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4HVG5		SIERRA NEVADA CORPORATION INTEGRATED MISSION SYSTEMS **18635 Jarkey Drive** **Hagerstown, MD 21742**

REVISIONS					
Issues	**Descriptions**	**Date**	**Author**	**TW/Checker**	**Engineering**
A	Initial Release				

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1.0 INTRODUCTION

1.1 GENERAL

Sierra Nevada Corporation (SNC), located at 18635 Jarkey Drive Hagerstown, MD. wishes to obtain a Special Temporary Authority (STA) from the Federal Communication Commission (FCC). Due to the unique nature of our testing and the number of frequencies requested, it is rationalized that obtaining an STA is the best approach. SNC is a Systems Integrator specializing in modifications to aircraft and producing Intelligence, Surveillance and Reconnaissance (ISR) systems for the United States Government as well as Foreign Military Sale. Final testing of the platform pre-delivery requires transmitting on known frequencies to exercise the installed equipment to validate performance requirements. Currently SNC has authority from the FCC for a limited number of frequencies under radio service AF- Aeronautical and Fixed utilizing call sign WQRI680 and WQRI681. The purpose of this exhibit is to document current needs, detail equipment that will be utilized, define the proposed test area and identify the frequency needs.

1.2 CURRENT NEEDS

SNC was recently awarded a contract with the U.S. Army to modify seven King Air Guardrail Common Sensor (GRCS) Aircraft with upgraded systems under contract NRO000-15-C-0346. Part of this contract will require re-verification (calibration) of an existing system on the aircraft. This system is a receive only system that operates in a range from 20 MHz to 1 Ghz. To calibrate this system it will be necessary to transmit RF energy from a ground station to the aircraft while airborne across this wide span at known frequencies/amplitudes. The spectral energy received at the aircraft is then collected and analyzed to produce calibration tables used by this system during operational use. Due to the wideband nature of this system it will be necessary to transmit across the entire 20 MHz to 1 Ghz band at a frequency spacing of 1.3%. These frequencies will be rounded to the nearest 5 kHz. See Table 1 below:

#	Frequency (20 MHz)
1	**20**
2	20 x 1.013 = **20.26**
3	20.26 x 1.013 = 20.52338 => **20.525**
4	20.525 x 1.013 = 20.791825 => **20.79**
	...
201	261.42 x 1.013 = 264.81846 => **264.82**
202	264.82 x 1.013 = 268.26266 => **268.265**
	...

Table 1: Frequency Example

Utilizing a 1.3% frequency spacing equates to transmitting on 323 frequencies. It will be necessary to transmit 8 frequencies simultaneously during these calibration events. Each group of eight

frequencies is defined as a Set. There are approximately 40 frequency Sets planned to cover the span of 20 MHz to 1 Ghz. The transmit system when commanded by the operator will automatically start at frequency set one, transmit that set for 10 milliseconds, end transmission and transition to frequency set two, transmit on that set for 10 milliseconds, end transmission and so on until all forty sets are complete. At the completion of all forty sets the system will start back at frequency set one and repeat. It is anticipated that it will require one flight per day for two days. Each flight is estimated at four hours.

2.0 TRANSMITTING EQUIPMENT

To automatically generate these frequency sets and to control the transmission length and timing SNC is required to utilize special equipment. For generation of individual frequencies SNC will utilize a National Instruments PXIe Chassis outfitted with a National Instruments 5840 Vector Signal Transceiver (VST). This device is used to consolidate frequency sets, allocate timing of each set and generate the RF signal set (that contains 8 individual frequencies). The output of the VST is then applied to the input of an AR amplifier which amplifies the signal set to 100 watts. When generating multiple frequencies within the set, the 100 watt output of the amp is divided up between the individual frequencies. The output of the amplifier is cabled to a log periodic transportable antenna that will be oriented in the vertical position.

