

Engineering Report

WTFM – FM  
70 kW ERP on 98.5 MHz

Kingsport, TN

Engineering Statement In Response To  
Condition Two of Construction Permit for  
Replacement of 6-Bay FM Antenna,  
Holston Valley Broadcasting Corporation  
Permit File No. BPH-20190205AAI

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11 April 2019

## **Executive Summary**

This engineering statement has been prepared on behalf of Holston Valley Broadcasting Corporation, licensee of FM broadcast station WTFM, serving the Kingsport, TN market area. A Construction Permit (CP File No. BPH-20190205AAI) has been granted to the licensee in order to replace their licensed antenna which was recently damaged by falling ice. The replacement antenna is similar to their existing 6-Bay FM antenna, and will be mounted 14.1 m higher on the same tower.

The CP, granted on 19 February 2019, includes the following special operating condition (Condition Two):

The permittee/licensee shall, upon completion of construction and during the equipment test period, make proper radiofrequency electromagnetic (RF) field strength measurements throughout the transmitter site area to determine if there are any areas that exceed the FCC guidelines for human exposure to RF fields. If necessary, a fence must be erected at such distances and in such a manner as to prevent the exposure of humans to RF fields in excess of the FCC Guidelines (OET Bulletin No. 65, Edition 978-01, August 1997). The fence must be a type which will preclude casual or inadvertent access, and must include warning signs at appropriate intervals which describe the nature of the hazard. Any areas within the fence found to exceed the recommended guidelines must be clearly marked with appropriate visual warning signs.

An engineering Site Visit was requested for the purpose of collecting the requisite data for fulfilling this condition, and to make plans for any changes in the existing property fence if such is indicated by the results of field measurements. The present report documents the measurements taken in the vicinity of the tower (both inside and outside its existing fence), the relevance of these measurements with respect to the human exposure limits, and recommendations for compliance with the FCC Guidelines.

Roughly 250 formal measurements of RF power density were made in the general vicinity of the WTFM tower, both within the space enclosed by a protective fence around the tower and transmitter building, and extending a considerable distance away from the tower in all directions (excluding generally inaccessible areas). All measurements were well within the required MPE occupational limits inside the protected area, and well within the required general population limits outside the fenced-in area, thereby demonstrating the satisfaction of the operating condition cited above.

Measurements were made during on-site visits on 7 April 2019 and 9 April 2019.

## **General Outline of Material:**

1. Description of Tower Site
2. Instrumentation Used
3. Measurement Methodology
4. Tabulated Data and Discussion of Results

## **Tower Site Description**

The tower on which the FM antenna referred to in the Construction Permit is mounted is located at the end of Panhandle Road on Holston Mountain, TN. There are a large number of other tower facilities in the near vicinity to this tower site. The nearest tower to the WTFM tower is that for WJHL, located roughly 100 feet due North of the WTFM tower.

The tower is immediately surrounded by a small, fenced-in area, and a second, more extensive fenced-in area encloses both the tower and the transmitter building.

When the measurements described in the present report were made, the new 6-Bay antenna for WTFM broadcasting on 98.5 MHz had been constructed on the tower, and the station was operating in compliance with its construction permit. Other FM and TV stations with transmitters on Holston Mountain were also operating normally at this time.

## **Instrumentation Used**

The instrumentation used for the power density measurements was a broadband RF survey meter in combination with an FCC-compliant frequency shaped probe. The meter used was a Narda broadband Field Meter, model NBM-550 - 2400/101B, Serial Number E-0025, last calibrated on 20 September 2017. The associated probe used was a Narda E-Field Probe, model EA5091, Serial Number 01029, last calibrated on 9 October 2017. The probe is a shaped E-field isotropic probe, capable of measurement from 300 kHz to 50 GHz. All “formal” measurements were made using the mode for which each measurement is reported as a percentage of the OET65 occupational MPE limit. (See pages 12-13 for calibration sheets.)

Measurements of GPS coordinates were made on a “spot-check” basis at various measurement locations using a Garmin eTrex-20 GPS receiver.

