

Harris Corporation

UAS C Band Radio

Attachment to FCC Experimental License (rev 2)

James Ziarno

Commercial UAS Solutions, Director of Technology

ELECTRONIC SYSTEMS / HARRIS CORPORATION

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FCC File Number: 0734-EX-CN-2018

Confirmation Number: EL308994

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	2800	Jordan Blvd, Malabar, FL 32950	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

(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

Action	Frequency	Station Class	Output Power/ERP	Mean Peak Frequency Tolerance (+/-)	Emission Designator	Modulating Signal
New	5041.27000000-5041.35400000 MHz	FX	10.000000 W 10.000000 W P	0.01000000 %	85K0G2D	20 kbps
New	5041.27000000-5041.35400000 MHz	FX	10.000000 W 10.000000 W P	0.01000000 %	85K0G2D	20 kbps
New	5041.27000000-5041.35400000 MHz	MO	1.000000 W 1.000000 W P	0.01000000 %	85K0G2D	20 kbps
New	5041.35400000-5041.44250000 MHz	FX	10.000000 W 10.000000 W P	0.01000000 %	85K0G2D	20 kbps
New	5041.35400000-5041.44250000 MHz	FX	10.000000 W 10.000000 W P	0.01000000 %	85K0G2D	20 kbps
New	5041.35400000-5041.44250000 MHz	MO	1.000000 W 1.000000 W P	0.01000000 %	85K0G2D	20 kbps
New	5041.35400000-5041.44250000 MHz	MO	1.000000 W 1.000000 W P	0.01000000 %	85K0G2D	20 kbps
New	5045.57000000-5045.65400000 MHz	FX	10.000000 W 10.000000 W P	0.01000000 %	85K0G2D	20 kbps
New	5045.57000000-5045.65400000 MHz	MO	1.000000 W 1.000000 W P	0.01000000 %	85K0G2D	20 kbps
New	5045.65400000-5045.74250000 MHz	FX	10.000000 W 10.000000 W P	0.01000000 %	85K0G2D	20 kbps
New	5045.65400000-5045.74250000 MHz	MO	1.000000 W 1.000000 W P	0.01000000 %	85K0G2D	20 kbps
New	5049.01000000-5049.09400000 MHz	FX	10.000000 W 10.000000 W P	0.01000000 %	85K0G2D	20 kbps
New	5049.01000000-5049.09400000 MHz	MO	1.000000 W 1.000000 W P	0.01000000 %	85K0G2D	20 kbps
Modified	5049.09400000-5049.18250000 MHz	FX	10.000000 W 10.000000 W P	0.01000000 %	85K0G2D	20 kbps
New	5049.09400000-5049.18250000 MHz	MO	1.000000 W 1.000000 W P	0.01000000 %	85K0G2D	20 kbps

1. Overview

Harris Corporation is requesting an FCC Experimental License within the allocated UAS C Band (5030 – 5091 MHz) to perform testing and validation of our Command & Non-Payload Communications (CNPC) Radio System. We will install a Mobile CNPC Radio in an Unmanned Air Vehicle (UAV) and communicate to the UAV via a Fixed CNPC Base Station Mobile Station. Our experimental UAS operations will be conducted within 17km (10 miles) of the Harris Corporation Manufacturing facility located in Malabar, FL. 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

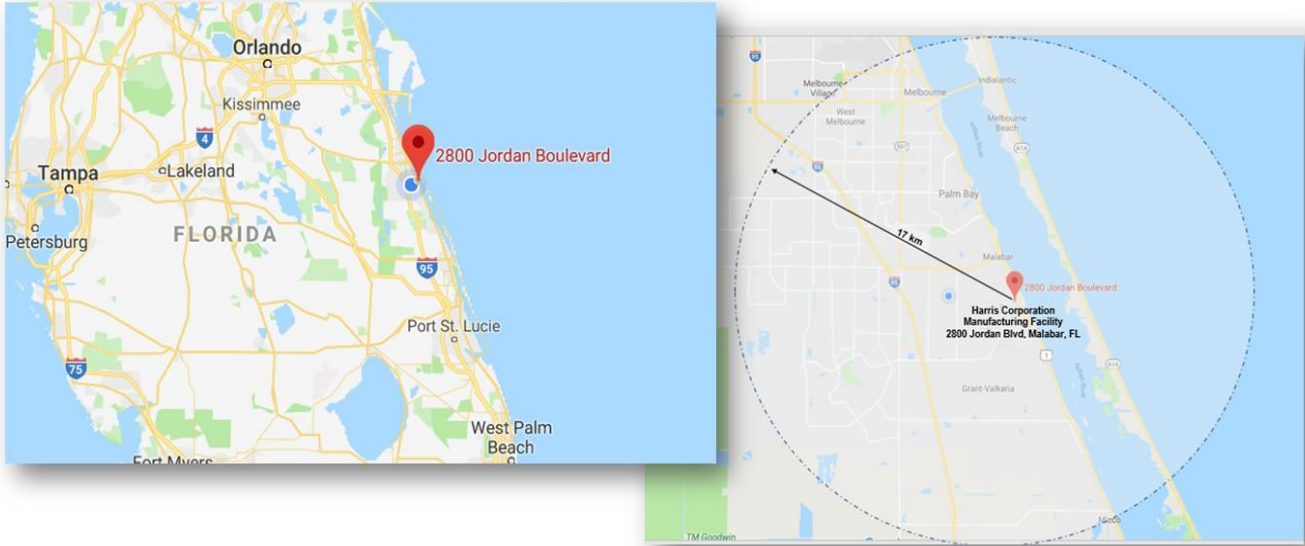
Based on this experience, Harris is developing initial UAS CNPC Radio and Beyond Visual Line of Sight (BVLOS) network capabilities which are at various levels of maturity given current state of the UAS standards such as RTCA DO-362 and the more recently published FAA Technical Standard Order (TSO) C213.

