

UNCLASSIFIED

**Supporting Exhibit in Reference to FCC
Special Temporary Authority Application File
Number 1391-EX-ST-2019**

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snc SIERRA
NEVADA
CORPORATION
INTEGRATED MISSION SYSTEMS

**18635 Jarkey Drive
Hagerstown, MD 21742**

REVISIONS					
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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	$20 \times 1.013 = 20.26$
3	$20.26 \times 1.013 = 20.52338 \Rightarrow 20.525$
4	$20.525 \times 1.013 = 20.791825 \Rightarrow 20.79$
...	
201	$261.42 \times 1.013 = 264.81846 \Rightarrow 264.82$
202	$264.82 \times 1.013 = 268.26266 \Rightarrow 268.265$
...	

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.

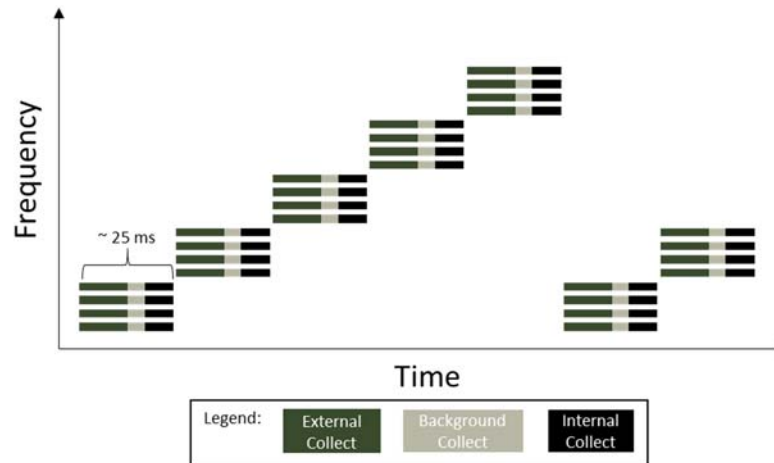


Figure 1: Scan Plan Illustration

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.

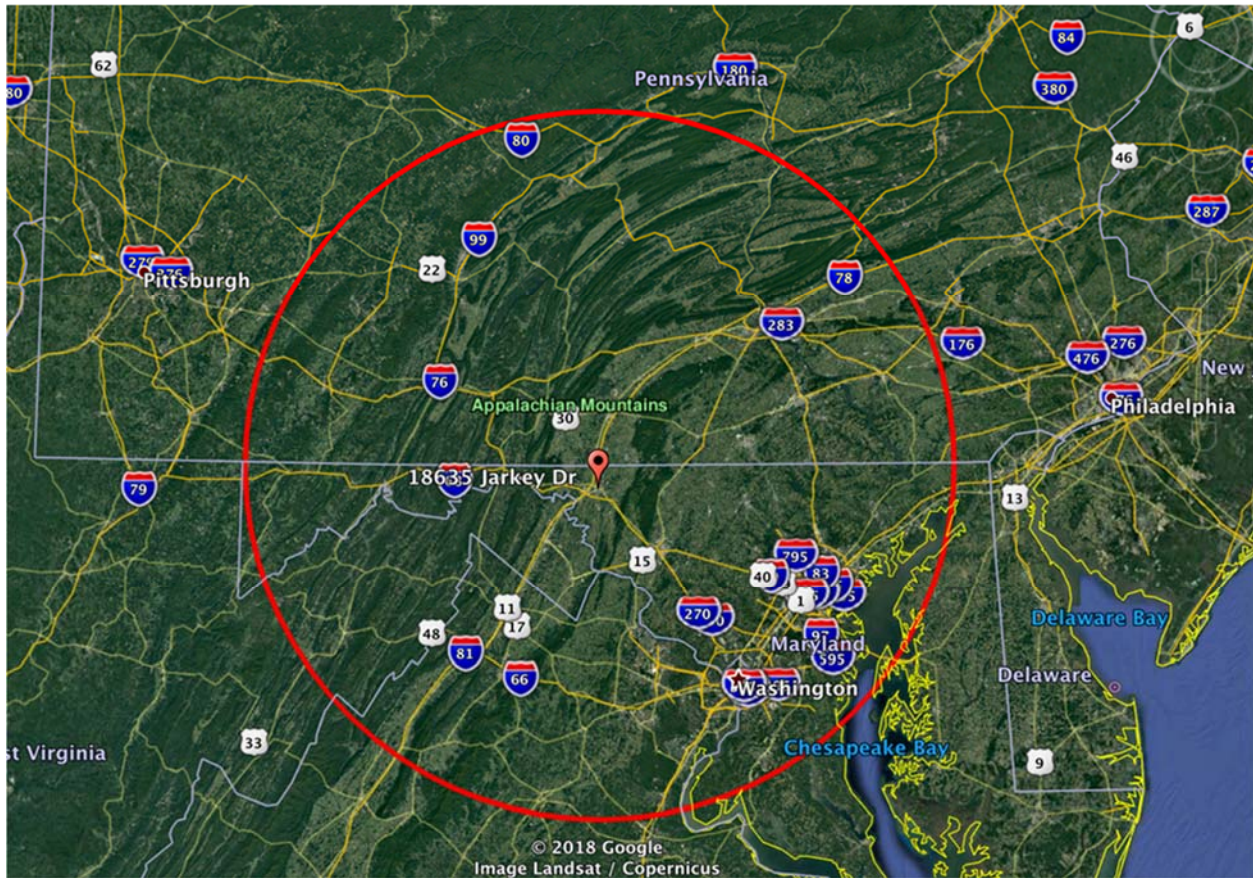


Figure 2: Test Location Radius

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				