A “calibrated rope” (NOT traceable to NIST) with markings at 10-foot intervals was used to facilitate the rapid discovery of measurement locations as marked distances from identifiable reference points.

## **Measurement Methodology**

Initial “informal” measurements were taken throughout the proposed measurement region, both inside and outside the area protected by fence, in order to locate possible “hot spots” at which the instantaneous power density exceeds the occupational MPE limit of  $1.0 \text{ mW/cm}^2$  (or general population limit of  $0.2 \text{ mW/cm}^2$ ), and to determine general locations where the readings tended to be higher than those of its immediate surroundings (even if not exceeding the limit).<sup>1</sup> No such “hot spots” were observed. The highest instantaneous readings inside the fence were observed near the (3, -2) measurement point in the vicinity of a section of 1-5/8” coaxial cable which was coiled up inside the fence (awaiting disposition). The highest instantaneous readings outside the fence were observed generally in the region south of the tower by 30 – 50 feet, with peak readings in the range of 60 – 75% of the General MPE limit.

All the “formal” power density measurements were taken at specific locations corresponding (roughly) to a grid matrix of points identified by their coordinates (x, y). The WTFM tower is located at the "origin" point of the measurement matrix (0, 0). The location of each measurement point is then identified by its set of coordinates (x, y), with each value of x and y generally being integral multiples of 10 feet, except where hindered by terrain, fence geometry, or other obstacles. All measurement locations are identified in a sketch of the tower site (p. 11).

The front face of the building (towards the road) is oriented roughly 4 degrees east of north (rotated CW from north-south line). For ease of measurement, the measurement grid was aligned with the geometry of the WTFM transmitter building, such that the "positive x" corresponds roughly (but not exactly) to points south of the tower, and "positive y" corresponds roughly to points east of the tower.

For the “formal” measurements, the meter was set up in the “continuous spatial averaging” mode, and in the mode for which measurements are expressed in terms of the percentage of the limit for a given standard. With the specific probe that was employed with the meter, the “standard” is automatically pre-selected by the meter to be the FCC occupational limit as described above. For this mode, a dominant measurement frequency is also to be inputted; the WTFM frequency of 98.5 MHz was selected for this purpose, although it is to be understood that the probe and meter combination still receives and makes use of the full instrument range of 300 kHz to 50 GHz for the measurements.

For each specific spatially averaged measurement, the meter is positioned near the ground, and when the spatial averaging is initiated, the meter is gradually and uniformly raised such that the probe traverses a vertical line extending from approximately 20 cm above the ground to a height of 2 meters in a time interval of 10 seconds. This is intended to simulate the “volume of space” taken up by a human body, and the measurement is designed to replicate the average amount of RF energy absorbed by a human standing at that location. The probe was kept at a minimum distance of 20 cm from other objects (such as near the fence line).

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<sup>1</sup> Note: This limit applies to frequencies in the range of 30 – 300 MHz. For other frequencies of interest (e.g., in the UHF band), the limits are less restrictive, hence for simplicity, the more restrictive limit is used as the basis for all the measurements.

## **Tabulated Data and Discussion of Results**

The data collected are presented in tabular form on the following five pages. The following should be noted:

1. The data are presented in the order in which the measurements were made.
2. GPS coordinate measurements were only made at strategic locations for “spot check” reference points. It was decided early on that attempting to obtain GPS coordinates for each measurement point would be too cumbersome, and potentially misleading since the GPS sensitivity for very small changes in position was not sufficient for differentiation.
3. The actual measured value, in every case, is the percent of the Occupational MPE limit. The other values presented (percent of General MPE, and Power Density) are calculated from the measured value.
4. The table indicates whether the measurement was made inside, or outside the fenced-in protected area. The % of MPE limit that applies for that location is highlighted (light beige).
5. For the measurements inside the fenced-in area, there were 3 locations for which the percent of the occupational MPE limit exceeded 10% of the limit, and the highest recorded measured value was 20.5%.
6. For the measurements outside the fenced-in area, there were 22 locations for which the percent of the General MPE limit exceeded 40% of the limit. The highest recorded value of these was 66.2%.
7. **It should therefore be noted that all measured values are well within the applicable limits of human exposure to RF per the FCC guidelines as documented in the OET Bulletin 65.**