2.1 NATIONAL INSTRUMENTS 5840 VST

The signal generation of the system resides within the National Instruments PXIe-1082 Chassis. The chassis contains the following Modules: PXIe-8861 Embedded Controller, and a PXI-5480 Vector Signal Transceiver (VST). The Embedded Controller is a Windows 10 computer that executes the LabVIEW operating environment code for timing, control and generation of signal sets. The GPS timing module provides an external time source to all components within the chassis and allows stable synchronization between the aircraft and the ground station. SNC developed LabVIEW code provides the user interface. Using this code the operator can import pre-programmed signal sets and generate the frequencies necessary. The VST operates as the signal generator in this system, generating low level RF outputs that are then applied to the AR amplifier.

2.2 AR AMPLIFIER

The Model 100U1000 is a solid-state, self-contained, air-cooled, broadband amplifier designed for applications where instantaneous bandwidth, high gain and linearity are required. The amplifier is rated for a frequency range of 10kHz to 1000 MHz and will provide 120W(typical) minimum output power. The maximum input rating for the amplifier is 1.0 mW. The amplifier receives an RF input from the VST, amplifies it accordingly and provides an amplified signal to the antenna to be transmitted over free space. Reference Table 2 for amplifier specifications.

100U1000 Electrical Specifications	
Specification	**Performance**
Frequency Range	10 kHz-1000 MHz
Input Impedance	1.5:1 (50 Ohm) maximum
Output Impedance	50 ohms nominal
Gain @ max setting	50 dB minimum
Flatness	+/- 1.5 dB typical, 2.0 dB max

Noise Figure	8.5 db typical
Harmonic Distortion max @100W	-20 dBc
Harmonic Distortion typ. @100W	-30 dBc
Third Order Intercept	60 dBm typical

Table 2: Amplifier Specifications

2.3 TLP-20 ANTENNA

The TLP-20 is a tactical log periodic antenna that cover the 20-1000 MHz frequency range and is designed for transmit and receive purposes. The antenna uses a three piece boom for quick assembly in the field and can be used in the vertical or horizontal mode. In this application it will be used in the vertical polarization mode. The antenna will provide 4-8 dbi of gain to the system. The antenna will be fastened to a mast assembly mounted on a rotator. The rotator will position the antenna to automatically track the flight path of the aircraft. This is to keep the main beam of the antenna focused during the test event. The height of the antenna above ground level is 5.2 meters (17 feet). Reference Table 3 below for electrical specification of the antenna.

TLP-20 Electrical Specifications	
Specification	**Performance**
Frequency Range	20-1000 MHz
VSWR	2.0:1 (50 Ohm) typical
Gain	4-8 dbi
Polarization	Linear
Vertical -3 dB Beamwidth	40-90 degrees
Horizontal -3 dB Beamwidth	70-140 degrees
Power Input	200 Watts

Table 3: Antenna Specifications

2.4 SCAN PLAN

The ground calibration source transmits multiple narrowband tones at once based upon the frequency set, while the airborne sensor collects the same multiple frequencies within a wideband tune. This is then repeated for the next set of frequencies working up through the 20-1000 MHz range. The system will then repeat this loop as the aircraft flies a predetermined flight path and RF data is collected at different arrival angles with respect to the ground station. The airborne system will collect frequency data over a 25 millisecond period, however the ground station will only be transmitting for 10 milliseconds within that period. The External Collect bars depicted below in green are the only times that ground station will be radiating RF energy. With 40 frequency sets (each containing 8 frequencies), it is anticipated that one full cycle of this plan will take 1 second. This will, however have to be repeated for a period of 4 hours to collect the necessary data.

