

L3 Harris Technologies
(Formerly Harris Corporation)

UAS C Band Radio

Attachment to FCC Experimental License (rev 5)
FCC File Number: 0572-EX-CN-2018
Confirmation Number: EL352009

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1. Overview

L3 Harris Technologies (formerly Harris Corporation) is requesting an FCC Experimental License within the allocated Unmanned Aircraft System (UAS) C Band (5030 – 5091 MHz) to perform additional testing and validation of our UAS Command & Non-Payload Communications (CNPC) Radio System in North Dakota.

1.1. Ongoing “Experiment being conducted in Malabar, FL”

Harris previously installed a Mobile Command & Non-Payload Communications (CNPC) Radio in an Unmanned Air Vehicle (UAV) and communicated to the UAV via a Fixed CNPC Base Station in Malabar, FL. This ongoing experiment is being conducted as authorized by FCC Experimental License:

FCC File Number: 0734-EX-CN-2018

Confirmation Number: EL308994

The primary purpose of this first experiment being conducted at Harris’ Malabar Manufacturing facilities in Florida is to test the RF performance of the Harris Software Defined CNPC Radio (Part Number HRS301737-001). The results from this experiment are documented in the attached Test Report:

UAS C Band CNPC Radio

FCC Experimental License

Experimental Application 0734-EX-CN-2018

TEST REPORT

The existing Harris Malabar RF Test Range (FCC File No: 0734-EX-CN-2018) is limited in size and not able to support simultaneous operations of multiple Ground Stations. Multiple Ground Stations are required to demonstrate the ability of the Harris CNPC to support “make-before-break” Network Controlled Hand Over” (NCHO) operations for UAVs operating in a BVLOS (Beyond Visual Line of Sight).

1.2. Expanded “Experiment Planned for North Dakota”

Our second experimental UAS operation will be conducted in North Dakota. This rural location is ideal for supporting a larger geographic test that allows (3) C Band CNPC Ground Stations to be installed over an approximate 50 mile area. The UAV will be operated below 400’ Above Ground Level (AGL) and In Accordance With (IAW) all applicable FAA rules

2. Harris Command & Non-Payload Communications (CNPC) Radio System

Harris Corporation is participating in several key FAA UAS initiatives, including FAA Pathfinder, FAA UAS test site projects, the RTCA Drone Advisory Committee and RTCA SC-228. We have also been an active participant in RTCA SC-228 “Minimum Performance Standards for Unmanned Aircraft Systems” and the follow-on Phase 1 Terrestrial-based CNPC Link (Command & Non-Payload Communications) committee

Based on this experience, Harris is developing initial UAS CNPC Radio and Beyond Visual Line of Sight (BVLOS) network capabilities which are at various levels of maturity given current state of the UAS standards such as RTCA DO-362 and the more recently published FAA Technical Standard Order (TSO) C213.

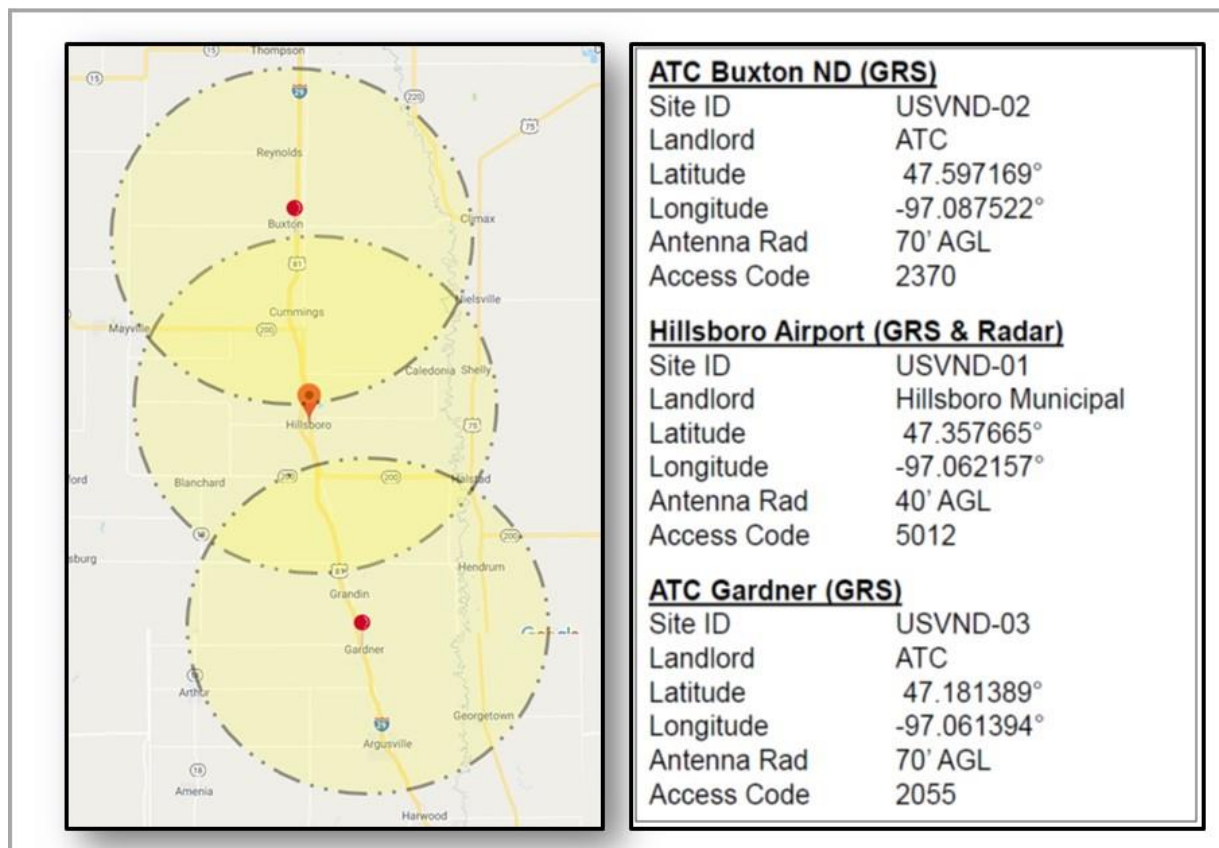
Our CNPC Radio systems are now at a point in development that we are ready to perform controlled RF radiation testing to verify the integrity and performance of the radio. Following the receipt of approval from the FAA we are hereby requesting an Experimental License from the FCC to further continue our testing.

3. North Dakota - Test Site Area

NPUASTS is one of only seven nationwide test sites that have been designated by the Federal Aviation Administration to research the safe integration of UAS into the national airspace system

Our planned North Dakota BVLOS Test Site will span an area of approximately 50 nm on the east side of the state centered about Hillsboro Airport in Traill County. This rural location was selected due to it's strategic convenience between Grand Forks (University of North Dakota) and Fargo (North Dakota State University) and is equally convenient to the Northern Plains UAS Test Site (NPUASTS). Harris has been a technology innovator and collaborator

Harris has selected (3) existing North Dakota towers for installing the UAS CNPC C Band Ground Radio Stations located at Buxton, Hillsboro and Gardner as shown in Figure 3.1 below:



North Dakota Test Site Area of Operation

3.1. Buxton, ND - Radio Tower Location



Buxton, ND Radio Tower

Buxton Tower Information

Lat / Long: 47.59716, -97.08752

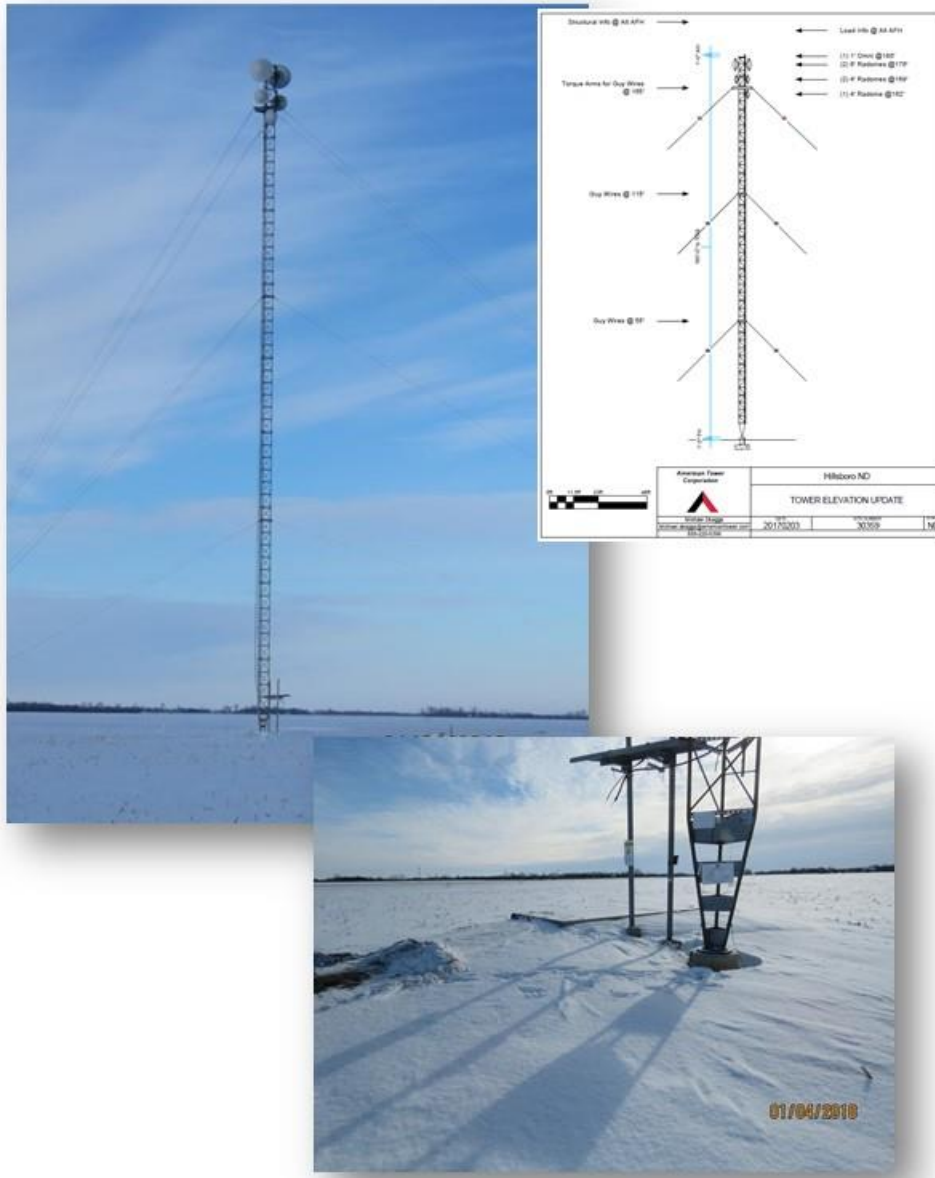
Address: 16218 13th Street, Buxton, North Dakota, 58218-4001

Structure Type: Self Support

Ground Elevation: 927 ft. (AMSL)

Structure Height: 190 ft. (AGL)

3.2. Hillsboro, ND – Radio Tower Location



Hillsboro, ND Radio Tower

Hillsboro Tower Information

Lat / Long: 47.42484, -97.07313

Address: West of SR-200, 2 miles North of Hillsboro, Hillsboro, North Dakota, 58045-4015

Structure Type: Guyed

Ground Elevation: 913 ft. (AMSL)

Structure Height: 172 ft. (AGL)