RF FIELD MEASUREMENTS - PER OET BULLETIN 65 FCC GUIDELINES							
Measurements taken at Holston Mountain TX Site for WTFM-FM							
Meas. No.	Loc. Coord. (x,y)	GPS Coordinates		Power Density mW/cm2	% MPE Limit		inside/outside fence
		North	West		Occupational	General	
0	(0, 0)	36 25 53.7	82 08 14.8	Location of WTFM Tower			
1	(0, 1)			0.05309	5.309	26.545	outside
2	(0, 2)			0.1053	10.53	52.65	outside
3	(0, 3)			0.07286	7.286	36.43	outside
4	(1, 1)			0.05727	5.727	28.635	outside
5	(2, 1)			0.03925	3.925	19.625	outside
6	(2, 2)			0.05662	5.662	28.31	outside
7	(1, 2)			0.09757	9.757	48.785	outside
8	(1, 3)			0.07476	7.476	37.38	outside
9	(2, 3)			0.07232	7.232	36.16	outside
10	(1, 0)			0.03336	3.336	16.68	inside
11	(1, -1)			0.04491	4.491	22.455	inside
12	(1, -2)			0.008513	0.8513	4.2565	inside
13	(2, -1)			0.0556	5.56	27.8	inside
14	(2, -2)			0.03021	3.021	15.105	inside
15	(3, -2)			0.07561	7.561	37.805	inside
16	(4, -2)			0.06087	6.087	30.435	outside
17	(5, -2)			0.07241	7.241	36.205	outside
18	(6, -2)			0.04964	4.964	24.82	outside
19	(7, -2)			0.02879	2.879	14.395	outside
20	(8, -2)	36 25 53.1	82 08 15.3	0.02759	2.759	13.795	outside
21	(9, -2)			0.01142	1.142	5.71	outside
22	(4, -3)			0.07235	7.235	36.175	outside
23	(5, -3)			0.1063	10.63	53.15	outside
24	(6, -3)			0.06458	6.458	32.29	outside
25	(7, -3)			0.0438	4.38	21.9	outside
26	(8, -3)			0.01366	1.366	6.83	outside
27	(9, -3)			0.01059	1.059	5.295	outside
28	(4, -4)			0.07678	7.678	38.39	outside
29	(5, -4)			0.0522	5.22	26.1	outside
30	(6, -4)			0.03567	3.567	17.835	outside
31	(7, -4)			0.02192	2.192	10.96	outside
32	(8, -4)			0.01012	1.012	5.06	outside
33	(9, -4)	36 25 52.9	82 08 15.6	0.01354	1.354	6.77	outside
34	(4, -5)			0.07845	7.845	39.225	outside
35	(5, -5)			0.07534	7.534	37.67	outside
36	(6, -5)			0.03368	3.368	16.84	outside
37	(7, -5)			0.02282	2.282	11.41	outside
38	(8, -5)			0.01694	1.694	8.47	outside
39	(9, -5)			0.01503	1.503	7.515	outside
40	(4, -6)			0.05061	5.061	25.305	outside
41	(5, -6)			0.06446	6.446	32.23	outside
42	(6, -6)			0.02374	2.374	11.87	outside
43	(7, -6)			0.01778	1.778	8.89	outside
44	(8, -6)			0.02045	2.045	10.225	outside
45	(9, -6)			0.02584	2.584	12.92	outside
46	(3, -3)			0.2047	20.47	102.35	inside
47	(3, -4)			0.07265	7.265	36.325	inside
48	(3, -5)			0.0709	7.09	35.45	inside
49	(2, -5.5)			0.133	13.3	66.5	inside
50	(1, -5.5)			0.06621	6.621	33.105	inside
51	(0, -5.5)			0.04514	4.514	22.57	inside
52	(-1, -5.5)			0.04739	4.739	23.695	inside
53	(-2, -5.5)			0.04355	4.355	21.775	inside