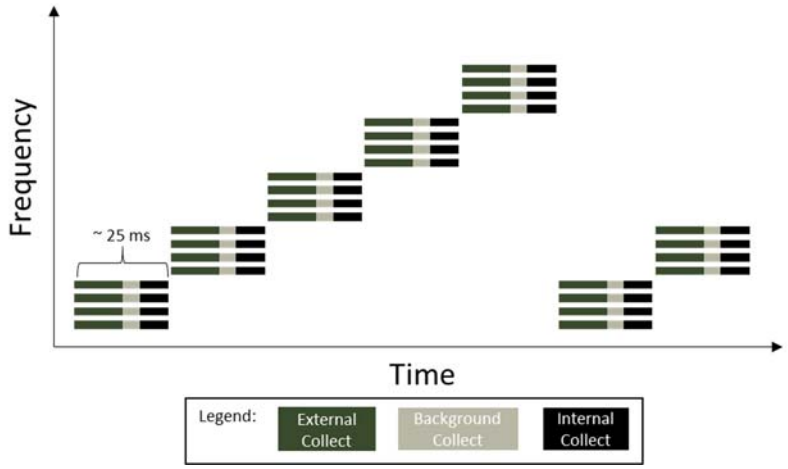

Figure 1: Scan Plan Illustration

2.5 RADIATION FREQUENCY

SNC is under contract to modify seven (7) aircraft over the next two years. It is anticipated that this testing will occur on each aircraft over a period of two days approximately 120 days apart. It is anticipated that the total number of days necessary to complete this testing will be fourteen (14).

2.6 SIGNAL CHARACTERISTICS

SNC will generate signals across the band of 20 MHz to 1000 MHz. Up to eight individual carriers will be generated for each frequency set. Approximately forty frequency sets will be generated for 10 milliseconds each. The approximate power level of each carrier signal will be 10 W with an individual signal bandwidth of 5 kHz.

3.0 TEST SITE

The ground transmit system will be housed in an enclosed trailer making it a mobile platform. This will allow SNC to perform calibration testing away from populated areas. At this time, an exact test location has not been identified. SNC is seeking a STA, which would allow testing within a 150 kilometer radius of the SNC facility at 18635 Jarkey Drive, Hagerstown, MD. 21742.