FAA Number 2004-AGL-2009-OE

3.3. Gardner, ND – Radio Tower Location

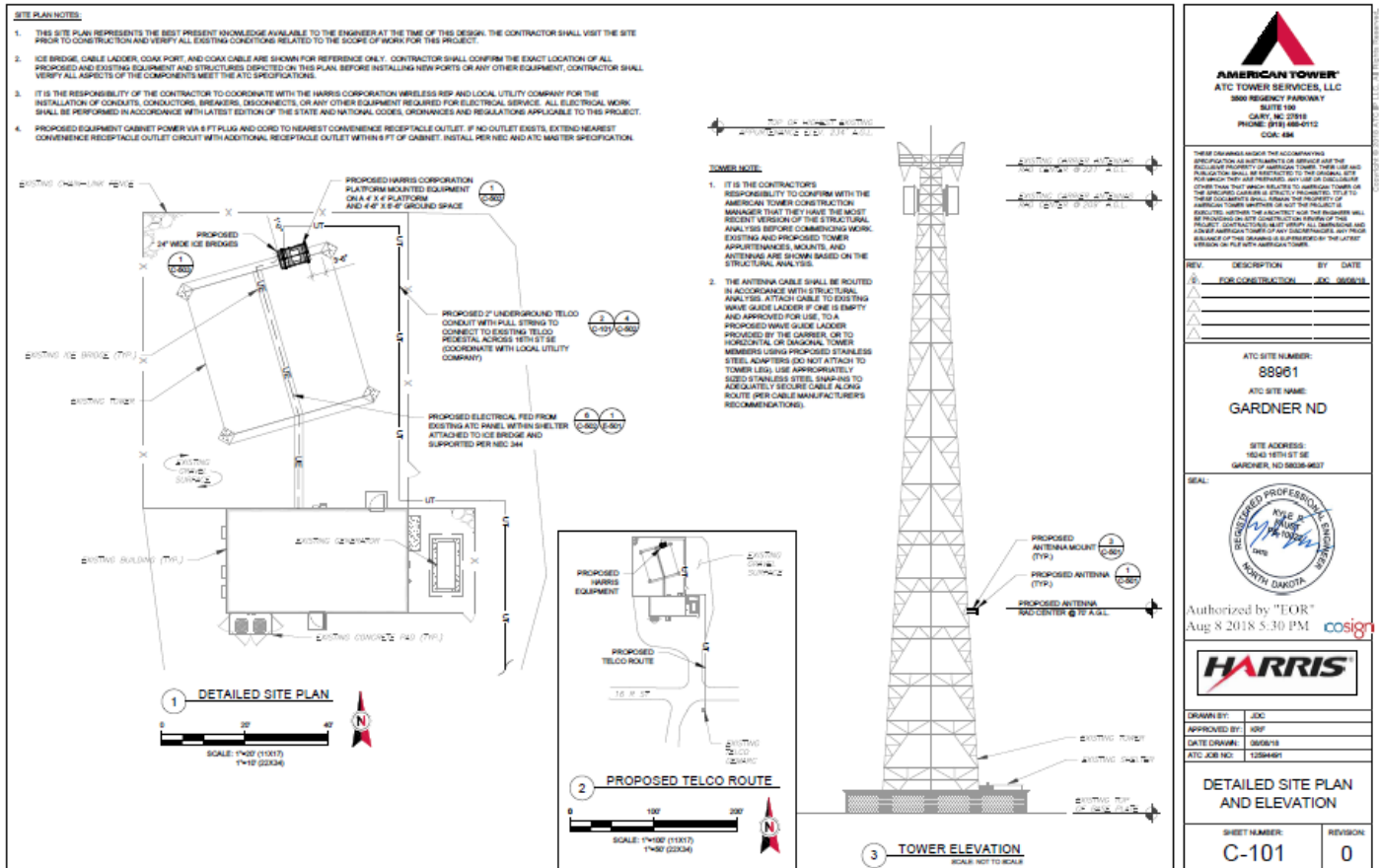


Gardner, ND Radio Tower

Gardner Tower Information

Lat / Long: 47.181389 -97.061394
Structure Type: Guyed
Ground Elevation: 913 ft. (AMSL)
Structure Height: 70 ft. (AGL)

Attachment – Form 442
FCC Experimental License



Gardner, ND Architectural Drawing

4. C Band Spectrum for Unmanned Air Systems (UAS)

The FAA has designated C Band Spectrum (5030 – 5091 MHz) for use by UAS. Additionally, the FAA Spectrum Office has recommended the band be divided into 41 channels, which are allocated based on the Data Class of operation and required bandwidth.

This Experimental License application request is for a "Low, Medium and High-end" 85 kHz channel (3 Total) to support initial testing of the Harris Command and NonPayload Communication (CNPC) radio designed to support UAS Operations. Our request is to allow Manufacturing Testing of the Harris CNPC Radio for channels 3, 23 and 39 for both D1 and D2 as shown in the table below:

85 KHz Bandwidth Channels		
Channel	D1 (MHz)	D2 (MHz)
3	5041.3125	5041.3975
23	5045.6125	5045.6975
39	5049.0525	5049.1375

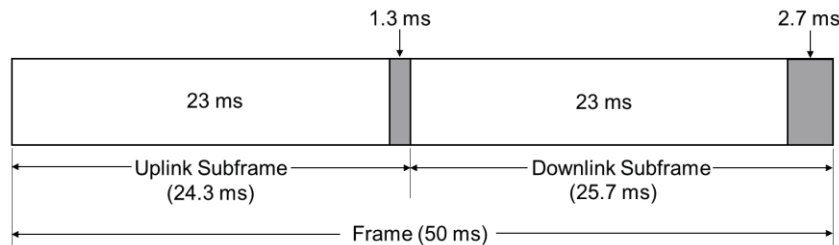
5. Modulating Signal Description

Both the fixed (Ground Base Station) and mobile (Unmanned Air Vehicle) transmitters use a GMSK (Gaussian Minimum Shift Keying) modulation scheme. Binary ones and zeroes are generated with a modulation index of 0.5 and a Bandwidth-Time (BT) product of 0.2.

5.1. RTCA TDD Format

RTCA DO-362 compliant Time Division Duplex (TDD) structure of 50 millisecond frames with 23 millisecond uplink and downlink sub-frames.

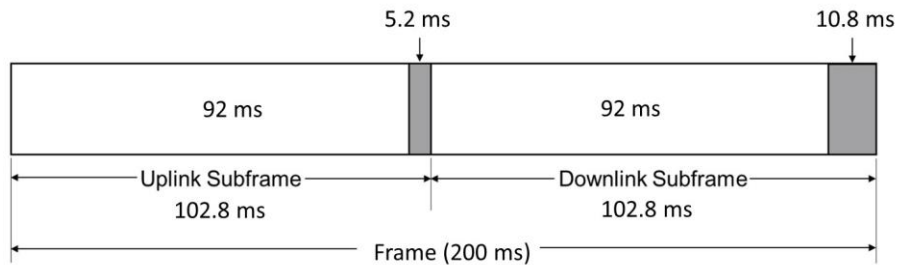
RTCA DO-362 Section 2.2.1.3 TDD Frame Structure Is shown below.



DO-362 TDD Frame Structure

5.2. Harris CNPC TDD Format

The Harris C Band CNPC Radio utilizes a very similar TDD subframe structure although currently with a 200 ms frame as shown below.



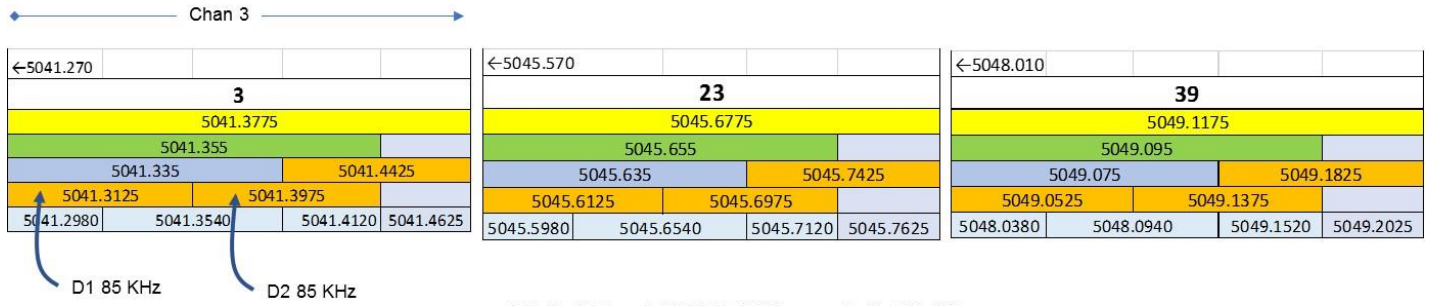
Harris CNPC TDD Frame Structure

Note: As part of our continuing development, Harris plans to modify our TDD structure to be fully compliant with the TDD (50 ms) frame structure specified in RTCA DO-362 Section 2.2.1.3.

6. UAS Requested Experimental License Channels

The FAA Spectrum Office has designated (41) channels at (5) different bandwidths (45 kHz, 85 kHz, 130 kHz, 170 kHz and 205 kHz). Harris is requesting Experimental Licenses at 85 kHz at the Low, Medium and High-end of the UAS C Band designated as channels 3, 23 and 39 as shown in the figure and chart below:

Attachment – Form 442
FCC Experimental License



UAS C Band (85 kHz) Channels 3, 23, 39

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FCC Experimental License

	205 kHz	170 kHz	130 kHz	85 kHz			45 kHz			
CH	A	B	C	D1	D2	D3	E1	E2	E3	E4
1	5040.9475	5040.925	5040.905	5040.8825	5040.8675	5041.0125	5040.8680	5040.9240	5040.9820	5041.0325
2	5041.1625	5041.140	5041.120	5041.0975	5041.1825	5041.2275	5041.0830	5041.1390	5041.1970	5041.2475
3	5041.3775	5041.355	5041.335	5041.3125	5041.3975	5041.4425	5041.2980	5041.3540	5041.4120	5041.4625
4	5041.5925	5041.570	5041.550	5041.5275	5041.6125	5041.6575	5041.5130	5041.5690	5041.6270	5041.6775
5	5041.8075	5041.785	5041.765	5041.7425	5041.8275	5041.8725	5041.7280	5041.7840	5041.8420	5041.8925
6	5042.0225	5042.000	5041.980	5041.9575	5042.0425	5042.0875	5041.9430	5041.9990	5042.0570	5042.1075
7	5042.2375	5042.215	5042.195	5042.1725	5042.2575	5042.3025	5042.1580	5042.2140	5042.2720	5042.3225
8	5042.4525	5042.430	5042.410	5042.3875	5042.4725	5042.5175	5042.3730	5042.4290	5042.4870	5042.5375
9	5042.6675	5042.645	5042.625	5042.6025	5042.6875	5042.7325	5042.5880	5042.6440	5042.7020	5042.7525
10	5042.8825	5042.860	5042.840	5042.8175	5042.9025	5042.9475	5042.8030	5042.8590	5042.9170	5042.9675
11	5043.0975	5043.075	5043.055	5043.0325	5043.1175	5043.1625	5043.0180	5043.0740	5043.1320	5043.1825
12	5043.3125	5043.290	5043.270	5043.2475	5043.3325	5043.3775	5043.2330	5043.2890	5043.3470	5043.3975
13	5043.5275	5043.505	5043.485	5043.4625	5043.5475	5043.5925	5043.4480	5043.5040	5043.5620	5043.6125
14	5043.7425	5043.720	5043.700	5043.6775	5043.7625	5043.8075	5043.6630	5043.7190	5043.7770	5043.8275
15	5043.9575	5043.935	5043.915	5043.8925	5043.9775	5044.0225	5043.8780	5043.9340	5043.9920	5044.0425
16	5044.1725	5044.150	5044.130	5044.1075	5044.1925	5044.2375	5044.0930	5044.1490	5044.2070	5044.2575
17	5044.3875	5044.365	5044.345	5044.3225	5044.4075	5044.4525	5044.3080	5044.3640	5044.4220	5044.4725
18	5044.6025	5044.580	5044.560	5044.5375	5044.6225	5044.6675	5044.5230	5044.5790	5044.6370	5044.6875
19	5044.8175	5044.795	5044.775	5044.7525	5044.8375	5044.8825	5044.7380	5044.7940	5044.8520	5044.9025
20	5045.0325	5045.010	5044.990	5044.9675	5045.0525	5045.0975	5044.9530	5045.0090	5045.0670	5045.1175
21	5045.2475	5045.225	5045.205	5045.1825	5045.2675	5045.3125	5045.1680	5045.2240	5045.2820	5045.3325
22	5045.4625	5045.440	5045.420	5045.3975	5045.4825	5045.5275	5045.3830	5045.4390	5045.4970	5045.5475
23	5045.6775	5045.655	5045.635	5045.6125	5045.6975	5045.7425	5045.5980	5045.6540	5045.7120	5045.7625
24	5045.8925	5045.870	5045.850	5045.8275	5045.9125	5045.9575	5045.8130	5045.8690	5045.9270	5045.9775
25	5046.1075	5046.085	5046.065	5046.0425	5046.1275	5046.1725	5046.0280	5046.0840	5046.1420	5046.1925
26	5046.3225	5046.300	5046.280	5046.2575	5046.3425	5046.3875	5046.2430	5046.2990	5046.3570	5046.4075
27	5046.5375	5046.515	5046.495	5046.4725	5046.5575	5046.6025	5046.4580	5046.5140	5046.5720	5046.6225
28	5046.7525	5046.730	5046.710	5046.6875	5046.7725	5046.8175	5046.6730	5046.7290	5046.7870	5046.8375
29	5046.9675	5046.945	5046.925	5046.9025	5046.9875	5047.0325	5046.8880	5046.9440	5047.0020	5047.0525
30	5047.1825	5047.160	5047.140	5047.1175	5047.2025	5047.2475	5047.1030	5047.1590	5047.2170	5047.2675
31	5047.3975	5047.375	5047.355	5047.3325	5047.4175	5047.4625	5047.3180	5047.3740	5047.4320	5047.4825
32	5047.6125	5047.590	5047.570	5047.5475	5047.6325	5047.6775	5047.5330	5047.5890	5047.6470	5047.6975
33	5047.8275	5047.805	5047.785	5047.7625	5047.8475	5047.8925	5047.7480	5047.8040	5047.8620	5047.9125
34	5048.0425	5048.020	5048.000	5047.9775	5048.0625	5048.1075	5047.9630	5048.0190	5048.0770	5048.1275
35	5048.2575	5048.235	5048.215	5048.1925	5048.2775	5048.3225	5048.1780	5048.2340	5048.2920	5048.3425
36	5048.4725	5048.450	5048.430	5048.4075	5048.4925	5048.5375	5048.3930	5048.4490	5048.5070	5048.5575
37	5048.6875	5048.665	5048.645	5048.6225	5048.7075	5048.7525	5048.6080	5048.6640	5048.7220	5048.7725
38	5048.9025	5048.880	5048.860	5048.8375	5048.9225	5048.9675	5048.8230	5048.8790	5048.9370	5048.9875
39	5049.1175	5049.095	5049.075	5049.0525	5049.1375	5049.1825	5048.9380	5048.9940	5049.0520	5049.1025
40	5049.3325	5049.310	5049.290	5049.2675	5049.3525	5049.3975	5049.2530	5049.3090	5049.3670	5049.4175
41	5049.5475	5049.525	5049.505	5049.4825	5049.5675	5049.6125	5049.4680	5049.5240	5049.5820	5049.6325

7. FAA Coordination & Approval - Aviation Protected Spectrum channels

Harris has received approval from the FAA for all (36) Aviation Protected Spectrum channels requested by Harris to support our Experimental License applications in North Dakota. The details of these approvals including FAA Tracking Numbers are described below:

For additional information please contact:
FAA Spectrum Office
Don Nellis
Donald.Nellis@faa.gov
(202)267.9779

Tracking Number	Submitted Date	City	State	FAA Coordination No.	FAA Status	FAA Last Updated Date	Project Exercise
TRK 183727	10/29/2018	GARDNER	ND	NG T180862	RA	12/17/2018	NFEJZ10/29/2018(4)
TRK 183726	10/29/2018	GARDNER	ND	NG T180861	RA	12/17/2018	NFEJZ10/29/2018(4)
TRK 183725	10/29/2018	GARDNER	ND	NG T180860	RA	12/17/2018	NFEJZ10/29/2018(4)
TRK 183724	10/29/2018	GARDNER	ND	NG T180859	RA	12/17/2018	NFEJZ10/29/2018(4)
TRK 183723	10/29/2018	GARDNER	ND	NG T180858	RA	12/17/2018	NFEJZ10/29/2018(4)
TRK 183722	10/29/2018	GARDNER	ND	NG T180857	RA	12/17/2018	NFEJZ10/29/2018(4)
TRK 183721	10/29/2018	GARDNER	ND	NG T180856	RA	12/17/2018	NFEJZ10/29/2018(4)
TRK 183720	10/29/2018	GARDNER	ND	NG T180855	RA	12/17/2018	NFEJZ10/29/2018(4)
TRK 183719	10/29/2018	GARDNER	ND	NG T180854	RA	12/17/2018	NFEJZ10/29/2018(4)
TRK 183718	10/29/2018	GARDNER	ND	NG T180853	RA	12/17/2018	NFEJZ10/29/2018(4)
TRK 183717	10/29/2018	GARDNER	ND	NG T180852	RA	12/17/2018	NFEJZ10/29/2018(3)
TRK 183716	10/29/2018	GARDNER	ND	NG T180851	RA	12/17/2018	NFEJZ10/29/2018(3)
TRK 183715	10/29/2018	HILLSBORO	ND	NG T180850	RA	12/17/2018	NFEJZ10/29/2018(2)
TRK 183714	10/29/2018	HILLSBORO	ND	NG T180849	RA	12/17/2018	NFEJZ10/29/2018(2)
TRK 183713	10/29/2018	HILLSBORO	ND	NG T180848	RA	12/17/2018	NFEJZ10/29/2018(2)
TRK 183712	10/29/2018	HILLSBORO	ND	NG T180847	RA	12/17/2018	NFEJZ10/29/2018(2)
TRK 183711	10/29/2018	HILLSBORO	ND	NG T180846	RA	12/17/2018	NFEJZ10/29/2018(2)
TRK 183710	10/29/2018	HILLSBORO	ND	NG T180845	RA	12/17/2018	NFEJZ10/29/2018(2)
TRK 183709	10/29/2018	HILLSBORO	ND	NG T180844	RA	12/17/2018	NFEJZ10/29/2018(2)
TRK 183708	10/29/2018	HILLSBORO	ND	NG T180843	RA	12/17/2018	NFEJZ10/29/2018(2)
TRK 183707	10/29/2018	HILLSBORO	ND	NG T180842	RA	12/17/2018	NFEJZ10/29/2018(2)
TRK 183706	10/29/2018	HILLSBORO	ND	NG T180841	RA	12/17/2018	NFEJZ10/29/2018(2)
TRK 183705	10/29/2018	HILLSBORO	ND	NG T180840	RA	12/17/2018	NFEJZ10/29/2018(2)
TRK 183704	10/29/2018	HILLSBORO	ND	NG T180839	RA	12/17/2018	NFEJZ10/29/2018(2)
TRK 183703	10/29/2018	BUXTON	ND	NG T180838	RA	12/17/2018	NFEJZ10/29/2018(1)
TRK 183702	10/29/2018	BUXTON	ND	NG T180837	RA	12/17/2018	NFEJZ10/29/2018(1)
TRK 183701	10/29/2018	BUXTON	ND	NG T180836	RA	12/17/2018	NFEJZ10/29/2018(1)
TRK 183700	10/29/2018	BUXTON	ND	NG T180835	RA	12/17/2018	NFEJZ10/29/2018(1)
TRK 183699	10/29/2018	BUXTON	ND	NG T180834	RA	12/17/2018	NFEJZ10/29/2018(1)
TRK 183698	10/29/2018	BUXTON	ND	NG T180833	RA	12/17/2018	NFEJZ10/29/2018(1)
TRK 183697	10/29/2018	BUXTON	ND	NG T180832	RA	12/17/2018	NFEJZ10/29/2018(1)
TRK 183696	10/29/2018	BUXTON	ND	NG T180831	RA	12/17/2018	NFEJZ10/29/2018(1)
TRK 183695	10/29/2018	BUXTON	ND	NG T180830	RA	12/17/2018	NFEJZ10/29/2018(1)
TRK 183694	10/29/2018	BUXTON	ND	NG T180829	RA	12/17/2018	NFEJZ10/29/2018(1)
TRK 183693	10/29/2018	BUXTON	ND	NG T180828	RA	12/17/2018	NFEJZ10/29/2018(1)
TRK 183692	10/29/2018	BUXTON	ND	NG T180827	RA	12/17/2018	NFEJZ10/29/2018(1)

7.1. FAA Approvals Gardner, ND

TRK 183716 (NG T180851) Summary

Attribute	Record Parameter
Serial Number	NG T180851
Frequency	M5041.3125
City	GARDNER
State	ND
Transmitter Radius	9
Transmitter Latitude	471053.00N
Transmitter Longitude	0970341.00W
Antenna Height	0000
Receiver Latitude	471053.00N
Receiver Longitude	0970341.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLARRAY
Flight Level	
Runway Number	

TRK 183717 (NG T180852) Summary

Attribute	Record Parameter
Serial Number	NG T180852
Frequency	M5041.3125
City	GARDNER
State	ND
Transmitter Radius	9
Transmitter Latitude	471053.00N
Transmitter Longitude	0970341.00W
Antenna Height	0000
Receiver Latitude	471053.00N
Receiver Longitude	0970341.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	BLADE
Flight Level	
Runway Number	

Gardner, ND Ground and Aircraft Stations Channel 3 D1 5041.3125 MHz

TRK 183718 (NG T180853) Summary

Attribute	Record Parameter
Serial Number	NG T180853
Frequency	M5041.3975
City	GARDNER
State	ND
Transmitter Radius	9
Transmitter Latitude	473550.00N
Transmitter Longitude	0970508.00W
Antenna Height	0000
Receiver Latitude	473550.00N
Receiver Longitude	0970508.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLARRAY
Flight Level	
Runway Number	

TRK 183719 (NG T180854) Summary

Attribute	Record Parameter
Serial Number	NG T180854
Frequency	M5041.3975
City	GARDNER
State	ND
Transmitter Radius	9
Transmitter Latitude	473550.00N
Transmitter Longitude	0970508.00W
Antenna Height	0000
Receiver Latitude	473550.00N
Receiver Longitude	0970508.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	BLADE
Flight Level	
Runway Number	

Gardner, ND Ground and Aircraft Stations Channel 3 D2 5041.3975 MHz

Attachment – Form 442
FCC Experimental License

TRK 183719(NG T180855) Summary

Attribute	Record Parameter
Serial Number	NG T180855
Frequency	M5045.6125
City	GARDNER
State	ND
Transmitter Radius	9
Transmitter Latitude	473550.00N
Transmitter Longitude	0970508.00W
Antenna Height	0000
Receiver Latitude	473550.00N
Receiver Longitude	0970508.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	BLADE
Flight Level	
Runway Number	

TRK 183720 (NG T180855) Summary

Attribute	Record Parameter
Serial Number	NG T180855
Frequency	M5045.6125
City	GARDNER
State	ND
Transmitter Radius	9
Transmitter Latitude	473550.00N
Transmitter Longitude	0970508.00W
Antenna Height	0000
Receiver Latitude	473550.00N
Receiver Longitude	0970508.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLARRY
Flight Level	
Runway Number	

**Gardner, ND Ground and Aircraft Stations
Channel 23 D1 5045.6125 MHz**

TRK 183722 (NG T180857) Summary

Attribute	Record Parameter
Serial Number	NG T180857
Frequency	M5045.6975
City	GARDNER
State	ND
Transmitter Radius	9
Transmitter Latitude	473550.00N
Transmitter Longitude	0970508.00W
Antenna Height	0000
Receiver Latitude	473550.00N
Receiver Longitude	0970508.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLARRY
Flight Level	
Runway Number	