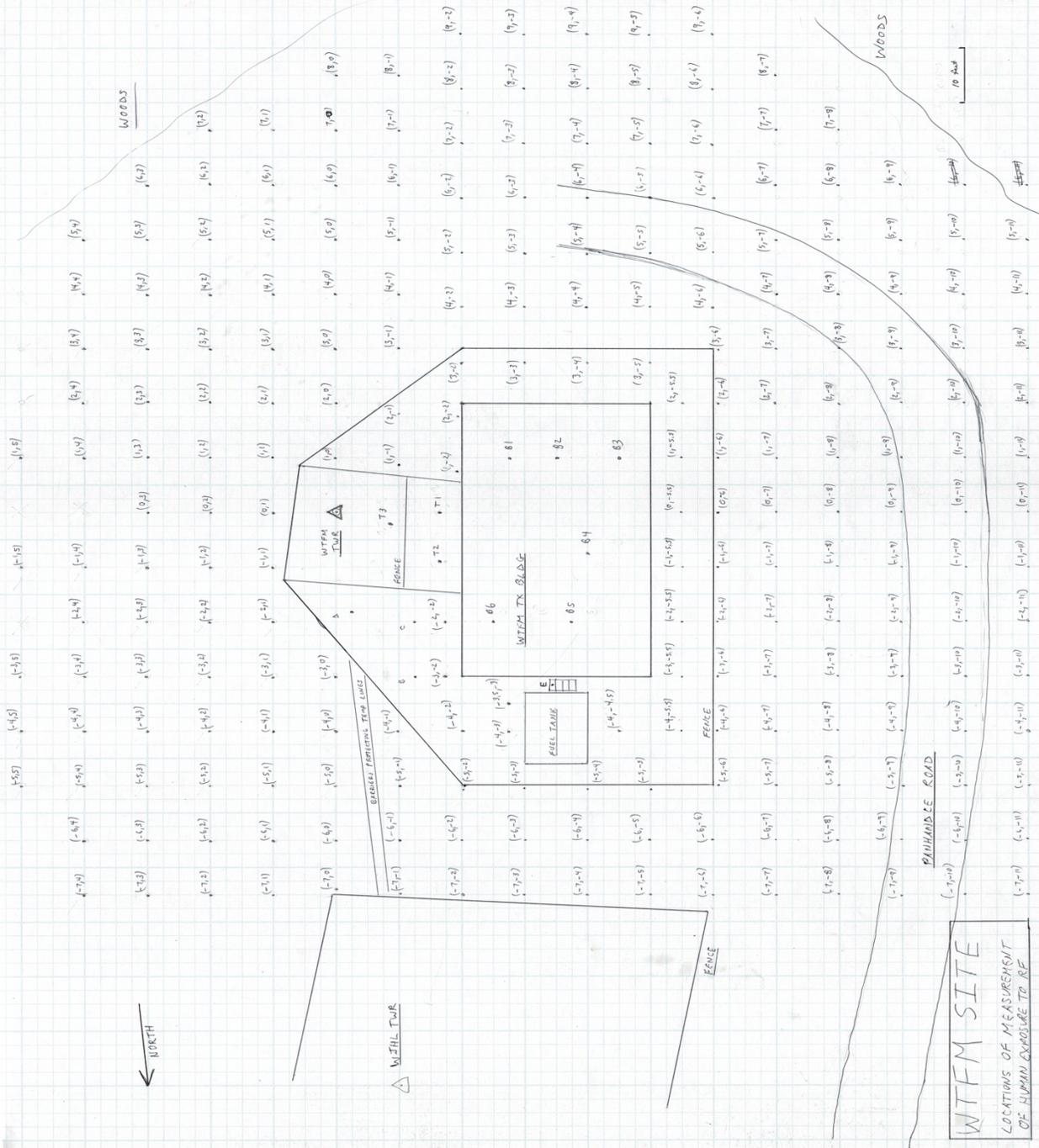
RF FIELD MEASUREMENTS - PER OET BULLETIN 65 FCC GUIDELINES							
Measurements taken at Holston Mountain TX Site for WTFM-FM							
Meas. No.	Loc. Coord. (x,y)	GPS Coordinates		Power Density mW/cm2	% MPE Limit		inside/outside fence
		North	West		Occupational	General	
54	(-3, -5.5)			0.05361	5.361	26.805	inside
55	(-4, -5.5)			0.06019	6.019	30.095	inside
56	(-4, -2)			0.06853	6.853	34.265	inside
57	B			0.1205	12.05	60.25	inside
58	C			0.06153	6.153	30.765	inside
59	D			0.02528	2.528	12.64	inside
60	E			0.08803	8.803	44.015	inside
61	(0, -6)			0.03495	3.495	17.475	outside
62	(0, -7)			0.1078	10.78	53.9	outside
63	(0, -8)			0.08518	8.518	42.59	outside
64	(0, -9)			0.05971	5.971	29.855	outside
65	(0, -10)			0.03882	3.882	19.41	outside
66	(0, -11)			0.04196	4.196	20.98	outside
67	(-1, -6)			0.04649	4.649	23.245	outside
68	(-1, -7)			0.07288	7.288	36.44	outside
69	(-1, -8)			0.0895	8.95	44.75	outside
70	(-1, -9)			0.04999	4.999	24.995	outside
71	(-1, -10)			0.03309	3.309	16.545	outside
72	(-1, -11)			0.04755	4.755	23.775	outside
73	(-2, -6)			0.02516	2.516	12.58	outside
74	(-2, -7)			0.06458	6.458	32.29	outside
75	(-2, -8)			0.05895	5.895	29.475	outside
76	(-2, -9)			0.03525	3.525	17.625	outside
77	(-2, -10)			0.03003	3.003	15.015	outside