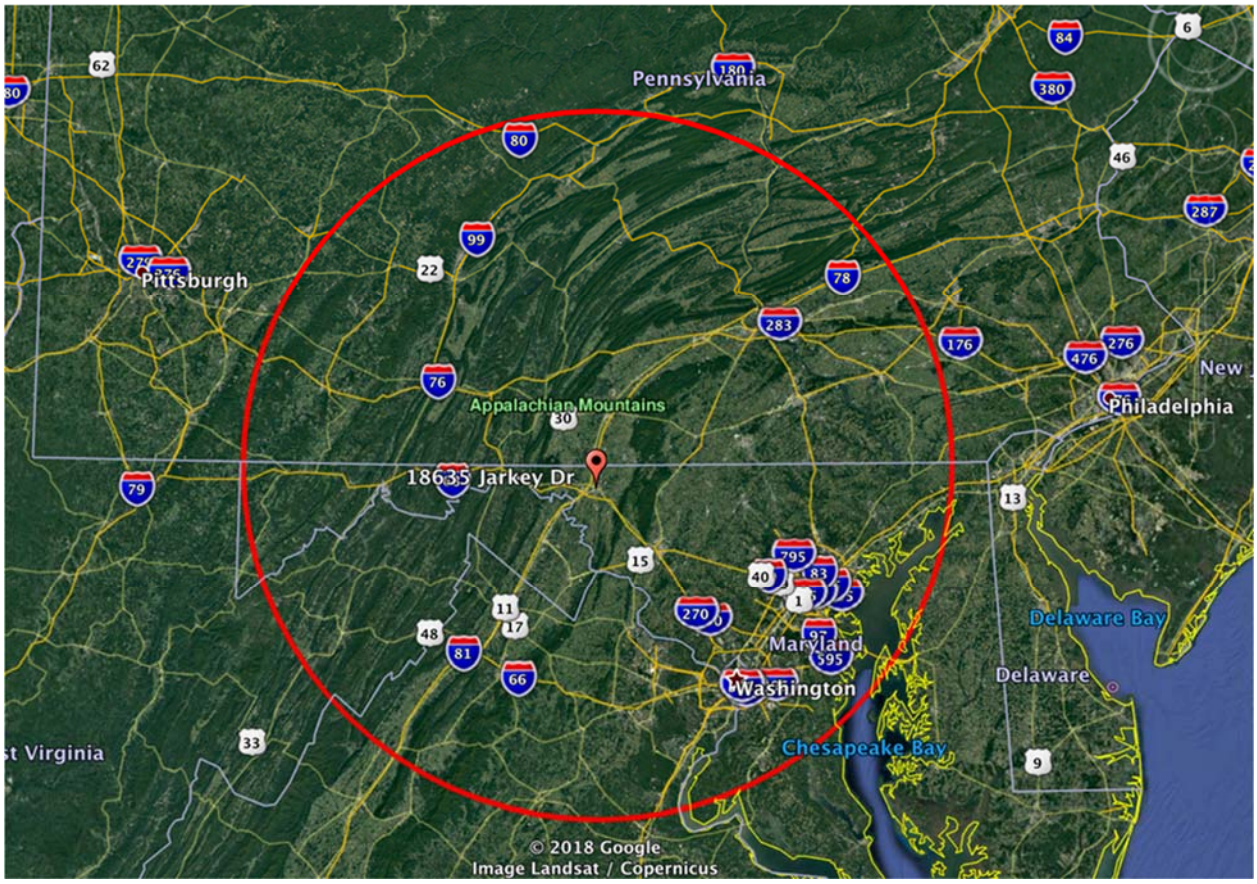

Figure 2: Test Location Radius

4.0 ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Description
FCC	Federal Communication Commission
GPS	Global Positioning System
GRCS	Guardrail Common Sensor
ISR	Intelligence, Surveillance and Reconnaissance
RF	Radio Frequency
SNC	Sierra Nevada Corporation
STA	Special Temporary Authority
VST	Vector Signal Transceiver

APPENDIX A REQUESTED FREQUENCIES

The frequencies listed within this Appendix are based upon a 1.3% spacing only without regard to the de-conflictions that will be necessary to avoid interference in excluded frequencies as outlined in the National Telecommunications and Information Administration, Manual of Regulations & Procedures for Federal Radio Frequency Management