TRK 183723 (NG T180858) Summary

Attribute	Record Parameter
Serial Number	NG T180858
Frequency	M5045.6975
City	GARDNER
State	ND
Transmitter Radius	9
Transmitter Latitude	473550.00N
Transmitter Longitude	0970508.00W
Antenna Height	0000
Receiver Latitude	473550.00N
Receiver Longitude	0970508.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	BLADE
Flight Level	
Runway Number	

**Gardner, ND Ground and Aircraft Stations
Channel 23 D2 5045.6975 MHz**

Attachment – Form 442
FCC Experimental License

TRK 183724 (NG T180859) Summary

Attribute	Record Parameter
Serial Number	NG T180859
Frequency	M5049.0525
City	GARDNER
State	ND
Transmitter Radius	9
Transmitter Latitude	473550.00N
Transmitter Longitude	0970508.00W
Antenna Height	0000
Receiver Latitude	473550.00N
Receiver Longitude	0970508.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLARRY
Flight Level	
Runway Number	

TRK 183725 (NG T180860) Summary

Attribute	Record Parameter
Serial Number	NG T180860
Frequency	M5049.0525
City	GARDNER
State	ND
Transmitter Radius	9
Transmitter Latitude	473550.00N
Transmitter Longitude	0970508.00W
Antenna Height	0000
Receiver Latitude	473550.00N
Receiver Longitude	0970508.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	BLADE
Flight Level	
Runway Number	

**Gardner, ND Ground and Aircraft Stations
Channel 39 D1 5049.0525 MHz**

TRK 183726 (NG T180861) Summary

Attribute	Record Parameter
Serial Number	NG T180861
Frequency	M5049.1375
City	GARDNER
State	ND
Transmitter Radius	9
Transmitter Latitude	473550.00N
Transmitter Longitude	0970508.00W
Antenna Height	0000
Receiver Latitude	473550.00N
Receiver Longitude	0970508.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLARRY
Flight Level	
Runway Number	

TRK 183727 (NG T180862) Summary

Attribute	Record Parameter
Serial Number	NG T180862
Frequency	M5049.1375
City	GARDNER
State	ND
Transmitter Radius	9
Transmitter Latitude	473550.00N
Transmitter Longitude	0970508.00W
Antenna Height	0000
Receiver Latitude	473550.00N
Receiver Longitude	0970508.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	BLADE
Flight Level	
Runway Number	

**Gardner, ND Ground and Aircraft Stations
Channel 39 D2 5049.1375 MHz**

7.2. FAA Approvals Hillsboro ND

TRK 183704 (NG T180839) Summary

Attribute	Record Parameter
Serial Number	NG T180839
Frequency	M5041.3125
City	HILLSBORO
State	ND
Transmitter Radius	9
Transmitter Latitude	472128.00N
Transmitter Longitude	0973438.00W
Antenna Height	0000
Receiver Latitude	472128.00N
Receiver Longitude	0973438.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLARRAY
Flight Level	
Runway Number	

TRK 183705 (NG T180840) Summary

Attribute	Record Parameter
Serial Number	NG T180840
Frequency	M5041.3125
City	HILLSBORO
State	ND
Transmitter Radius	9
Transmitter Latitude	472128.00N
Transmitter Longitude	0973438.00W
Antenna Height	0000
Receiver Latitude	472128.00N
Receiver Longitude	0973438.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	BLADE
Flight Level	
Runway Number	

Hillsboro, ND Ground and Aircraft Stations Channel 3 D1 5041.3125 MHz

TRK 183706 (NG T180841) Summary

Attribute	Record Parameter
Serial Number	NG T180841
Frequency	M5041.3975
City	HILLSBORO
State	ND
Transmitter Radius	9
Transmitter Latitude	472128.00N
Transmitter Longitude	0973438.00W
Antenna Height	0000
Receiver Latitude	472128.00N
Receiver Longitude	0973438.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLARRAY
Flight Level	
Runway Number	

TRK 183707 (NG T180842) Summary

Attribute	Record Parameter
Serial Number	NG T180842
Frequency	M5041.3975
City	HILLSBORO
State	ND
Transmitter Radius	9
Transmitter Latitude	472128.00N
Transmitter Longitude	0973438.00W
Antenna Height	0000
Receiver Latitude	472128.00N
Receiver Longitude	0973438.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	BLADE
Flight Level	
Runway Number	

Hillsboro, ND Ground and Aircraft Stations Channel 3 D2 5041.3975 MHz

Attachment – Form 442
FCC Experimental License

TRK 183710 (NG T180845) Summary

Attribute	Record Parameter
Serial Number	NG T180845
Frequency	M5045.6125
City	HILLSBORO
State	ND
Transmitter Radius	9
Transmitter Latitude	472128.00N
Transmitter Longitude	0973438.00W
Antenna Height	0000
Receiver Latitude	472128.00N
Receiver Longitude	0973438.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLARRAY
Flight Level	
Runway Number	

TRK 183711 (NG T180846) Summary

Attribute	Record Parameter
Serial Number	NG T180846
Frequency	M5045.6125
City	HILLSBORO
State	ND
Transmitter Radius	9
Transmitter Latitude	472128.00N
Transmitter Longitude	0973438.00W
Antenna Height	0000
Receiver Latitude	472128.00N
Receiver Longitude	0973438.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	BLADE
Flight Level	
Runway Number	

**Hillsboro, ND Ground and Aircraft Stations
Channel 23 D1 5045.6125 MHz**

TRK 183708 (NG T180843) Summary

Attribute	Record Parameter
Serial Number	NG T180843
Frequency	M5045.6975
City	HILLSBORO
State	ND
Transmitter Radius	9
Transmitter Latitude	472128.00N
Transmitter Longitude	0973438.00W
Antenna Height	0000
Receiver Latitude	472128.00N
Receiver Longitude	0973438.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLARRAY
Flight Level	
Runway Number	

TRK 183709 (NG T180844) Summary

Attribute	Record Parameter
Serial Number	NG T180844
Frequency	M5045.6975
City	HILLSBORO
State	ND
Transmitter Radius	9
Transmitter Latitude	472128.00N
Transmitter Longitude	0973438.00W
Antenna Height	0000
Receiver Latitude	472128.00N
Receiver Longitude	0973438.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	BLADE
Flight Level	
Runway Number	

**Hillsboro, ND Ground and Aircraft Stations
Channel 23 D2 5045.6975 MHz**

Attachment – Form 442
FCC Experimental License

TRK 183712 (NG T180847) Summary

Attribute	Record Parameter
Serial Number	NG T180847
Frequency	M5049.0525
City	HILLSBORO
State	ND
Transmitter Radius	9
Transmitter Latitude	472128.00N
Transmitter Longitude	0973438.00W
Antenna Height	0000
Receiver Latitude	472128.00N
Receiver Longitude	0973438.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLARRAY
Flight Level	
Runway Number	

TRK 183713(NG T180855) Summary

Attribute	Record Parameter
Serial Number	NG T180855
Frequency	M5045.0525
City	GARDNER
State	ND
Transmitter Radius	9
Transmitter Latitude	473550.00N
Transmitter Longitude	0970508.00W
Antenna Height	0000
Receiver Latitude	473550.00N
Receiver Longitude	0970508.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	BLADE
Flight Level	
Runway Number	

**Hillsboro, ND Ground and Aircraft Stations
Channel 39 D1 5045.0525 MHz**

TRK 183714 (NG T180849) Summary

Attribute	Record Parameter
Serial Number	NG T180849
Frequency	M5049.1375
City	HILLSBORO
State	ND
Transmitter Radius	9
Transmitter Latitude	472128.00N
Transmitter Longitude	0973438.00W
Antenna Height	0000
Receiver Latitude	472128.00N
Receiver Longitude	0973438.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLARRAY
Flight Level	
Runway Number	

TRK 183715 (NG T180850) Summary

Attribute	Record Parameter
Serial Number	NG T180850
Frequency	M5049.1375
City	HILLSBORO
State	ND
Transmitter Radius	9
Transmitter Latitude	472128.00N
Transmitter Longitude	0973438.00W
Antenna Height	0000
Receiver Latitude	472128.00N
Receiver Longitude	0973438.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	BLADE
Flight Level	
Runway Number	

**Hillsboro, ND Ground and Aircraft Stations
Channel 39 D2 5045.1375 MHz**

7.3. FAA Approvals Buxton, ND

TRK 183693 (NG T180828) Summary

Attribute	Record Parameter
Serial Number	NG T180828
Frequency	M5041.3125
City	BUXTON
State	ND
Transmitter Radius	9
Transmitter Latitude	473550.00N
Transmitter Longitude	0970515.00W
Antenna Height	0000
Receiver Latitude	473550.00N
Receiver Longitude	0970515.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	BLADE
Flight Level	
Runway Number	

TRK 183692 (NG T180827) Summary

Attribute	Record Parameter
Serial Number	NG T180827
Frequency	M5041.3125
City	BUXTON
State	ND
Transmitter Radius	9
Transmitter Latitude	473550.00N
Transmitter Longitude	0970515.00W
Antenna Height	0000
Receiver Latitude	473550.00N
Receiver Longitude	0970515.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLARRAY
Flight Level	
Runway Number	

Buxton, ND Ground and Aircraft Stations Channel 3 D1 5041.3125 MHz

TRK 183695 (NG T180830) Summary

Attribute	Record Parameter
Serial Number	NG T180830
Frequency	M5041.3975
City	BUXTON
State	ND
Transmitter Radius	9
Transmitter Latitude	473550.00N
Transmitter Longitude	0970515.00W
Antenna Height	0000
Receiver Latitude	473550.00N
Receiver Longitude	0970515.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	BLADE
Flight Level	
Runway Number	

TRK 183694 (NG T180829) Summary

Attribute	Record Parameter
Serial Number	NG T180829
Frequency	M5041.3975
City	BUXTON
State	ND
Transmitter Radius	9
Transmitter Latitude	473550.00N
Transmitter Longitude	0970515.00W
Antenna Height	0000
Receiver Latitude	473550.00N
Receiver Longitude	0970515.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLARRAY
Flight Level	
Runway Number	

Buxton, ND Ground and Aircraft Stations Channel 3 D2 5041.3975 MHz

Attachment – Form 442
FCC Experimental License

TRK 183697 (NG T180832) Summary

Attribute	Record Parameter
Serial Number	NG T180832
Frequency	M5045.6125
City	BUXTON
State	ND
Transmitter Radius	9
Transmitter Latitude	473550.00N
Transmitter Longitude	0970515.00W
Antenna Height	0000
Receiver Latitude	473550.00N
Receiver Longitude	0970515.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	BLADE
Flight Level	
Runway Number	

TRK 183696 (NG T180831) Summary

Attribute	Record Parameter
Serial Number	NG T180831
Frequency	M5045.6125
City	BUXTON
State	ND
Transmitter Radius	9
Transmitter Latitude	473550.00N
Transmitter Longitude	0970515.00W
Antenna Height	0000
Receiver Latitude	473550.00N
Receiver Longitude	0970515.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLEARRY
Flight Level	
Runway Number	

**Buxton, ND Ground and Aircraft Stations
Channel 23 D1 5045.6125 MHz**

TRK 183699 (NG T180834) Summary

Attribute	Record Parameter
Serial Number	NG T180834
Frequency	M5045.6975
City	BUXTON
State	ND
Transmitter Radius	9
Transmitter Latitude	473550.00N
Transmitter Longitude	0970515.00W
Antenna Height	0000
Receiver Latitude	473550.00N
Receiver Longitude	0970515.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	BLADE
Flight Level	
Runway Number	