78	(-2, -11)			0.03278	3.278	16.39	outside
79	(-3, -6)			0.0323	3.23	16.15	outside
80	(-3, -7)			0.06491	6.491	32.455	outside
81	(-3, -8)			0.04515	4.515	22.575	outside
82	(-3, -9)	36 25 53.9	82 08 16.1	0.03185	3.185	15.925	outside
83	(-3, -10)			0.0277	2.77	13.85	outside
84	(-3, -11)			0.04257	4.257	21.285	outside
85	(-4, -6)	36 25 53.4	82 08 15.7	0.0185	1.85	9.25	outside
86	(-4, -7)			0.03853	3.853	19.265	outside
87	(-4, -8)			0.06654	6.654	33.27	outside
88	(-4, -9)			0.04779	4.779	23.895	outside
89	(-4, -10)			0.03267	3.267	16.335	outside
90	(-4, -11)			0.03988	3.988	19.94	outside
91	(-5, -6)			0.02677	2.677	13.385	outside
92	(-5, -7)			0.02475	2.475	12.375	outside
93	(-5, -8)			0.0319	3.19	15.95	outside
94	(-5, -9)			0.02616	2.616	13.08	outside
95	(-5, -10)			0.02389	2.389	11.945	outside
96	(-5, -11)			0.03874	3.874	19.37	outside
97	(-6, -1)	36 25 54.2	82 08 15.2	0.04924	4.924	24.62	outside
98	(-6, -2)			0.05298	5.298	26.49	outside
99	(-6, -3)			0.0502	5.02	25.1	outside
100	(-6, -4)			0.04293	4.293	21.465	outside
101	(-6, -5)			0.03926	3.926	19.63	outside
102	(-6, -6)			0.0293	2.93	14.65	outside
103	(-6, -7)			0.022	2.2	11	outside
104	(-6, -8)			0.01749	1.749	8.745	outside
105	(-6, -9)			0.01688	1.688	8.44	outside
106	(-6, -10)			0.03032	3.032	15.16	outside
107	(-6, -11)			0.03823	3.823	19.115	outside

