Response for file # 0321-EX-CN-2017: Raven Industries, Inc.

Overview and Explanation of Use & Compliance with NTIA 8.3.28

Overview: Raven Industries, Inc. is filing this application for use of a GPS re-radiation system at its facility at 47513 254th Street, Baltic, Minnehaha County, South Dakota to re-radiate GPS within the building in order to verify signal acquisition of GPS products being developed. This product relies on an antenna that is integrated into the unit requiring the re-radiated signal to verify operation.

General compliance with NTIA section 8.3.28 set forth below are Raven's responses to the requirements of 8.3.28 as those answers apply for this location.

For any questions about this application please contact Laura Zumhofe, Raven Compliance Manager, 605-731-0982, laura.zumhofe@ravenind.com

Compliance with the Requirements of NTIA Manual Section 8.3.28

1. Individual authorization is for indoor use only, and is required for each device at a specific site.
   Answer: Yes, Raven Industries, Inc. confirms that this device is for indoor use only inside Raven's facility and used by Raven employees

2. Applications for frequency assignment should be applied for as an XT station class with a note indicating the device is to be used as an "Experimental RNSS Test Equipment for the purpose of testing GPS receivers" and describing how the device will be used.
   Answer: Yes, Raven Industries, Inc. confirms that this application for frequency assignment is applied for as an XT station class and will be used as Experimental RNSS Test Equipment for the purpose of testing GPS receivers. Specifically, this device is used to re-radiate GPS within the building in order to verify signal acquisition of GPS products being developed and tested. Many of these products rely on an antenna that is integrated into the unit requiring the re-radiated signal to verify operation.

3. Approved applications for frequency assignment will be entered in the GMF.
   Answer: Yes, Raven Industries, Inc. affirms that we accept the fact that the requested frequency of 1575.42 Mhz will be published in the Government Master File (GMF) database.

4. The maximum length of the assignment will be two years, with possible renewal.
   Answer: Yes, Raven Industries, Inc. confirms understanding that the authorization will be for two (2) years, and it will seek renewals when required.

5. The area of potential interference to GPS reception (e.g., military or contractor facility) has to be under the control of the user.
   Answer: Yes, Raven Industries, Inc. is in sole control of the GPS re-radiator units inside the building at 47513 254th Street, Baltic, SD 57003

6. The maximum equivalent isotropically radiated power (EIRP) must be such that the calculated emissions are no greater than -140 dBm/24 MHz as received by an isotropic antenna at a distance of 100 feet (30 meters) from the building where the test is being conducted. The calculations showing compliance with this requirement must be provided with the

application for frequency assignment and should be based on free space propagation with no allowance for additional attenuation (e.g., building attenuation.)

Answer: The re-radiators will be running at -146.69857 dBm at 100 feet from the building, this does not include attenuation from the building itself. Free space loss includes the 100 feet outside of the nearest point of the building. The calculations showing compliance with this requirement are provided below, under Question 2.

7. GPS users in the area of potential interference to GPS reception must be notified that GPS information may be impacted for periods of time.

Answer: Raven Industries, Inc. will post notices that re-radiated GPS is in use and may cause disruption of GPS service.

8. The use is limited to activity for the purpose of testing RNSS equipment/systems.

Answer: Raven Industries, Inc. confirms that these units are for testing of its GPS related products only.

9. A "Stop Buzzer" point of contact for the authorized device must be identified and available at all times during GPS re-radiation operation of the device under any condition.

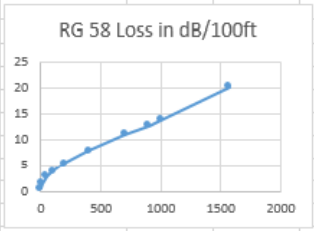
Answer: To "Stop Buzzer" contact: Nathan Dixon @ Nathan.dixon@ravenind.com or 800-243-5435 ext. 2618

Question 2. *"Please provide a detailed calculation(s) for the link budget specified on item 6 of section 8.3.28. Please make certain the ERP submitted on your application matches with what you calculate on the link budget."*

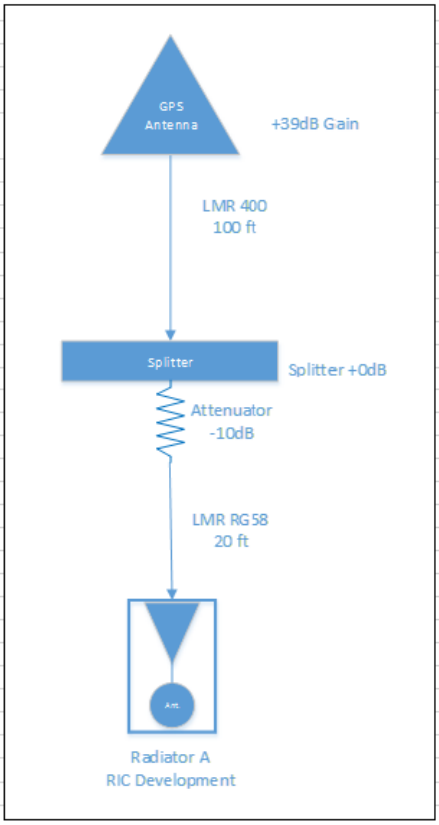
Link Budget Power Level (Radiator A - RIC Development)

	Distance (ft)	Gain/Loss dB	dBW	dBm	Watts	pW	
Received Signal Level			-157	-127	1.995E-16	2E-10	
Antenna Gain		39	-118	-88	1.585E-12	1.58E-06	
LMR 400 Cable	100	-5.1	-123.1	-93.1	4.898E-13	4.9E-07	
Attenuator		-10	-133.1	-103.1	4.898E-14	4.9E-08	
1:2 Splitter		0	-133.1	-103.1	4.898E-14	4.9E-08	
RG58 Cable	20	-4.6	-137.7	-107.7	1.698E-14	1.7E-08	
Radiator Amplifier		30	-107.7	-77.7	1.698E-11	1.7E-05	Radiated Power Level
Free Space Loss	140	-68.99857	-176.69857	-146.6986	2.139E-18	2.14E-12	Received Power @ 100 feet from building (no attenuation figured for building

Speed of light	299792458	m/s	LMR 400		RG 58	
GPS Frequency	1575420000	Hz	freq (Mhz)	dB/100ft	Freq	dB/100 ft
Wavelength	0.190293673	meters	1500	5.1	1500	23
meters/foot	0.3048					



RG 58 freq (MHz)	dB/100ft
1	0.46
10	1.4
50	2.8
100	3.8
200	5.4
400	7.9
700	11.1
900	12.8
1000	14.5
1500	*23*



205 E 6th Street, Sioux Falls, SD 57104
www.ravenind.com