TRK 183698 (NG T180833) Summary

Attribute	Record Parameter
Serial Number	NG T180833
Frequency	M5045.6975
City	BUXTON
State	ND
Transmitter Radius	9
Transmitter Latitude	473550.00N
Transmitter Longitude	0970515.00W
Antenna Height	0000
Receiver Latitude	473550.00N
Receiver Longitude	0970515.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLEARRY
Flight Level	
Runway Number	

**Buxton, ND Ground and Aircraft Stations
Channel 23 D2 5045.6975 MHz**

Attachment – Form 442
FCC Experimental License

TRK 183700 (NG T180835) Summary

Attribute	Record Parameter
Serial Number	NG T180835
Frequency	M5049.0525
City	BUXTON
State	ND
Transmitter Radius	9
Transmitter Latitude	473550.00N
Transmitter Longitude	0970515.00W
Antenna Height	0000
Receiver Latitude	473550.00N
Receiver Longitude	0970515.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLARRY
Flight Level	
Runway Number	

TRK 183701 (NG T180836) Summary

Attribute	Record Parameter
Serial Number	NG T180836
Frequency	M5049.0525
City	BUXTON
State	ND
Transmitter Radius	9
Transmitter Latitude	473550.00N
Transmitter Longitude	0970515.00W
Antenna Height	0000
Receiver Latitude	473550.00N
Receiver Longitude	0970515.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	BLADE
Flight Level	
Runway Number	

**Buxton, ND Ground and Aircraft Stations
Channel 39 D1 5045.0525 MHz**

TRK 183702 (NG T180837) Summary

Attribute	Record Parameter
Serial Number	NG T180837
Frequency	M5049.1375
City	BUXTON
State	ND
Transmitter Radius	9
Transmitter Latitude	473550.00N
Transmitter Longitude	0970515.00W
Antenna Height	0000
Receiver Latitude	473550.00N
Receiver Longitude	0970515.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLARRY
Flight Level	
Runway Number	

TRK 183703 (NG T180838) Summary

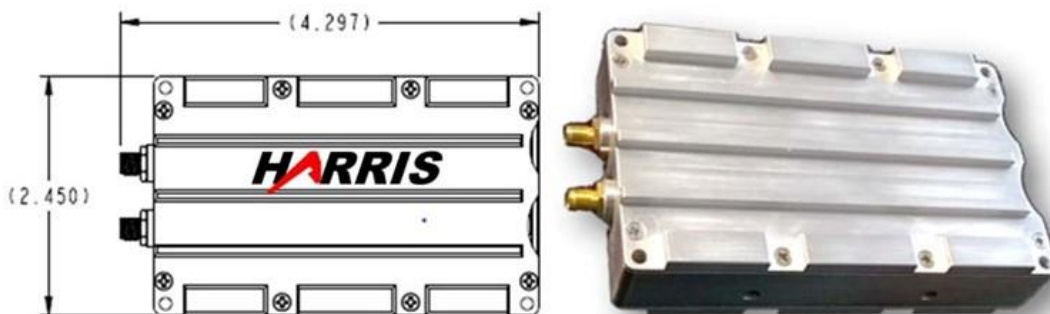
Attribute	Record Parameter
Serial Number	NG T180838
Frequency	M5049.1375
City	BUXTON
State	ND
Transmitter Radius	9
Transmitter Latitude	473550.00N
Transmitter Longitude	0970515.00W
Antenna Height	0000
Receiver Latitude	473550.00N
Receiver Longitude	0970515.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	BLADE
Flight Level	
Runway Number	

**Hillsboro, ND Ground and Aircraft Stations
Channel 39 D2 5045.1375 MHz**

8. Harris CNPC Airborne (Mobile) Radio

The Harris CNPC radio is a Software Defined Radio (SDR) that has been guided by the evolution of UAS Industry Standards and our participation in SC-228, RTCA MOPs and RTCA DO-362. Our CNPC Radio implementation incorporates quad core processors, the latest generation Field Programmable Gate Array (FPGA), and a state of the art programmable frequency agile transceiver. The radio is a Technology Readiness Level of 7 and sufficiently mature to support Experimental Tests and demonstrations.

The Harris CNPC radio supports the C-band spectrum approved by the FAA for UAS CNPC radio use. The radio has 2 RF SMA Connectors to support the option of 2 Spatial Diversity antennas, required to mitigate against multipath propagation losses, reducing Bit Error Rates, and improving overall link performance. The radio also includes a connector J1 main interface, providing DC Power Input, USB, Ethernet, RS-232, etc. and a J2 camera interface, providing video inputs.



Harris CNPC (Mobile) UAV Radio

A web-based Graphical User Interface (GUI) is used to configure the radio. The radio control screen allows the operator to configure both ends of the link. A health and status monitoring feature is available via the GUI as well.

9. Harris CNPC (Fixed) Base Radio System

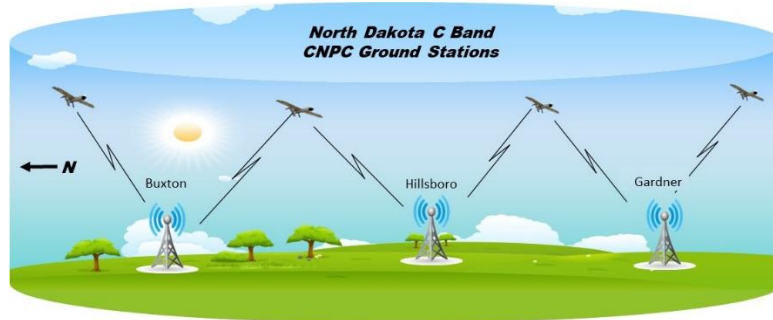
The Harris ground radio system includes a Harris CNPC radio, RF power amplifier (RFPA), and DC power supply. The RFPA increases the RF Power to 10 watts (40 dBm), which fulfills the need to close the CNPC Link with sufficient margin (12dB), while capable of supporting a minimum data rate of 20 kbps throughout all phases of planned UAV flight.

For the North Dakota Experimental License we plan on using a COTS omnidirectional C-band antenna with a gain of 1 dBi. The CNPC ground radio system will be housed in a NEMA enclosure and mounted on existing radio towers at Gardner, Hillsboro and Buxton, North Dakota.

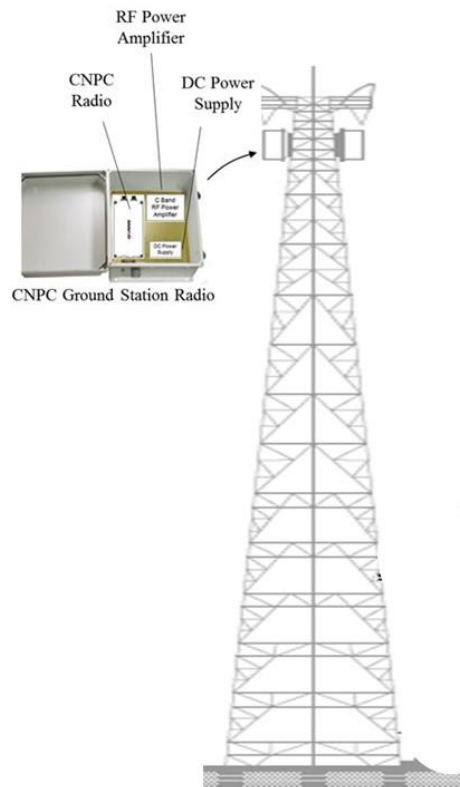
The Harris CNPC Base Station will be configured as shown in the figure below:

10. Automatic Handover Between Ground Stations

One of the most important challenges for the UAS Industry in developing a Beyond Visual Line of Sight (BVLOS) network is the ability to automatically connect the UAV without interruption of data by establishing a “*Make - Before - Break*” connection between Ground Stations.



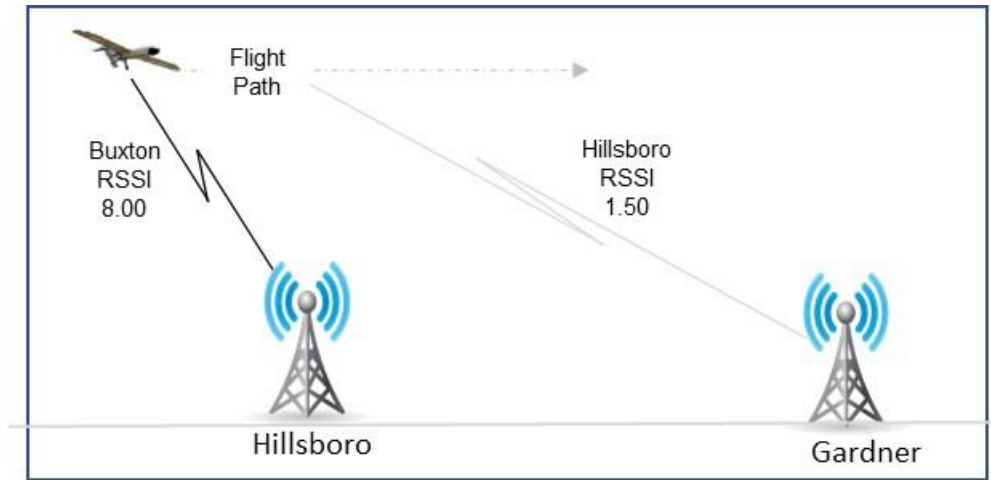
Harris CNPC Ground Stations in North Dakota



Harris CNPC Tower Installation

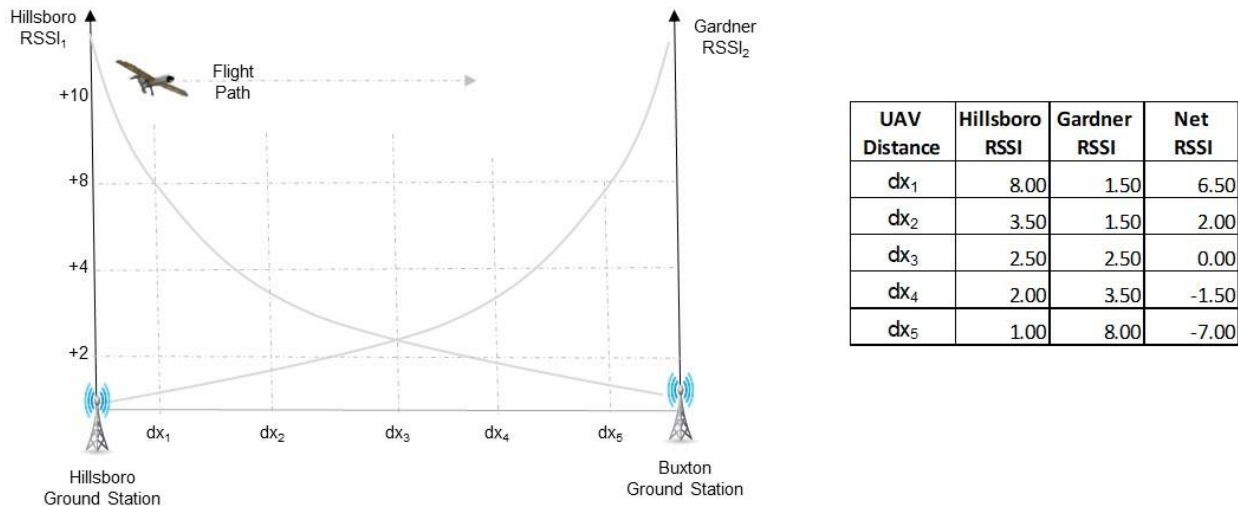
The continuation and expansion of the original “*Harris Experiment*” in Malabar, FL. into North Dakota will focus on methodologies and processes to enable automatic handovers between Buxton, Hillsboro and Gardner to support BVLOS operations. Various software switching techniques and algorithms including those predicated on measuring and comparing Receive Signal Strength Indications (RSSI) between Ground Stations and UAVs will be evaluated. The

efficacy of various algorithms will be evaluated including those based on predicted and measured data to ensure link integrity throughout the UAS flight.