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. Test Site Area (Malabar, FL)

The planned Test Site is centered on Harris Corporation’s Manufacturing facility located at 2800 Jordan Blvd. Malabar, FL. This is a remote area rural area with a small General Aviation Airport (Valkaria) located about 1 1/2 miles from the Harris facility. We will closely coordinate our flight tests with Valkaria Airport Manager (Steve Borowski).

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 FCC Experimental License



Test Site Area of Operation

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. Coordination with FAA

The requested C Band allocation is within the FAA Aviation Protected Spectrum and therefore requires pre-coordination and approval from the FAA prior to applying for an Experimental License from the FCC. Correspondingly, we have been closely coordinating with the FAA Spectrum Engineering Office and the use of these (12) channels have been determined to be acceptable to the FAA.

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

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Our Frequency Coordination Requests have been engineered by the FAA Spectrum Engineering Office resulting in the following (12) FAA approvals:

Chan	D1/D2	Center Freq	TRK #	NG #	Details
3	D1	5041.3125	TRK 183072	T180550	Frequency Range: 5041.27000000 to 5041.35400000 MHz, Power: 10.000000 W, Mean Peak: Peak, Tolerance: 0.01000000, Station Class: Fixed
3	D1	5041.3125	TRK 183071	T180549	Frequency Range: 5041.27000000 to 5041.35400000 MHz, Power: 1.000000 W, Mean Peak: Peak, Tolerance: 0.01000000, Station Class: Mobile
3	D2	5041.3925	TRK 183076	T180554	Frequency Range: 5041.35400000 to 5041.44250000 MHz, Power: 10.000000 W, Mean Peak: Peak, Tolerance: 0.01000000, Station Class: Fixed
3	D2	5041.3925	TRK 183075	T180553	Frequency Range: 5041.35400000 to 5041.44250000 MHz, Power: 1.000000 W, Mean Peak: Peak, Tolerance: 0.01000000, Station Class: Mobile
23	D1	5045.6125	TRK 183078	T180556	Frequency Range: 5045.57000000 to 5045.65400000 MHz, Power: 10.000000 W, Mean Peak: Peak, Tolerance: 0.01000000, Station Class: Fixed
23	D1	5045.6125	TRK 183077	T180555	Frequency Range: 5045.57000000 to 5045.65400000 MHz, Power: 1.000000 W, Mean Peak: Peak, Tolerance: 0.01000000, Station Class: Mobile
23	D2	5041.6925	TRK 183081	T180558	Frequency Range: 5045.65400000 to 5045.74250000 MHz, Power: 10.000000 W, Mean Peak: Peak, Tolerance: 0.01000000, Station Class: Fixed
23	D2	5041.6925	TRK 183080	T180557	Frequency Range: 5045.65400000 to 5045.74250000 MHz, Power: 1.000000 W, Mean Peak: Peak, Tolerance: 0.01000000, Station Class: Mobile
39	D1	5049.0525	TRK 183083	T180560	Frequency Range: 5049.01000000 to 5049.09400000 MHz, Power: 10.000000 W, Mean Peak: Peak, Tolerance: 0.01000000, Station Class: Fixed
39	D1	5049.0525	TRK 183082	T180559	Frequency Range: 5049.01000000 to 5049.09400000 MHz, Power: 1.000000 W, Mean Peak: Peak, Tolerance: 0.01000000, Station Class: Mobile
39	D2	5049.1375	TRK 183087	T180564	Frequency Range: 5049.09400000 to 5049.18250000 MHz, Power: 10.000000 W, Mean Peak: Peak, Tolerance: 0.01000000, Station Class: Fixed
39	D2	5049.1375	TRK 183086	T180563	Frequency Range: 5049.09400000 to 5049.18250000 MHz, Power: 1.000000 W, Mean Peak: Peak, Tolerance: 0.01000000, Station Class: Mobile