RF FIELD MEASUREMENTS - PER OET BULLETIN 65 FCC GUIDELINES								
Measurements taken at Holston Mountain TX Site for WTFM-FM								
Meas. No.	Loc. Coord. (x,y)	GPS Coordinates		Power Density mW/cm2	% MPE Limit		inside/outside fence	
		North	West		Occupational	General		
108	(-7, -6)			0.02188	2.188	10.94	outside	
109	(-7, -7)			0.01733	1.733	8.665	outside	
110	(-7, -8)			0.02007	2.007	10.035	outside	
111	(-7, -9)			0.03324	3.324	16.62	outside	
112	(-7, -10)			0.04697	4.697	23.485	outside	
113	(-7, -11)	36 25 54.5	82 08 16.3	0.0299	2.99	14.95	outside	
114	(-7, -1)			0.03214	3.214	16.07	outside	
115	(-7, -2)			0.03902	3.902	19.51	outside	
116	(-7, -3)			0.02949	2.949	14.745	outside	
117	(-7, -4)			0.02727	2.727	13.635	outside	
118	(-7, -5)			0.02397	2.397	11.985	outside	
119	(-7, -6)	36 25 54.4	82 08 15.8	0.01697	1.697	8.485	outside	
120	(-5, -6)			0.03131	3.131	15.655	outside	
121	(-5, -5)			0.01541	1.541	7.705	outside	
122	(-5, -4)			0.01205	1.205	6.025	outside	
123	(-5, -3)			0.02347	2.347	11.735	outside	
124	(-5, -2)			0.04172	4.172	20.86	outside	
125	(-5, -1)			0.05309	5.309	26.545	outside	
126	(1, -6)			0.0652	6.52	32.6	outside	
127	(1, -7)			0.09999	9.999	49.995	outside	
128	(1, -8)			0.0681	6.81	34.05	outside	
129	(1, -9)			0.04795	4.795	23.975	outside	
130	(1, -10)			0.03485	3.485	17.425	outside	
131	(1, -11)			0.02561	2.561	12.805	outside	
132	(2, -6)			0.05781	5.781	28.905	outside	
133	(2, -7)			0.0863	8.63	43.15	outside	
134	(2, -8)			0.1162	11.62	58.1	outside	
135	(2, -9)			0.0482	4.82	24.1	outside	
136	(2, -10)			0.02097	2.097	10.485	outside	
137	(2, -11)			0.01393	1.393	6.965	outside	
138	(3, -6)			0.07896	7.896	39.48	outside	
139	(3, -7)			0.06383	6.383	31.915	outside	
140	(3, -8)			0.04478	4.478	22.39	outside	
141	(3, -9)			0.0423	4.23	21.15	outside	
142	(3, -10)			0.02953	2.953	14.765	outside	
143	(3, -11)			0.02226	2.226	11.13	outside	
144	(4, -7)			0.04601	4.601	23.005	outside	
145	(4, -8)			0.03164	3.164	15.82	outside	
146	(4, -9)			0.03184	3.184	15.92	outside	
147	(4, -10)			0.0296	2.96	14.8	outside	
148	(4, -11)			0.02026	2.026	10.13	outside	
149	(5, -7)			0.03183	3.183	15.915	outside	
150	(5, -8)			0.01737	1.737	8.685	outside	
151	(5, -9)			0.02317	2.317	11.585	outside	
152	(5, -10)			0.02386	2.386	11.93	outside	
153	(5, -11)			0.02308	2.308	11.54	outside	
154	(6, -7)			0.02262	2.262	11.31	outside	
155	(6, -8)			0.02141	2.141	10.705	outside	
156	(6, -9)			0.02461	2.461	12.305	outside	
157	(7, -7)			0.02167	2.167	10.835	outside	
158	(7, -8)			0.02171	2.171	10.855	outside	
159	(8, -7)			0.03858	3.858	19.29	outside	
160	(2, 0)			0.06961	6.961	34.805	outside	
161	(3, -1)			0.1323	13.23	66.15	outside	