#	Frequency (MHz)	Power	BW	#	Frequency (MHz)	Power	BW	#	Frequency (MHz)	Power	BW	#	Frequency (MHz)	Power	BW
1	20	10 W	5 kHz	**26**	27.62	10 W	5 kHz	**51**	38.165	10 W	5 kHz	**76**	52.705	10 W	5 kHz
2	20.26	10 W	5 kHz	**27**	27.98	10 W	5 kHz	**52**	38.66	10 W	5 kHz	**77**	53.39	10 W	5 kHz
3	20.525	10 W	5 kHz	**28**	28.345	10 W	5 kHz	**53**	39.165	10 W	5 kHz	**78**	54	10 W	5 kHz
4	20.79	10 W	5 kHz	**29**	28.715	10 W	5 kHz	**54**	39.675	10 W	5 kHz	**79**	54.79	10 W	5 kHz
5	21.06	10 W	5 kHz	**30**	29.09	10 W	5 kHz	**55**	40.19	10 W	5 kHz	**80**	55.5	10 W	5 kHz
6	21.335	10 W	5 kHz	**31**	29.47	10 W	5 kHz	**56**	40.71	10 W	5 kHz	**81**	56.22	10 W	5 kHz
7	21.61	10 W	5 kHz	**32**	29.855	10 W	5 kHz	**57**	41.24	10 W	5 kHz	**82**	56.95	10 W	5 kHz
8	21.89	10 W	5 kHz	**33**	30.245	10 W	5 kHz	**58**	41.775	10 W	5 kHz	**83**	57.69	10 W	5 kHz
9	22.175	10 W	5 kHz	**34**	30.64	10 W	5 kHz	**59**	42.32	10 W	5 kHz	**84**	58.44	10 W	5 kHz
10	22.465	10 W	5 kHz	**35**	31.04	10 W	5 kHz	**60**	42.87	10 W	5 kHz	**85**	59.2	10 W	5 kHz
11	22.755	10 W	5 kHz	**36**	31.445	10 W	5 kHz	**61**	43.425	10 W	5 kHz	**86**	60	10 W	5 kHz
12	23.05	10 W	5 kHz	**37**	31.855	10 W	5 kHz	**62**	43.99	10 W	5 kHz	**87**	60.75	10 W	5 kHz
13	23.35	10 W	5 kHz	**38**	32.27	10 W	5 kHz	**63**	44.56	10 W	5 kHz	**88**	61.54	10 W	5 kHz
14	23.655	10 W	5 kHz	**39**	32.69	10 W	5 kHz	**64**	45.14	10 W	5 kHz	**89**	62.34	10 W	5 kHz
15	23.965	10 W	5 kHz	**40**	33.115	10 W	5 kHz	**65**	45.725	10 W	5 kHz	**90**	63.15	10 W	5 kHz
16	24.275	10 W	5 kHz	**41**	33.545	10 W	5 kHz	**66**	46.32	10 W	5 kHz	**91**	63.97	10 W	5 kHz
17	24.59	10 W	5 kHz	**42**	33.98	10 W	5 kHz	**67**	46.92	10 W	5 kHz	**92**	64.8	10 W	5 kHz
18	24.91	10 W	5 kHz	**43**	34.42	10 W	5 kHz	**68**	47.53	10 W	5 kHz	**93**	65.64	10 W	5 kHz
19	25.235	10 W	5 kHz	**44**	34.865	10 W	5 kHz	**69**	48.15	10 W	5 kHz	**94**	66	10 W	5 kHz
20	25.565	10 W	5 kHz	**45**	35.32	10 W	5 kHz	**70**	48.775	10 W	5 kHz	**95**	67.36	10 W	5 kHz
21	25.895	10 W	5 kHz	**46**	35.78	10 W	5 kHz	**71**	49.41	10 W	5 kHz	**96**	68.235	10 W	5 kHz
22	26.23	10 W	5 kHz	**47**	36.245	10 W	5 kHz	**72**	50.05	10 W	5 kHz	**97**	69.12	10 W	5 kHz
23	26.57	10 W	5 kHz	**48**	36.715	10 W	5 kHz	**73**	50.7	10 W	5 kHz	**98**	70.02	10 W	5 kHz
24	26.915	10 W	5 kHz	**49**	37.19	10 W	5 kHz	**74**	51.36	10 W	5 kHz	**99**	70.93	10 W	5 kHz
25	27.265	10 W	5 kHz	**50**	37.675	10 W	5 kHz	**75**	52.03	10 W	5 kHz	**100**	72	10 W	5 kHz