Simplistic View, UAV Flight from Hillsboro to Gardner

The Harris CNPC Network will continuously monitor all TCP/IP, or the Transmission Control Protocol/Internet Protocol connections between the UAV and all CNPC Ground Stations within sight. Each nodal connection and the corresponding RSSI will be monitored in real time to determine the “*Best Quality*” connection available.



Network Controlled Hand Over (NCHO) via Differential RSSI

In the above example, the UAV is flying from Hillsboro to Gardner with notional RSSIs being recorded throughout the flight. The Hillsboro RSSI₁ at location dx_1 is 6.50 RSSI units greater than the Gardner RSSI₂ which results in the Hillsboro Ground Station remaining connected to

the UAV. This (UAV to RSSI₁) connection continues until the (Gardner RSSI₂ > Hillsboro RSSI₁) by some (TBD) predetermined RSSI level.

Our North Dakota experiment will perform multiple UAV Flight Tests throughout the coverage area to determine the optimum switchover point between towers and to ensure parameters such as switching latency between towers has minimal impact on UAS BVLOS operations.

11. Unmanned Air Vehicle (UAV) Mobile Antenna

We will evaluate several small form factor blade antennas, that are certified for aircraft use that are vertically polarized, low gain (<3 dBi), omnidirectional, with elevation patterns that are near-hemispherical in coverage such as the Octane and Taoglas mini-UAV antennas shown below:

1. Octane www.octanewireless.com Model AU-800-6000 shown below:

Multiband Antenna for Mini UAVs



Features and Benefits

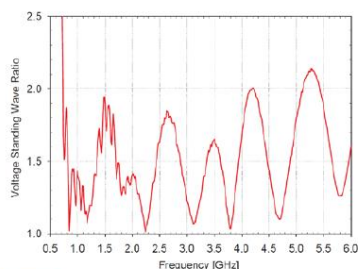
- UHF Operation
- Small & Thin
 - Aerodynamic
- Lightweight
 - Less than 75 grams!

Pharad's *octane*® Mini UAV antennas are the highest performing light weight antennas available for small UAV applications. Weighing only 75 grams, these antennas provide broadband operation from UHF through C-band. No other lightweight UAV antenna provides a single solution for such a variety of UAV communications equipment.

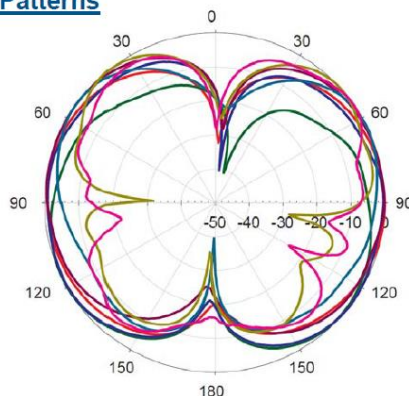
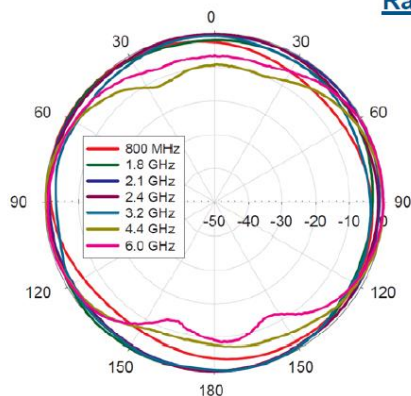
Characteristics

Model #	AU-800-6000
Frequency	800 – 6000 MHz
Gain	2.4 dBi @ 800 MHz 4.3 dBi @ 1500 MHz 5.0 dBi @ 6000 MHz
VSWR	< 2:1 800 – 4400 MHz < 2.2:1 4400 – 6000 MHz
Maximum Power	10 Watts
Pattern	Near omni
Polarization	Vertical
Radiator Size (H x W x L)	5.1" x 0.9" x 4.5"
Weight	75 grams
Connector Type	SMA

Typical VSWR



Radiation Patterns



2. Taoglas WCM.10.005QQ111

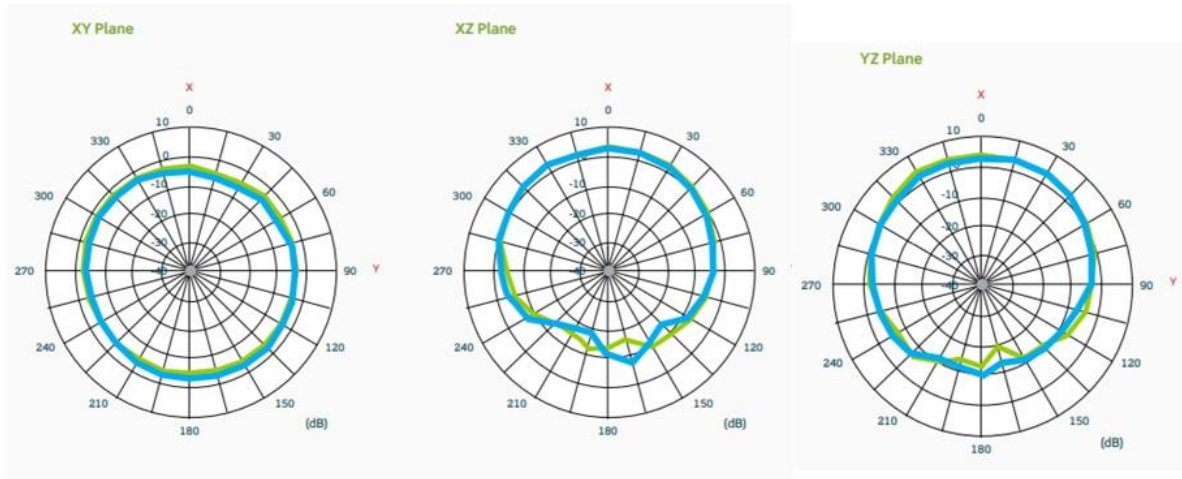


- Designed for UAV / Drone Applications
- Connector Mount
- Right Hand Circularly Polarized
- IP67 Rating
- Dimensions: 30.7x34.9x17mm
- Cable: 50mm SS402 Coaxial Cable
- Connector: RP-SMA(M)

Part No: **WCM.10.005QQ111**

Description: Stratus 5-5.8GHz 3dBi
SMA(M) Connector Mount Antenna
with Semi-Rigid Flexiform 402 Cable

<https://cdn.taoglas.com/datasheets/WCM.10.005QQ111.pdf>



Typical UAV (Mobile Antenna)

12. CNPC (Fixed) Base Station Antenna

We will also evaluate several base station antennas, that are certified are vertically polarized, low gain (<3 dBi), omnidirectional, with elevation patterns that are near-hemispherical in coverage such as the Aruba and Southwest Antennas shown below:

12.1. Aruba Base Station Antenna

ANT-2x2-5010 is a kit of two omnidirectional antennas for use in 802.11n MIMO mesh link and client access applications. The kit contains

2 differently polarized antennas to be used as a 2x2 MIMO pair, and provides coverage in the 4.9 – 5.875 GHz frequency band.

FREQUENCY/MAX GAIN

- 4.9 – 5.875 GHz (10dBi)

POLARIZATION

- Vpol antenna: linear, vertical
- Hpol antenna: linear, horizontal

BEAMWIDTH

- E-plane: 8 degrees (Vpol antenna), 9.5 degrees (Hpol antenna)
- H-plane: 360 degrees

IMPEDANCE

- 50 ohms

MAXIMUM INPUT POWER

- 10 watts

VSWR (MINIMUM PERFORMANCE)

- 2.0:1

DIMENSIONS

- 490 x 25 x 25 (Vpol), 451 x 25 x 25 (Hpol)

WEIGHT

- 400 (Vpol), 180 (Hpol)

HOUSING

- Radome: Polycarbonate, UV, White

CONNECTOR

- N-type male (Note: RF cables not included)

OPERATING / STORAGE TEMP.

- -30C to +70C (operating), -40C to +85C (storage)

MOUNTING STYLE

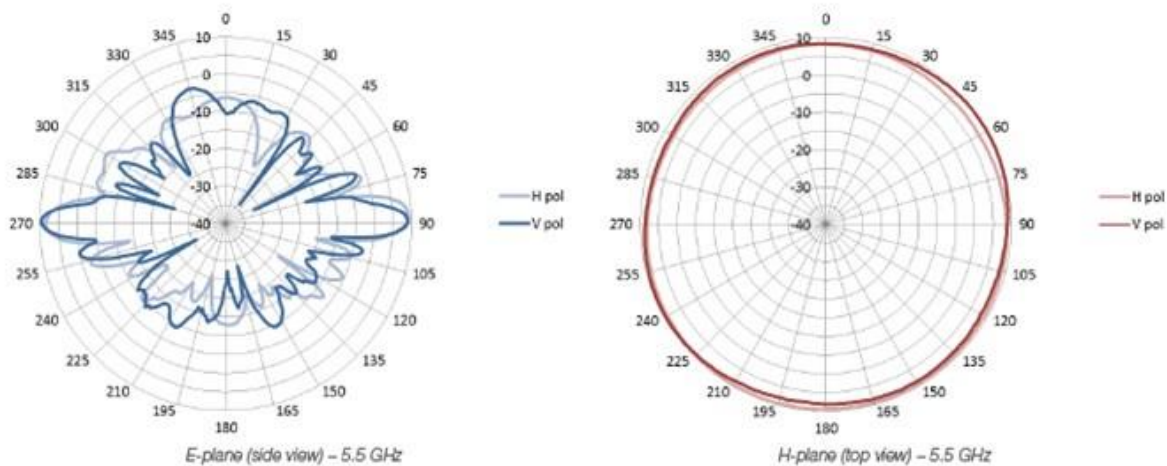
- Direct mount on AP or pole mount

INSTALLATION HARDWARE

- Pole mount kit included.



Aruba Antenna -2x2-5010



Aruba Antenna Patterns

Attachment – Form 442
FCC Experimental License

12.2. Southwest Antenna Part # 1032-012

Features:

- Broad Band Coverage
- 4.7 - 5.2 GHz
- RHCP
- 3 dBic Omni Radiation Pattern
- Rugged G10 Radome, Flat Black
- Black Chrome N(m) RF Connector



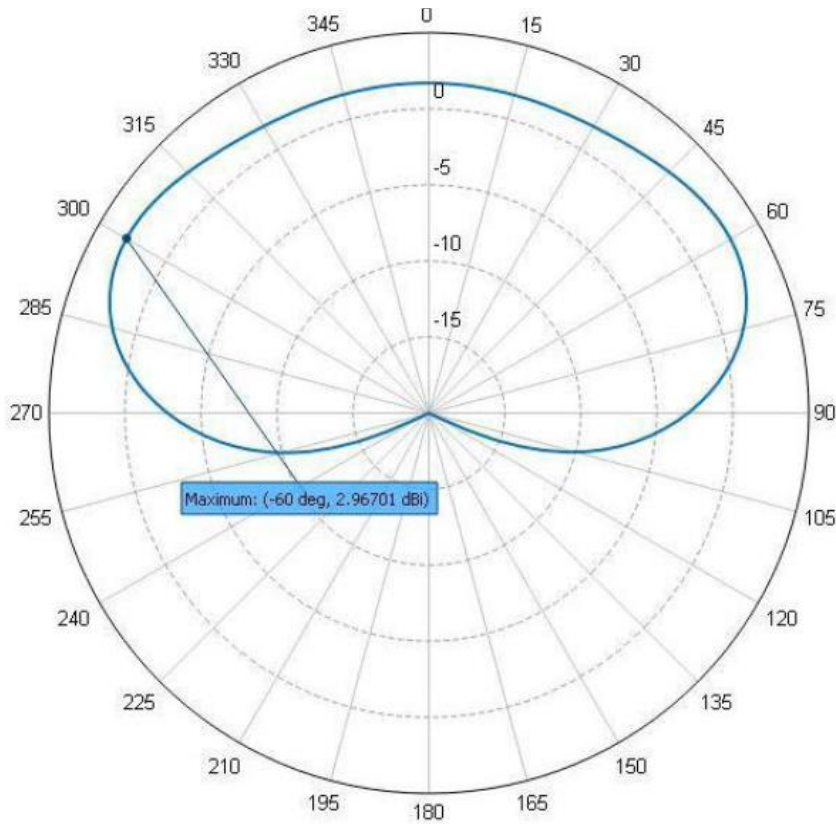
Southwest Antenna
Omni Bifilar Antenna, Circularly Polarized, 4.7 - 5.2 GHz, 3 dBic

