside of Restricted or Warning Areas designated for aviation activities must file a Federal Aviation Administration (FAA) Form 7711, Certificate of Waiver or Authorization with the FAA. The form will initiate a comprehensive safety review for the UAS operation and provide airspace coordination with air traffic control facilities. Special note S405 will be entered on all UAS frequency assignments operating outside of Restricted or Warning Areas designated for aviation. For UAS operations within Restricted and Warning Areas designated for aviation activities the specific airspace shall be identified in the frequency assignment and will preclude the submission of FAA Form 7711 and the addition of S405 to the assignment record.

As we are not a Federal agency and are a civil aircraft we do not believe this section applies to our platform/operation. The FAA Order 8130.34C process, that we and other civilian OPA/UAS follow, is the FAA required method for the comprehensive safety review for the OPA/UAS operation and to provide airspace coordination with air traffic control facilities.

f. Given the timeline for complete coordination this will also need to be processed through the appropriate AFC office(s).

We are currently coordinating with SpacePort and WSMR for airspace and frequency utilization and scheduling. WSMR appears to be the Area Spectrum Coordinator for the New Mexico area. If there are different or additional offices, we can coordinate with them for frequency utilization and scheduling as well.