Summary of (12) FAA C Band UAS Channel Approvals

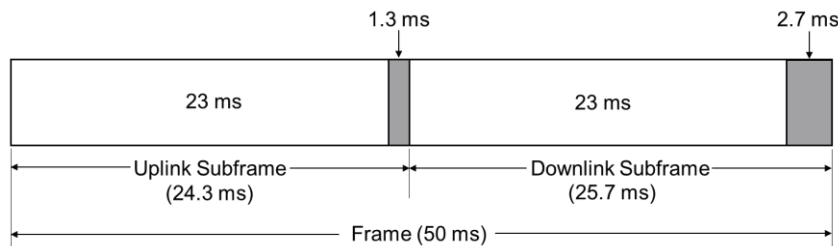
6. Modulating Signal Description

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.

6.1. RTCA TDD Format

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

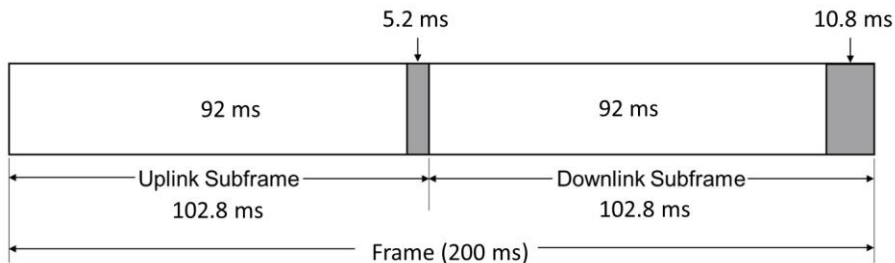
RTCA DO-362 Section 2.2.1.3 TDD Frame Structure is shown below.



DO-362 TDD Frame Structure

6.2. 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.



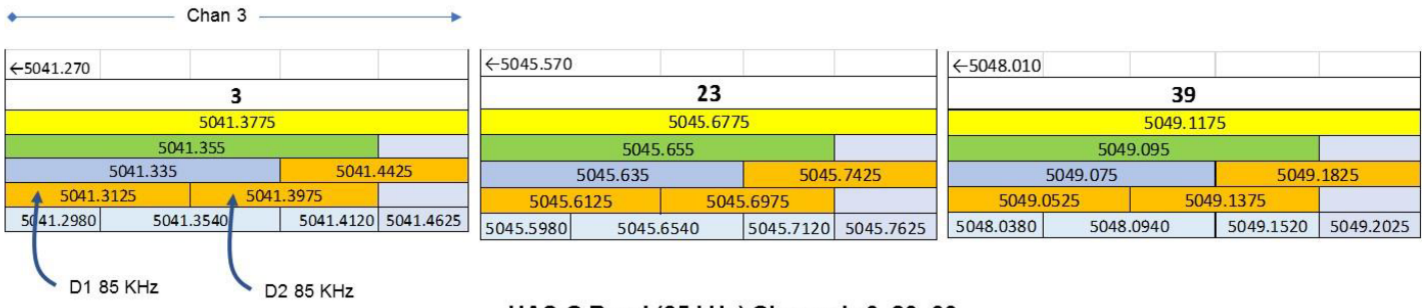
Harris CNPC TDD Frame Structure

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.

7. 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:

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 FCC Experimental License



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

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FCC Experimental License

CH	205 kHz		170 kHz	130 kHz	85 kHz			45 kHz			
	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	5041.0850	5041.1590	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	5049.0380	5049.0940	5049.1520	5049.2025	
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	

Channel 3
D1 & D2

Channel 23
D1 & D2

Channel 39
D1 & D2

8. FAA Approval - Aviation Protected Spectrum channels

Harris has received approval from the FAA for all (12) Aviation Protected Spectrum channels requested by Harris to support our Experimental License application with the FCC. 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

8.1. FAA Approvals UAS C Band Channel 3 – D1 Base Station and Mobile

TRK 183072 (NG T180550) Summary

Attribute	Record Parameter
Serial Number	NG T180550
Frequency	M5041.3125
City	MALABAR
State	FL
Transmitter Radius	9
Transmitter Latitude	275853.00N
Transmitter Longitude	0803320.00W
Antenna Height	0015
Receiver Latitude	275853.00N
Receiver Longitude	0803320.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLE
Flight Level	
Runway Number	