Antenna Specifications

Parameter	Value	Units	Tolerance
Antenna Pattern	Omni Antenna		
Frequency Band	C		
Impedance	50	Ohms	
Minimum Frequency	4.7 / 4,700	GHz / MHz	
Maximum Frequency	5.2 / 5,200	GHz / MHz	
Frequency Bandwidth	0.5 / 500	GHz / MHz	
Maximum VSWR	2:1	Ratio	
Gain	3.00	dBic	
Horizontal (AZ) Beamwidth	360	Degrees	
Vertical (EL) Beamwidth	158	Degrees	
Ground Plane Required	No		
Radome Material	G10 Fiberglass		

Southwest Antenna – Key Parameters

Attachment – Form 442
FCC Experimental License



Southwest Antenna – Elevation Pattern

FCC OET Experimental License System (ELS)

FCC FORM 442 - FEDERAL COMMUNICATIONS COMMISSION
APPLICATION FOR NEW OR MODIFIED RADIO STATION UNDER PART 5 OF FCC RULES - EXPERIMENTAL RADIO SERVICE (OTHER THAN BROADCAST)

Approved by OMB
3060 - 0065
Expires 09/30/98

Applicant's Name (company): Harris Corporation File No.: 0572-EX-CN-2019

Mailing Address

Attention: James J Ziarno
Street Address: 1025 West NASA Blvd
P.O. Box:
City: Melbourne
State: FL
Country:
Zip Code: 32902
E-Mail Address: jziarno@harris.com

Application Purpose

Application is for: NEW LICENSE

For Modification Indicate below

File No.: Callsign:

Government Contract

Is this authorization to be used for fulfilling the requirement of a government contract with an agency of the United States Government? If "YES", include as an exhibit a narrative statement describing the government project, agency and contract number.
No

Foreign Government Use

Is this authorization to be used for the exclusive purpose of developing radio equipment for export to be employed by stations under the jurisdiction of a foreign government? If "YES", include the contract number and the name of the foreign government concerned as an exhibit. No

Research Project

Is this authorization to be used for providing communications essential to a research project? (The radio communication is not the objective of the research project)? If "YES", include as an exhibit the following information:

- A description of the nature of the research project being conducted.
- A showing that the communications facilities requested are necessary for the research project involved.
- A showing that existing communications facilities are inadequate.

Yes

Attachment – Form 442

FCC Experimental License

Exhibit Information

If all the answers to Items 4, 5, 6 are "NO", include as an exhibit a narrative statement describing in detail the following items:

- The complete program of research and experimentation proposed including description of equipment and theory of operation.
- The specific objectives sought to be accomplished.
- How the program of experimentation has a reasonable promise of contribution to the development, extension, expansion or utilization of the radio art, or is along line not already investigated.

Estimated Duration

Give an estimate of the length of time that will be required to complete the program of experimentation proposed in this application: 24 Months

Environmental Impact

Would a commission grant of this application come within Section 1.1307 of the FCC Rules, such that it may have a significant environmental impact? If "YES", include as an exhibit an Environmental Assessment as required by Section 1.1311. No

Manufacturer

List below transmitting equipment to be installed (if experimental, so state) if additional rows are required, please submit equipment list as an exhibit :

Manufacturer	Model Number	No. Of Units	Experimental
Harris Corporation	HRS102721-001	10	Yes

Station ID

Is the equipment listed in Item 10 capable of station identification pursuant to Section 5.115? No

Applicant Type

Applicant is: Corporation

Foreign Government

Is applicant a foreign government or a representative of a foreign government? No

License Denied or Revoked

Has applicant or any party to this application had any FCC station license or permit revoked or any application for permit, license or renewal denied by this Commission?

If "YES", include as an exhibit a statement giving call sign of license or permit revoked and relate circumstances. No

Owner and Operator

Will applicant be owner and operator of the station? Yes

Contact Information

Give the following information of person who can best handle inquiries pertaining to this application: First Name: James

Last Name: Ziarno
Title: Director of Technology, Commercial UAS Solutions
Phone Number: 321-309-6130
E-Mail Address: jziarno@harris.com

Drug Abuse Question

APPLICANT ANTI-DRUG ABUSE CERTIFICATION: By checking "YES", the individual applicant certifies that he or she is eligible for this license. This requires that he or she is not subject to a denial of federal benefits, including FCC benefits, as a result of a drug offense conviction pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 862. A non-individual applicant, e.g., corporation, partnership or other unincorporated association, certifies that no party to the application is subject to a denial of federal benefits, pursuant to that section. For definition of a "party" for these purposes, see 47CFR 1.2002(b). Yes

Certification

THE APPLICANT CERTIFIES THAT:

- Copies of the FCC Rule Parts 2 and 5 are on hand; and
- Adequate financial appropriations have been made to carry on the program of experimentation which will be conducted by qualified personnel; and
- All operations will be on an experimental basis in accordance with Part 5 and other applicable rules, and will be conducted in such a manner and at such a time as to preclude harmful interference to any authorized station; and
- Grant of the authorization requested herein will not be construed as a finding on the part of the Commission:
 - that the frequencies and other technical parameters specified in the authorization are the best suited for the proposed program of experimentation, and
 - that the applicant will be authorized to operate on any basis other than experimental, and
 - that the Commission is obligated by the results of the experimental program to make provision in its rules including its table of frequency allocations for applicant's type of operation on a regularly licensed basis.

THE APPLICANT FURTHER CERTIFIES THAT:

- All the statements in the application and attached exhibits are true, complete and correct to the best of the applicant's knowledge; and
- The applicant is willing to finance and conduct the experimental program with full knowledge and understanding of the above limitations; and
- The applicant waives any claim to the use of any particular frequency or of the electromagnetic spectrum as against the regulatory power of the USA.

Name of Applicant: Harris Corporation

Signature (Authorized person filing form): James Ziarno

Signature Date (Authorized person filing form): 07/17/2019

Title of Person Signing Application: UAS Commercial Solutions, Director of Technology

Classification: Authorized employee

WILLFUL FALSE STATEMENTS MADE ON THIS FORM ARE PUNISHABLE BY FINE AND/OR IMPRISONMENT (U.S. CODE, TITLE 18, SECTION 1001), AND/OR REVOCATION OF ANY STATION LICENSE OR CONSTRUCTION PERMIT (U.S. CODE, TITLE 47, SECTION 312(A)(1)), AND/OR FORFEITURE (U.S. CODE, TITLE 47, SECTION 303).

NOTIFICATION TO INDIVIDUALS UNDER PRIVACY ACT OF 1974 AND THE PAPERWORK REDUCTION ACT OF 1980

Information requested through this form is authorized by the Communications Act of 1934, as amended, and specified by Section 308 therein. The information will be used by Federal Communications Commission staff to determine eligibility for issuing authorizations in the use of the frequency spectrum and to effect the provisions of regulatory responsibilities rendered by the Commission by the Act. Information requested by this form will be available to the public unless otherwise requested pursuant to 47 CFR 0.459 of the FCC Rules and Regulations. Your response is required to obtain this authorization.

Public reporting burden for this collection of information is estimated to average four (4) hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden to the Federal Communications Commission, Records Management Branch, Paperwork Reduction Project (3060-0065), Washington DC 20554. DO NOT send completed applications to this address. Individuals are not required to respond to this collection unless it displays a currently valid OMB control number.

THE FOREGOING NOTICE IS REQUIRED BY THE PRIVACY ACT OF 1974, P.L. 93-579, DECEMBER 31, 1974, 5 U.S.C. 552a(e)(3), AND THE PAPERWORK REDUCTION ACT OF 1980, P.L. 96-511, DECEMBER 11, 1980, 44 U.S.C. 3507.

Attachment – Form 442
FCC Experimental License

Station Location

City State Latitude Longitude Mobile Street (or other indication of location) County Radius of Operation
0 Malabar Florida North 27 58 53 West 80 33 20 Max altitude 400 ft. AGL 2800 Jordan Blvd, Malabar, FL 32950 17.00 km

Datum: NAD 83

Is a directional antenna (other than radar) used? No

Exhibit submitted: No

(a) Width of beam in degrees at the half-power point:

(b) Orientation in horizontal plane (degrees from True North):

(c) Orientation in vertical plane (degrees from horizontal):

Will the antenna extend more than 6 meters above the ground, or if mounted on an existing building, will it extend more than 6 meters above the building, or will the proposed antenna be mo

(a) Overall height above ground to tip of antenna in meters: 5.00

(b) Elevation of ground at antenna site above mean sea level in meters:

(c) Distance to nearest aircraft landing area in kilometers:

(d) List any natural formations of existing man-made structures (hills, trees, water tanks, towers, etc.) which, in the opinion of the applicant, would tend to shield the antenna from aircraft:

Action Frequency	Station Class	Output Power/ERP	Mean Peak Frequency Tolerance (+/-)	Emission Designator	Modulating Signal
New 5041.31250000- MHz FX		10.000000 W 10.000000 W P	0.01000000 %	85K0G2D	20 kbps
Action Frequency	Station Class	Output Power/ERP	Mean Peak Frequency Tolerance (+/-)	Emission Designator	Modulating Signal
New 5041.31250000- MHz MO		1.000000 W 1.000000 W P	0.01000000 %	85K0G2D	20 kbps
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Action Frequency	Station Class	Output Power/ERP	Mean Peak Frequency Tolerance (+/-)	Emission Designator	Modulating Signal
New 5049.05250000- MHz FX		10.000000 W 10.000000 W P	0.01000000 %	85K0G2D	20 kbps
Action Frequency	Station Class	Output Power/ERP	Mean Peak Frequency Tolerance (+/-)	Emission Designator	Modulating Signal
New 5049.05250000- MHz MO		1.000000 W 1.000000 W P	0.01000000 %	85K0G2D	20 kbps
Action Frequency	Station Class	Output Power/ERP	Mean Peak Frequency Tolerance (+/-)	Emission Designator	Modulating Signal
New 5049.13750000- MHz FX		10.000000 W 10.000000 W P	0.01000000 %	85K0G2D	20 kbps
Action Frequency	Station Class	Output Power/ERP	Mean Peak Frequency Tolerance (+/-)	Emission Designator	Modulating Signal
New 5049.13750000- MHz MO		1.000000 W 1.000000 W P	0.01000000 %	85K0G2D	20 kbps

City State Latitude Longitude Mobile Street (or other indication of location) County Radius of Operation
0 Hillsboro North Dakota North 47 10 53 West 97 3 41 Max altitude 400 ft. AGL Lat/Long: 47.357665, -97.062157 TRAILL 17.00 km

Datum: NAD 83

Is a directional antenna (other than radar) used? No

Exhibit submitted: No

(a) Width of beam in degrees at the half-power point:

(b) Orientation in horizontal plane (degrees from True North):

(c) Orientation in vertical plane (degrees from horizontal):

Will the antenna extend more than 6 meters above the ground, or if mounted on an existing building, will it extend more than 6 meters above the building, or will the proposed antenna be m

(a) Overall height above ground to tip of antenna in meters: 12.19

(b) Elevation of ground at antenna site above mean sea level in meters: 908.00

(c) Distance to nearest aircraft landing area in kilometers: 0.15

(d) List any natural formations of existing man-made structures (hills, trees, water tanks, towers, etc.) which, in the opinion of the applicant, would tend to shield the antenna from aircraft:
ensure our antenna installation complies with all applicable regulations.