RF FIELD MEASUREMENTS - PER OET BULLETIN 65 FCC GUIDELINES							
Measurements taken at Holston Mountain TX Site for WTFM-FM							
Meas. No.	Loc. Coord. (x,y)	GPS Coordinates		Power Density mW/cm2	% MPE Limit		inside/outside fence
		North	West		Occupational	General	
162	(3, 0)			0.096	9.6	48	outside
163	(3, 1)			0.1043	10.43	52.15	outside
164	(3, 2)			0.07807	7.807	39.035	outside
165	(3, 3)			0.095	9.5	47.5	outside
166	(3, 4)			0.06433	6.433	32.165	outside
167	(4, -1)			0.0931	9.31	46.55	outside
168	(4, 0)			0.09778	9.778	48.89	outside
169	(4, 1)			0.07837	7.837	39.185	outside
170	(4, 2)			0.1068	10.68	53.4	outside
171	(4, 3)			0.08388	8.388	41.94	outside
172	(4, 4)			0.04695	4.695	23.475	outside
173	(5, -1)			0.08673	8.673	43.365	outside
174	(5, 0)			0.05481	5.481	27.405	outside
175	(5, 1)			0.05923	5.923	29.615	outside
176	(5, 2)			0.1182	11.82	59.1	outside
177	(5, 3)			0.07614	7.614	38.07	outside
178	(5, 4)			0.02743	2.743	13.715	outside
179	(6, -1)			0.06554	6.554	32.77	outside
180	(6, 0)			0.06745	6.745	33.725	outside
181	(6, 1)			0.07092	7.092	35.46	outside
182	(6, 2)			0.06749	6.749	33.745	outside
183	(6, 3)			0.09332	9.332	46.66	outside
184	(7, -1)			0.04748	4.748	23.74	outside
185	(7, 0)			0.0416	4.16	20.8	outside
186	(7, 1)			0.0671	6.71	33.55	outside
187	(7, 2)			0.08881	8.881	44.405	outside
188	(8, -1)			0.02459	2.459	12.295	outside
189	(8, 0)			0.01951	1.951	9.755	outside
190	(-3, -2)			0.09789	9.789	48.945	inside
191	(-2, -2)			0.05928	5.928	29.64	inside
192	(-4, -3)			0.0765	7.65	38.25	inside
193	(-3, -3.5)			0.05796	5.796	28.98	inside
194	(-4, -4.5)			0.04321	4.321	21.605	inside
195	(2, 4)			0.07884	7.884	39.42	outside
196	(2, 5)			0.04176	4.176	20.88	outside
197	(1, 4)			0.04124	4.124	20.62	outside
198	(1, 5)			0.02771	2.771	13.855	outside
199	(-1, 1)			0.07956	7.956	39.78	outside
200	(-1, 2)			0.09056	9.056	45.28	outside
201	(-1, 3)			0.06334	6.334	31.67	outside
202	(-1, 4)			0.04273	4.273	21.365	outside
203	(-1, 5)			0.04412	4.412	22.06	outside
204	(-2, 1)			0.03624	3.624	18.12	outside
205	(-2, 2)			0.05476	5.476	27.38	outside
206	(-2, 3)			0.0787	7.87	39.35	outside
207	(-2, 4)			0.05574	5.574	27.87	outside
208	(-3, 0)			0.06809	6.809	34.045	outside
209	(-3, 1)			0.04984	4.984	24.92	outside
210	(-3, 2)			0.06342	6.342	31.71	outside
211	(-3, 3)			0.05407	5.407	27.035	outside
212	(-3, 4)			0.03576	3.576	17.88	outside
213	(-3, 5)			0.02038	2.038	10.19	outside
214	(-4, -1)			0.06073	6.073	30.365	outside
215	(-4, 0)			0.0626	6.26	31.3	outside