Channel 3 – D1 (Base Station)

TRK 183071 (NG T180549) Summary

Attribute	Record Parameter
Serial Number	NG T180549
Frequency	M5041.3125
City	MALABAR
State	FL
Transmitter Radius	9
Transmitter Latitude	275853.00N
Transmitter Longitude	0803320.00W
Antenna Height	0000
Receiver Latitude	275853.00N
Receiver Longitude	0803320.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLE
Flight Level	
Runway Number	

Channel 3 – D1 (Mobile)

8.2. FAA Approvals UAS C Band Channel 3 – D2 Base Station and Mobile

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TRK 183076 (NG T180554) Summary

Attribute	Record Parameter
Serial Number	NG T180554
Frequency	M5041.3975
City	MALABAR
State	FL
Transmitter Radius	9
Transmitter Latitude	275853.00N
Transmitter Longitude	0803320.00W
Antenna Height	0015
Receiver Latitude	275853.00N
Receiver Longitude	0803320.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLE
Flight Level	
Runway Number	

Channel 3 – D2 (Base Station)

TRK 183075 (NG T180553) Summary

Attribute	Record Parameter
Serial Number	NG T180553
Frequency	M5041.3975
City	MALABAR
State	FL
Transmitter Radius	9
Transmitter Latitude	275853.00N
Transmitter Longitude	0803320.00W
Antenna Height	0000
Receiver Latitude	275853.00N
Receiver Longitude	0803320.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLE
Flight Level	
Runway Number	

Channel 3 – D2 (Mobile)

8.3. FAA Approvals UAS C Band Channel 23 – D1 Base Station and Mobile

TRK 183078 (NG T180556) Summary

Attribute	Record Parameter
Serial Number	NG T180556
Frequency	M5045.6125
City	MALABAR
State	FL
Transmitter Radius	9
Transmitter Latitude	275853.00N
Transmitter Longitude	0803320.00W
Antenna Height	0015
Receiver Latitude	275853.00N
Receiver Longitude	0803320.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLE
Flight Level	
Runway Number	

Channel 23 – D1 (Base)

TRK 183077 (NG T180555) Summary

Attribute	Record Parameter
Serial Number	NG T180555
Frequency	M5045.6125
City	MALABAR
State	FL
Transmitter Radius	9
Transmitter Latitude	275853.00N
Transmitter Longitude	0803320.00W
Antenna Height	0000
Receiver Latitude	275853.00N
Receiver Longitude	0803320.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLE
Flight Level	
Runway Number	

Channel 23 – D1 (Mobile)

8.4. FAA Approvals UAS C Band Channel 23 – D2 Base Station and Mobile

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TRK 183081 (NG T180558) Summary

Attribute	Record Parameter
Serial Number	NG T180558
Frequency	M5045.6975
City	MALABAR
State	FL
Transmitter Radius	9
Transmitter Latitude	275853.00N
Transmitter Longitude	0803320.00W
Antenna Height	0015
Receiver Latitude	275853.00N
Receiver Longitude	0803320.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLE
Flight Level	
Runway Number	

Channel 23 – D2 (Base)

TRK 183080 (NG T180557) Summary

Attribute	Record Parameter
Serial Number	NG T180557
Frequency	M5045.6975
City	MALABAR
State	FL
Transmitter Radius	9
Transmitter Latitude	275853.00N
Transmitter Longitude	0803320.00W
Antenna Height	0000
Receiver Latitude	275853.00N
Receiver Longitude	0803320.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLE
Flight Level	
Runway Number	

Channel 23 – D2 (Mobile)

8.5. FAA Approvals UAS C Band Channel 39 – D1 Base Station and Mobile

TRK 183083 (NG T180560) Summary

Attribute	Record Parameter
Serial Number	NG T180560
Frequency	M5049.0525
City	MALABAR
State	FL
Transmitter Radius	9
Transmitter Latitude	275853.00N
Transmitter Longitude	0803320.00W
Antenna Height	0015
Receiver Latitude	275853.00N
Receiver Longitude	0803320.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLE
Flight Level	
Runway Number	

Channel 39 – D1 (Base)

TRK 183082 (NG T180559) Summary

Attribute	Record Parameter
Serial Number	NG T180559
Frequency	M5049.0525
City	MALABAR
State	FL
Transmitter Radius	9
Transmitter Latitude	275853.00N
Transmitter Longitude	0803320.00W
Antenna Height	0000
Receiver Latitude	275853.00N
Receiver Longitude	0803320.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLE
Flight Level	
Runway Number	