Action Frequency	Station Class	Output Power/ERP	Mean Peak Frequency Tolerance (+/-)	Emission Designator	Modulating Signal
New 5041.31250000- MHz FX		10.000000 W 10.000000 W P	0.01000000 %	85K0G2D	20 kbps
Action Frequency	Station Class	Output Power/ERP	Mean Peak Frequency Tolerance (+/-)	Emission Designator	Modulating Signal
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New 5049.13750000- MHz MO		1.000000 W 1.000000 W P	0.01000000 %	85K0G2D	20 kbps

Attachment – Form 442
FCC Experimental License

City	State	Latitude	Longitude	Mobile	Street (or other indication of location)	County	Radius of Operation
0 Buxton	North Dakota	North 47 35 50	West 97 5 15	Max altitude 400 ft. AGL	Within 16 KM of Base Station	TRAILL	16.00 km
Datum: NAD 83							
Is a directional antenna (other than radar) used? No							
Exhibit submitted: No							
(a) Width of beam in degrees at the half-power point:							
(b) Orientation in horizontal plane (degrees from True North):							
(c) Orientation in vertical plane (degrees from horizontal):							
Will the antenna extend more than 6 meters above the ground, or if mounted on an existing building, will it extend more than 6 meters above the building, or will the proposed antenna be mo							
(a) Overall height above ground to tip of antenna in meters: 21.30							
(b) Elevation of ground at antenna site above mean sea level in meters: 932.00							
(c) Distance to nearest aircraft landing area in kilometers: 76.00							
(d) List any natural formations of existing man-made structures (hills, trees, water tanks, towers, etc.) which, in the opinion of the applicant, would tend to shield the antenna from aircraft:							
Action Frequency	Station Class	Output Power/ERP	Mean Peak	Frequency Tolerance (+/-)	Emission Designator	Modulating Signal	
New 5041.31250000- MHz FX		10.000000 W 10.000000 W P	0.01000000 %	85K0G2D	20 kbps		
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City	State	Latitude	Longitude	Mobile	Street (or other indication of location)	County	Radius of Operation
0 Gardner	North Dakota	North 47 10 53	West 97 3 41	Max altitude 400 ft. AGL	Within 16 KM of Base Station	TRAILL	16.00 km
Datum: NAD 83							
Is a directional antenna (other than radar) used? No							
Exhibit submitted: No							
(a) Width of beam in degrees at the half-power point:							
(b) Orientation in horizontal plane (degrees from True North):							
(c) Orientation in vertical plane (degrees from horizontal):							
Will the antenna extend more than 6 meters above the ground, or if mounted on an existing building, will it extend more than 6 meters above the building, or will the proposed antenna be mo							
(a) Overall height above ground to tip of antenna in meters: 21.30							
(b) Elevation of ground at antenna site above mean sea level in meters: 886.00							
(c) Distance to nearest aircraft landing area in kilometers: 13.80							
(d) List any natural formations of existing man-made structures (hills, trees, water tanks, towers, etc.) which, in the opinion of the applicant, would tend to shield the antenna from aircraft:							
Action Frequency	Station Class	Output Power/ERP	Mean Peak	Frequency Tolerance (+/-)	Emission Designator	Modulating Signal	
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New 5049.13750000- MHz MO		1.000000 W 1.000000 W P	0.01000000 %	85K0G2D	20 kbps		

Attachment – Form 442
FCC Experimental License



Online Payment

[Return to your originating application](#)

Step 2: Authorize Payment

1 | 2 | 3

Payment Summary [Edit this information](#)

Address Information	Account Information	Payment Information
Account Holder Name: James Ziarno 2457 Lineberry Billing Address: Lane Billing Address 2: City: Malabar State/Province: FL ZIP/Postal Code: 32950 Country: USA	Credit Card Type: Visa Credit Card Number: *****2221	Payment Amount: \$140.00 Transaction Date and Time: 09/21/2018 14:24 EDT

Email Confirmation Receipt

To have a confirmation sent to you upon completion of this transaction, provide an email address and confirmation below.

Email:

Confirm Email Address:

CC:

Separate multiple email addresses with a comma

Authorization and Disclosure

Required fields are indicated with a red asterisk *

I authorize a charge to my card account for the above amount in accordance with my card issuer agreement. ☐ *

Press the "Submit Payment" Button only once. Pressing the button more than once could result in multiple transactions.

Note: Please avoid navigating the site using your browser's Back Button - this may lead to incomplete data being transmitted and pages being loaded incorrectly. Please use the links provided whenever possible.

Owner and Operator

Will applicant be owner and operator of the station? Yes

Contact Information

Give the following information of person who can best handle inquiries pertaining to this application: First Name: James

Last Name: Ziarno
Title: Director of Technology, Commercial UAS Solutions
Phone Number: 3219179437
E-Mail Address: jziarno@harris.com

Drug Abuse Question

APPLICANT ANTI-DRUG ABUSE CERTIFICATION: By checking "YES", the individual applicant certifies that he or she is eligible for this license. This requires that he or she is not subject to a denial of federal benefits, including FCC benefits, as a result of a drug offense conviction pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 882. A non-individual applicant, e.g., corporation, partnership or other unincorporated association, certifies that no party to the application is subject to a denial of federal benefits, pursuant to that section. For definition of a "party" for these purposes, see 47CFR 1.2002(b). Yes

Certification

THE APPLICANT CERTIFIES THAT:

- Copies of the FCC Rule Parts 2 and 5 are on hand; and
- Adequate financial appropriations have been made to carry on the program of experimentation which will be conducted by qualified personnel; and
- All operations will be on an experimental basis in accordance with Part 5 and other applicable rules, and will be conducted in such a manner and at such a time as to preclude harmful interference to any authorized station; and
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THE APPLICANT FURTHER CERTIFIES THAT:

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- The applicant is willing to finance and conduct the experimental program with full knowledge and understanding of the above limitations; and
- The applicant waives any claim to the use of any particular frequency or of the electromagnetic spectrum as against the regulatory power of the USA.

Name of Applicant: Harris Corporation
Signature (Authorized person filing form): James J Ziarno
Signature Date (Authorized person filing form): 09/18/2018
Title of Person Signing Application: UAS Commercial Solutions, Director of Technology
Classification: Authorized employee

WILLFUL FALSE STATEMENTS MADE ON THIS FORM ARE PUNISHABLE BY FINE AND/OR IMPRISONMENT (U.S. CODE, TITLE 18, SECTION 1001), AND/OR REVOCATION OF ANY STATION LICENSE OR CONSTRUCTION PERMIT (U.S. CODE, TITLE 47, SECTION 312(A)(1)), AND/OR FORFEITURE (U.S. CODE, TITLE 47, SECTION 503).

NOTIFICATION TO INDIVIDUALS UNDER PRIVACY ACT OF 1974 AND THE PAPERWORK REDUCTION ACT OF 1980

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Public reporting burden for this collection of information is estimated to average four (4) hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden to the Federal Communications Commission, Records Management Branch, Paperwork Reduction Project (3060-0065), Washington DC 20554. DO NOT send completed applications to this address. Individuals are not required to respond to this collection unless it displays a currently valid OMD control number.

Attachment – Form 442
FCC Experimental License

Your payment has been submitted to Pay.gov and the details are below. If you have any questions or you wish to cancel this payment, please contact FCC Financial Operations Group Help Desk at ARINQUIRIES@fcc.gov at 877-480-3201 option 6.

Application Name: Remittance Advice
Pay.gov Tracking ID: 26CD13CK
Agency Tracking ID: PGC3151418
Transaction Type: Sale
Transaction Date: Sep 21, 2018 2:25:19 PM

Account Holder Name: James Ziarno
Transaction Amount: \$140.00
Card Type: Visa
Card Number: *****2221

THIS IS AN AUTOMATED MESSAGE. PLEASE DO NOT REPLY.

Application Status Report

Secure | <https://apps.fcc.gov/oetcf/els/reports/ApplicationSearchResult.cfm>

FCC Federal Communications Commission

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View Form	View Exhibits	View Notes	View Correspondence	View File	Grant Number	Call Sign	Applicant Name	Receipt Date	Status	Status Date
Initial Filing Current Version		N/A			N/A	0734-EX-CN-2018N/A	Harris Corporation	09/21/2018	Pending	09/21/2018

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Filing Options

- [Form 405 - License Renewal](#)
- [Form 442 - New License/Modification of License](#)
- [Form 702 - Assignment of License](#)
- [Form 703 - Transfer of Control](#)
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Attachment – Form 442
FCC Experimental License

Web FCR Forms (Set 1 of 12)

Attachment – Form 442
FCC Experimental License

Transmitter Information		Help?
Each Frequency will be submitted with Airborne data first and Ground Location		
Location: *	BOTH	
Coordinates:		
Antenna Latitude: *	N 27° 58' 53.00	
Antenna Longitude: *	W 080° 33' 20.00	
Equipment:		
Manufacturer:	HARRIS CORP(HAC)	
Model Number:	HRS102721-001	
Radius of Operation:	17 KM	
Flight Level:	Min: 0 Feet Max: 400 Feet	
PRR (Pulse Repetition Rate):	Pulses Per Second	Pulse Characteristics (IE Interface Pattern, Stagger, Jitter, etc):
Pulse Duration:	MILLISECONDS	

Emission Information		Help?
Emission Designator: 85K00G2D		
*Emission characteristics:		
Bandwidth: *	85 KHz	
Modulation: *	PHASE MODULATION (G)	
Type of Signal: *	A SINGLE CHANNEL CONTAINING A QU	
Type of Information: *	DATA TRANSMISSION, TELEMETRY, TE	
Power and System Loss Information:		
System Loss:	1 db	
Power: *	Tx OUTPUT = 3 Watts	
Other Emission characteristics:		
☐ Chirp		
☐ Impulse		
☐ Frequency Hopping		
☐ Stepped Interval. If fixed provide interval		
1030 MHz modes of operation:		
Aviation :	☐ 3A	☐ C ☐ S
Military :	☐ 1	☐ 2 ☐ 4 ☐ 5

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Note: Please use the dashboard attachment functionality to upload the Spectrum plot from the Spectrum analyzer showing the emission mask of the transmitter signal and receiver selectivity

Attachment – Form 442
FCC Experimental License

Receiver Information		Help?
☒ Select if Transmitter and Receiver are in the same location		
Coordinates:		
Antenna Latitude:	N 27° 58' 53.00"	
Antenna Longitude:	W 080° 33' 20.00"	
Equipment:		
Manufacturer:	HARRIS CORP(HAC)	
Model Number:	HRS102721-001	
Radius of Operation:	17	KM
Antenna Height:		FEET
Antenna Gain:	0	dB
Antenna Type:	DIPOLE	
Antenna Polarization:	V	
Antenna Azimuth:	OMNIDIRECTIONA	Degrees
+Add More		

Additional Information		Help?
Purpose of the Request:	TESTING AND VALIDATION OF HARRIS DEVELOPED CNPC RADIO SYSTEM WHICH HAS BEEN DEVELOPED USING RTCA MOPS (DO-362) AND FAA TSO C213 FOR GUIDANCE. INITIAL TESTING TO BE PERFORMED IN MALABAR, FL.	
Additional Comments:	THIS EXPERIMENTAL LICENSE APPLICATION HAS BEEN COORDINATED WITH THE FAA. THE USE OF THESE CHANNELS HAVE BEEN DETERMINED TO BE ACCEPTABLE TO THE FAA. FAA POINT OF CONTACT: DON NELLIS DONALD.NELLIS@FAA.GOV (202)267.9779	
Contract Information:		
Contract Number:		
Agency:		
NTIA SPS Number:		
Agency POC:		
J/F-12:		

Note: The fields marked * is required entry field, others are optional. But providing the optional fields information will expedite the process