#	Frequency (MHz)	Power	BW	#	Frequency (MHz)	Power	BW	#	Frequency (MHz)	Power	BW	#	Frequency (MHz)	Power	BW
101	72.785	10 W	5 kHz	**126**	100.6	10 W	5 kHz	**151**	138.835	10 W	5 kHz	**176**	192	10 W	5 kHz
102	73.73	10 W	5 kHz	**127**	101.8	10 W	5 kHz	**152**	140.64	10 W	5 kHz	**177**	194.23	10 W	5 kHz
103	74.69	10 W	5 kHz	**128**	103.2	10 W	5 kHz	**153**	142.47	10 W	5 kHz	**178**	196.755	10 W	5 kHz
104	75.66	10 W	5 kHz	**129**	104.6	10 W	5 kHz	**154**	144.32	10 W	5 kHz	**179**	198	10 W	5 kHz
105	76	10 W	5 kHz	**130**	105.8	10 W	5 kHz	**155**	146.195	10 W	5 kHz	**180**	201.905	10 W	5 kHz
106	77.64	10 W	5 kHz	**131**	107.2	10 W	5 kHz	**156**	148.095	10 W	5 kHz	**181**	204	10 W	5 kHz
107	78.65	10 W	5 kHz	**132**	108.6	10 W	5 kHz	**157**	150.02	10 W	5 kHz	**182**	207.19	10 W	5 kHz
108	79.67	10 W	5 kHz	**133**	110.04	10 W	5 kHz	**158**	151.97	10 W	5 kHz	**183**	210	10 W	5 kHz
109	80.705	10 W	5 kHz	**134**	111.47	10 W	5 kHz	**159**	153.945	10 W	5 kHz	**184**	212.615	10 W	5 kHz
110	81.755	10 W	5 kHz	**135**	112.92	10 W	5 kHz	**160**	155.945	10 W	5 kHz	**185**	216	10 W	5 kHz
111	82	10 W	5 kHz	**136**	114.39	10 W	5 kHz	**161**	157.97	10 W	5 kHz	**186**	218.18	10 W	5 kHz
112	83.895	10 W	5 kHz	**137**	115.875	10 W	5 kHz	**162**	160.025	10 W	5 kHz	**187**	221.015	10 W	5 kHz
113	84.985	10 W	5 kHz	**138**	117.38	10 W	5 kHz	**163**	162.105	10 W	5 kHz	**188**	223.89	10 W	5 kHz
114	86.09	10 W	5 kHz	**139**	118.905	10 W	5 kHz	**164**	164.21	10 W	5 kHz	**189**	226.8	10 W	5 kHz
115	87.21	10 W	5 kHz	**140**	120.45	10 W	5 kHz	**165**	166.345	10 W	5 kHz	**190**	229.75	10 W	5 kHz
116	88	10 W	5 kHz	**141**	122.015	10 W	5 kHz	**166**	168.505	10 W	5 kHz	**191**	232.735	10 W	5 kHz
117	89.4	10 W	5 kHz	**142**	123.6	10 W	5 kHz	**167**	170.695	10 W	5 kHz	**192**	235.76	10 W	5 kHz
118	90.6	10 W	5 kHz	**143**	125.205	10 W	5 kHz	**168**	172.915	10 W	5 kHz	**193**	238.825	10 W	5 kHz
119	91.8	10 W	5 kHz	**144**	126.835	10 W	5 kHz	**169**	174	10 W	5 kHz	**194**	241.93	10 W	5 kHz
120	93	10 W	5 kHz	**145**	128.485	10 W	5 kHz	**170**	177.44	10 W	5 kHz	**195**	245.075	10 W	5 kHz
121	94.2	10 W	5 kHz	**146**	130.155	10 W	5 kHz	**171**	180	10 W	5 kHz	**196**	248.26	10 W	5 kHz
122	95.4	10 W	5 kHz	**147**	131.845	10 W	5 kHz	**172**	182.08	10 W	5 kHz	**197**	251.485	10 W	5 kHz
123	96.8	10 W	5 kHz	**148**	133.56	10 W	5 kHz	**173**	184.445	10 W	5 kHz	**198**	254.755	10 W	5 kHz
124	98	10 W	5 kHz	**149**	135.295	10 W	5 kHz	**174**	186	10 W	5 kHz	**199**	258.065	10 W	5 kHz
125	99.2	10 W	5 kHz	**150**	137.055	10 W	5 kHz	**175**	189.275	10 W	5 kHz	**200**	261.42	10 W	5 kHz