Channel 39 – D1 (Mobile)

8.6. FAA Approvals UAS C Band Channel 39 – D2 Base Station and Mobile

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 FCC Experimental License

TRK 183087 (NG T180564) Summary

Attribute	Record Parameter
Serial Number	NG T180564
Frequency	M5049.1375
City	MALABAR
State	FL
Transmitter Radius	9
Transmitter Latitude	275853.00N
Transmitter Longitude	0803320.00W
Antenna Height	0015
Receiver Latitude	275853.00N
Receiver Longitude	0803320.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLE
Flight Level	
Runway Number	

Channel 39 – D2 (Base)

TRK 183086 (NG T180563) Summary

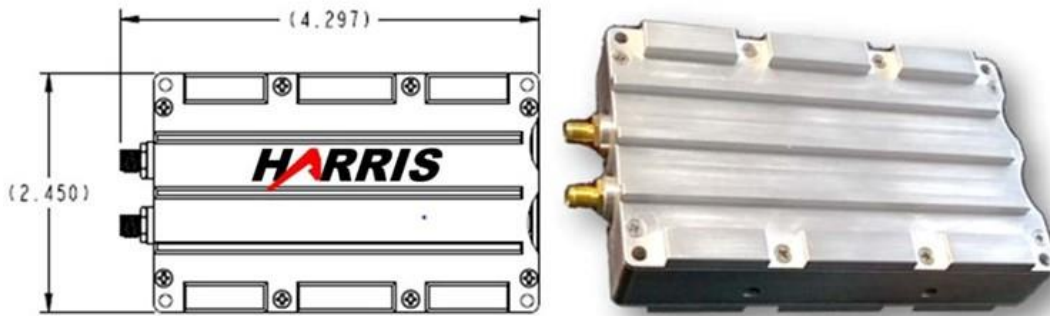
Attribute	Record Parameter
Serial Number	NG T180563
Frequency	M5049.1375
City	MALABAR
State	FL
Transmitter Radius	9
Transmitter Latitude	275853.00N
Transmitter Longitude	0803320.00W
Antenna Height	0000
Receiver Latitude	275853.00N
Receiver Longitude	0803320.00W
Service Type	
Equipment Type	C,HAC HRS102721-001
Antenna Type	DIPOLE
Flight Level	
Runway Number	

Channel 39 – D2 (Mobile)

9. 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.

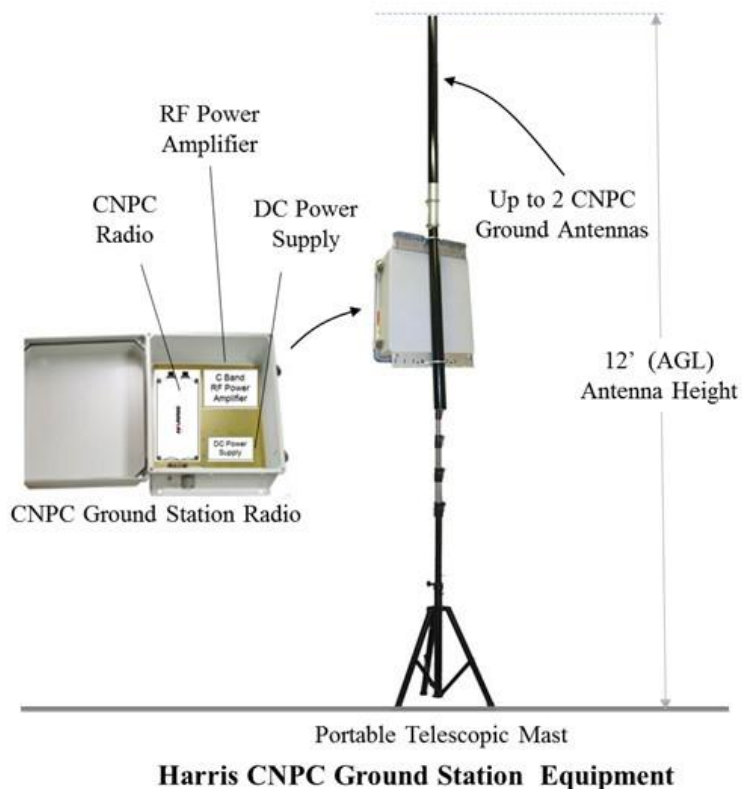
10. Harris CNPC (Fixed) Base Radio System

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 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 a portable telescopic antenna mast that extends a minimum of 12 feet Above Ground Level (AGL). Note: Depending on area ground clutter it may be necessary to increase the height of the C Band Antenna to maintain VLOS with the HALE UAV.

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

Attachment – Form 42
FCC Experimental License



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!

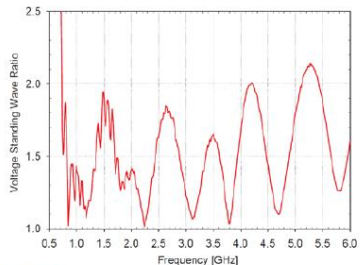
Pharad's *octane*® Mini UAV antennas are the highest performing light weight antennas available for small UAV applications. Weighing only 75 grams, these antennas provide broadband operation from UHF through C-band. No other lightweight UAV antenna provides a single solution for such a variety of UAV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

Attachment – Form 42
FCC Experimental License

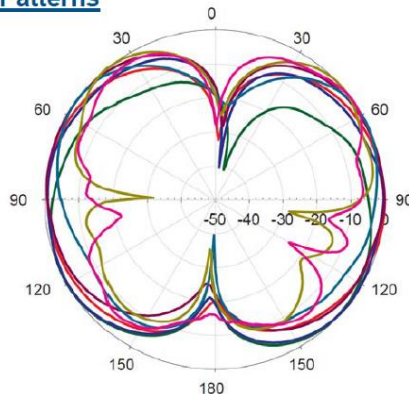
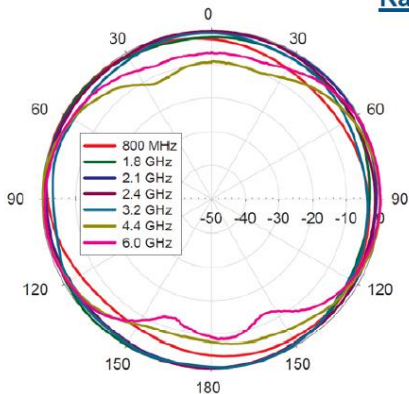
Characteristics

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:

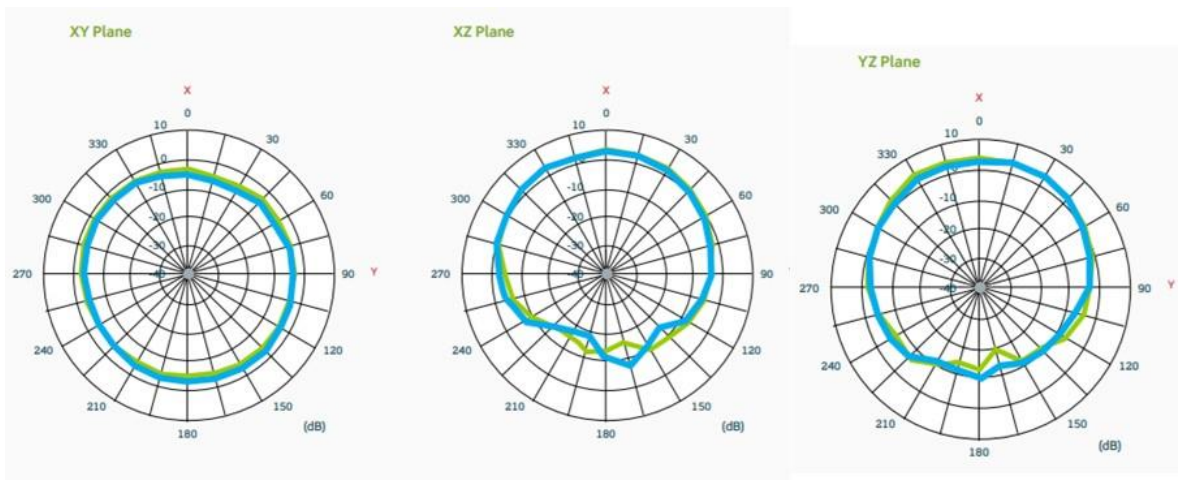
WCM.10.005QQ111

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>

Attachment – Form 42
FCC Experimental License



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

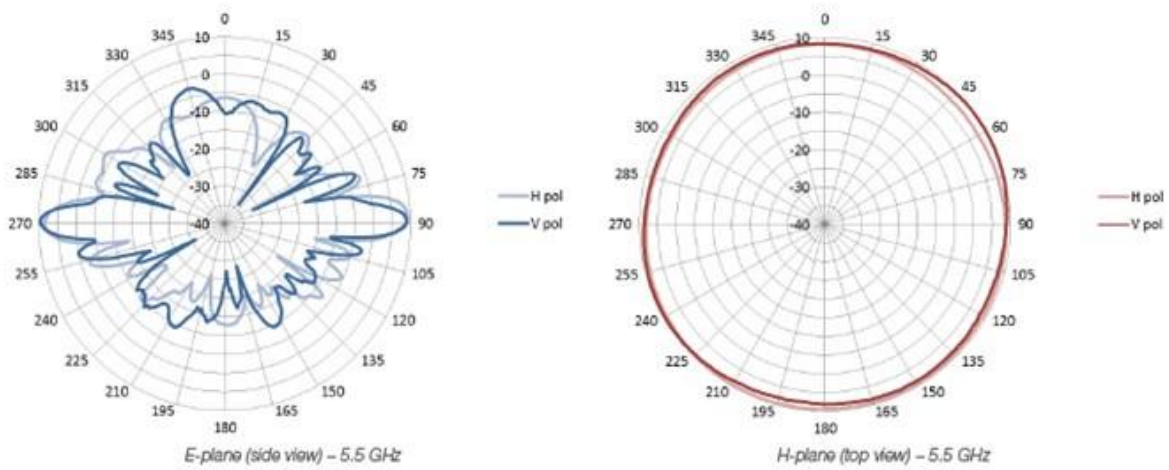
INSTALLATION HARDWARE

- Pole mount kit included.



Aruba Antenna -2x2-5010

Attachment – Form 42
FCC Experimental License



Aruba Antenna Patterns

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



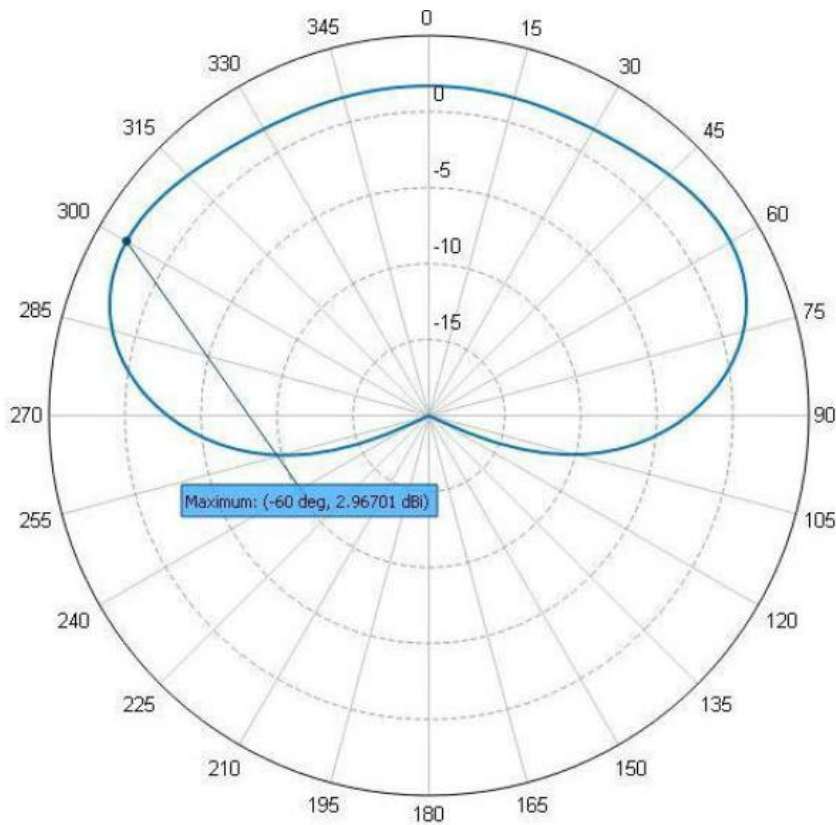
Southwest Antenna
Omni Bifilar Antenna, Circularly Polarized, 4.7 - 5.2 GHz, 3 dBic

Attachment – Form 42
FCC Experimental License

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



Southwest Antenna – Elevation Pattern

Attachment – Form 42
FCC Experimental License

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.: 0734-EX-CN-2018

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

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:
a. The complete program of research and experimentation proposed including description of equipment and theory of operation.
b. The specific objectives sought to be accomplished.
c. 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

Attachment – Form 42 FCC Experimental License

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: 3219172437
 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:

- a. Copies of the FCC Rule Parts 2 and 5 are on hand; and
- b. Adequate financial appropriations have been made to carry on the program of experimentation which will be conducted by qualified personnel; and
- c. 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
- d. Grant of the authorization requested herein will not be construed as a finding on the part of the Commission:
 - 1. that the frequencies and other technical parameters specified in the authorization are the best suited for the proposed program of experimentation, and
 - 2. that the applicant will be authorized to operate on any basis other than experimental, and
 - 3. 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:

- e. All the statements in the application and attached exhibits are true, complete and correct to the best of the applicant's knowledge; and
- f. The applicant is willing to finance and conduct the experimental program with full knowledge and understanding of the above limitations; and
- g. 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

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 OMD control number.