#	Frequency (MHz)	Power	BW	#	Frequency (MHz)	Power	BW	#	Frequency (MHz)	Power	BW	#	Frequency (MHz)	Power	BW
201	264.82	10 W	5 kHz	**233**	405.57	10 W	5 kHz	**265**	590	10 W	5 kHz	**297**	782	10 W	5 kHz
202	268.265	10 W	5 kHz	**234**	410.84	10 W	5 kHz	**266**	596	10 W	5 kHz	**298**	788	10 W	5 kHz
203	271.75	10 W	5 kHz	**235**	416.18	10 W	5 kHz	**267**	602	10 W	5 kHz	**299**	794	10 W	5 kHz
204	278.865	10 W	5 kHz	**236**	421.59	10 W	5 kHz	**268**	608	10 W	5 kHz	**300**	800	10 W	5 kHz
205	282.49	10 W	5 kHz	**237**	427.07	10 W	5 kHz	**269**	614	10 W	5 kHz	**301**	806	10 W	5 kHz
206	286.16	10 W	5 kHz	**238**	432.62	10 W	5 kHz	**270**	620	10 W	5 kHz	**302**	812	10 W	5 kHz
207	289.88	10 W	5 kHz	**239**	438.245	10 W	5 kHz	**271**	626	10 W	5 kHz	**303**	824	10 W	5 kHz
208	293.65	10 W	5 kHz	**240**	443.94	10 W	5 kHz	**272**	632	10 W	5 kHz	**304**	830	10 W	5 kHz
209	297.465	10 W	5 kHz	**241**	449.71	10 W	5 kHz	**273**	638	10 W	5 kHz	**305**	836	10 W	5 kHz
210	301.33	10 W	5 kHz	**242**	455.555	10 W	5 kHz	**274**	644	10 W	5 kHz	**306**	842	10 W	5 kHz
211	305.245	10 W	5 kHz	**243**	461.475	10 W	5 kHz	**275**	650	10 W	5 kHz	**307**	848	10 W	5 kHz
212	309.215	10 W	5 kHz	**244**	467.475	10 W	5 kHz	**276**	656	10 W	5 kHz	**308**	854	10 W	5 kHz
213	313.235	10 W	5 kHz	**245**	470	10 W	5 kHz	**277**	662	10 W	5 kHz	**309**	860	10 W	5 kHz
214	317.305	10 W	5 kHz	**246**	476	10 W	5 kHz	**278**	668	10 W	5 kHz	**310**	866	10 W	5 kHz
215	321.43	10 W	5 kHz	**247**	482	10 W	5 kHz	**279**	674	10 W	5 kHz	**311**	872	10 W	5 kHz
216	325.61	10 W	5 kHz	**248**	488	10 W	5 kHz	**280**	680	10 W	5 kHz	**312**	878	10 W	5 kHz
217	329.845	10 W	5 kHz	**249**	494	10 W	5 kHz	**281**	686	10 W	5 kHz	**313**	884	10 W	5 kHz
218	334.135	10 W	5 kHz	**250**	500	10 W	5 kHz	**282**	692	10 W	5 kHz	**314**	890	10 W	5 kHz
219	338.48	10 W	5 kHz	**251**	506	10 W	5 kHz	**283**	698	10 W	5 kHz	**315**	903.31	10 W	5 kHz
220	342.88	10 W	5 kHz	**252**	512	10 W	5 kHz	**284**	704	10 W	5 kHz	**316**	915.055	10 W	5 kHz
221	347.335	10 W	5 kHz	**253**	518	10 W	5 kHz	**285**	710	10 W	5 kHz	**317**	926.95	10 W	5 kHz
222	351.85	10 W	5 kHz	**254**	524	10 W	5 kHz	**286**	716	10 W	5 kHz	**318**	939	10 W	5 kHz
223	356.425	10 W	5 kHz	**255**	530	10 W	5 kHz	**287**	722	10 W	5 kHz	**319**	951.205	10 W	5 kHz
224	361.06	10 W	5 kHz	**256**	536	10 W	5 kHz	**288**	728	10 W	5 kHz	**320**	963.57	10 W	5 kHz
225	365.755	10 W	5 kHz	**257**	542	10 W	5 kHz	**289**	734	10 W	5 kHz	**321**	976.095	10 W	5 kHz
226	370.51	10 W	5 kHz	**258**	548	10 W	5 kHz	**290**	740	10 W	5 kHz	**322**	988.785	10 W	5 kHz
227	375.325	10 W	5 kHz	**259**	554	10 W	5 kHz	**291**	746	10 W	5 kHz	**323**	1001.64	10 W	5 kHz
228	380.205	10 W	5 kHz	**260**	560	10 W	5 kHz	**292**	752	10 W	5 kHz				
229	385.15	10 W	5 kHz	**261**	566	10 W	5 kHz	**293**	758	10 W	5 kHz				
230	390.155	10 W	5 kHz	**262**	572	10 W	5 kHz	**294**	764	10 W	5 kHz				
231	395.225	10 W	5 kHz	**263**	578	10 W	5 kHz	**295**	770	10 W	5 kHz				
232	400.365	10 W	5 kHz	**264**	584	10 W	5 kHz	**296**	776	10 W	5 kHz				