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.
 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.

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	2800 Jordan Blvd, Malabar, FL 32950	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 5 meters above the building, or will the proposed antenna be mounted on an existing structure other than a building? No

(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 5041.27000000-5041.35400000 MHz FX		10.000000 W 10.000000 W P	0.01000000 %	8SK0G2D	20 kbps
New 5041.27000000-5041.35400000 MHz FX		10.000000 W 10.000000 W P	0.01000000 %	8SK0G2D	20 kbps
New 5041.27000000-5041.35400000 MHz MO		1.000000 W 1.000000 W P	0.01000000 %	8SK0G2D	20 kbps
New 5041.35400000-5041.44250000 MHz FX		10.000000 W 10.000000 W P	0.01000000 %	8SK0G2D	20 kbps
New 5041.35400000-5041.44250000 MHz MO		1.000000 W 1.000000 W P	0.01000000 %	8SK0G2D	20 kbps
New 5041.35400000-5041.44250000 MHz MO		1.000000 W 1.000000 W P	0.01000000 %	8SK0G2D	20 kbps
New 5045.57000000-5045.65400000 MHz FX		10.000000 W 10.000000 W P	0.01000000 %	8SK0G2D	20 kbps
New 5045.57000000-5045.65400000 MHz MO		1.000000 W 1.000000 W P	0.01000000 %	8SK0G2D	20 kbps
New 5045.65400000-5045.74250000 MHz FX		10.000000 W 10.000000 W P	0.01000000 %	8SK0G2D	20 kbps
New 5045.65400000-5045.74250000 MHz MO		1.000000 W 1.000000 W P	0.01000000 %	8SK0G2D	20 kbps
New 5049.01000000-5049.09400000 MHz FX		10.000000 W 10.000000 W P	0.01000000 %	8SK0G2D	20 kbps
New 5049.01000000-5049.09400000 MHz MO		1.000000 W 1.000000 W P	0.01000000 %	8SK0G2D	20 kbps
Modified 5049.09400000-5049.18250000 MHz FX		10.000000 W 10.000000 W P	0.01000000 %	8SK0G2D	20 kbps
New 5049.09400000-5049.18250000 MHz MO		1.000000 W 1.000000 W P	0.01000000 %	8SK0G2D	20 kbps

Attachment – Form 42
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 Lane 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.

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.

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FCC Experimental License

Application Status Report x

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

FCC Federal Communications Commission

Search | RSS | Updates | E-Filing | Initiatives | Consumers | Find People

OET

Office of Engineering and Technology

FCC > FCC E-filing > ELS > Application Status Report

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

[Current Version](#)

[Perform Application Status Search Again](#)

Filing Options

- [Form 405 - License Renewal](#)
- [Form 442 - New License/Modification of License](#)
- [Form 702 - Assignment of License](#)
- [Form 703 - Transfer of Control](#)
- [Special Temporary Authority](#)
- [Add Attachments](#)
- [Reply to Correspondence](#)
- [Amend/Complete Application](#)
- [Return to 159 Form](#)
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Reports

- [Application Status](#)
- [Call Sign Search](#)
- [Generic Search](#)

Windows taskbar: 2:37 PM, 9/21/2018

Attachment – Form 42
FCC Experimental License

Web FCR Forms (Set 1 of 12)

Transmitter Information Help?

Each Frequency will be submitted with Airborne data first and Ground Location

Location: *

Coordinates:

Antenna Latitude: *

Antenna Longitude: *

Equipment:

Manufacturer:

Model Number:

Radius of Operation:

Flight Level: Min: Feet Max: Feet

Antenna Height:

Antenna Gain: dB

Antenna Type:

Antenna Polarization:

Antenna Azimuth: Degrees

PRR (Pulse Repetition Rate): Pulses Per Second

Pulse Duration:

Pulse Characteristics (IE Interlace Pattern, Stagger, Jitter, etc):

Emission Information Help?

Emission Designator: 85K00G2D

*Emission characteristics:

Bandwidth: *

Modulation: *

Type of Signal: *

Type of Information: *

Power and System Loss Information:

System Loss: db

Power: * =

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

[View/Update](#) [Save](#) [+Add More](#)

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 42
FCC Experimental License

Help?

Receiver Information

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: OMNIDIRECTIONAL Degrees

[+Add More](#)

Help?

Additional Information

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:
JIF-12:

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