NORTH



**WFTM SITE**  
 LOCATIONS OF MEASUREMENT  
 OF HUMAN EXPOSURE TO RF



# Certificate of Calibration



Certificate Number: 26800  
 Certificate Date: 3/28/2019  
 Manufacturer: Narda  
 Model: NBM-550,2400/101B  
 Serial Number: E-0025  
 Description: 100 kHz - 60 GHz Broadband Field Strength M

Date Received: 08/11/2017  
 Date of Calibration: 9/20/2017  
 Recommended Due Date: 9/20/2019  
 Temperature: 23.50 °C  
 Relative Humidity: 38.0 %RH

Cal Procedure  
 2401-8700-00A

Customer Name: Advanced Test Equipment Corporation  
 Customer Address: 10401 Roselle Street, San Diego CA 92121  
 PO Number:  
 CRM Order Number: Stock Calibration

Comments:

Calibration performed by an Authorized Subcontractor.

This Calibration is traceable to the International System of Units (SI), through National Metrology Institutes, ratio metric techniques, or natural physical constants. This certificate applies only to the item identified and shall not be reproduced other than in full, without the specific written approval by ATEC Corporation Laboratory. The calibration has been completed in accordance with ATEC's Active Use Calibration System.

This calibration conforms to the requirements of ISO/IEC 17025:2005 and ANSI/NCSL Z540-1:1994 (R2002). In the attached measurement results, deviation may be expressed with units, Measured Value (MV) - Nominal Value (NV) or as a proportion of the nominal value ((MV-NV)/NV), expressed without units with a scalar multiplier such as % (0.01), or as a ratio of the units (mA/A,  $\mu$ V/V, etc.) Descriptions such as  $\mu$ A/A,  $\mu$ V/V, and others, where used to annotate results or column headings are the preferred replacements for what was historically labeled as "ppm" or parts-per-million and described the results in that column, unless otherwise noted by units symbols.

Where applicable, the expanded uncertainty of measurement at the time of test is given in the following pages. They are calculated in accordance with the method described in the ISO Guide to the Expression of Uncertainty in Measurement (GUM). The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k, such that the confidence level approximates 95%.

This Calibration certificate may contain data that is not covered by the A2LA Scope of Accreditation. Unaccredited material, where applicable is indicated by an asterisk (\*), or confined to clearly marked sections. Functional (Pass / Fail) tests are not accredited.

No statement of compliance with specifications is made or implied on this certificate. However, measurement results are reviewed, where applicable, to establish where any measurement result exceeded the manufacturer's specifications.

Measured values (MV) greater than the Manufacturer's specification (Spec) are indicated by "X".

Calibration Performed By:		Authorized by:	
Christensen, Rick	Technician	Javier Estrada	03/28/2019
Name	Title	Montage Supervisor	Certificate Date

*ATEC Corporation calibration documents are electronically signed utilizing MetaCert Metrology Software Suite of Applications*

ATEC Corporation  
 10401 Roselle St  
 San Diego, CA 92121

Telephone  
 888-488-2832

Facsimile  
 858-588-6570

Internet  
 www.ATECorp.com

QF21/122713



# Certificate of Calibration



Certificate Number: 27020  
Certificate Date: 3/28/2019

Date Received: 09/05/2017  
Date of Calibration: 10/9/2017  
Recommended Due Date: 10/9/2019  
Temperature: 23.90 °C  
Relative Humidity: 34.2 %RH

Manufacturer: Narda  
Model: EA5091  
Serial Number: 01029  
Description: 300kHz-50GHz Isotropic Probe, Shaped E-Fie

Cal Procedures  
Probe ATE Software, 990313 v3.0.2

Customer Name: Advanced Test Equipment Corporation  
Customer Address: 10401 Roselle Street, San Diego CA 92121  
PO Number:  
CRM Order Number: Stock Calibration

Comments:

Calibration performed by an Authorized Subcontractor.

This Calibration is traceable to the International System of Units (SI), through National Metrology Institutes, ratio metric techniques, or natural physical constants. This certificate applies only to the item identified and shall not be reproduced other than in full, without the specific written approval by ATEC Corporation Laboratory. The calibration has been completed in accordance with ATEC's Active Use Calibration System. This calibration conforms to the requirements of ISO/IEC 17025:2005 and ANSI/NCSL Z540-1-1994 (R2002).

In the attached measurement results, deviation may be expressed with units, Measured Value (MV) - Nominal Value (NV) or as a proportion of the nominal value ((MV-NV)/NV), expressed without units with a scalar multiplier such as % (0.01), or as a ratio of the units (mA/A,  $\mu$ V/V, etc.) Descriptions such as  $\mu$ A/A,  $\mu$ V/V, and others, where used to annotate results or column headings are the preferred replacements for what was historically labeled as "ppm" or parts-per-million and described the results in that column, unless otherwise noted by units symbols.

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Measured values (MV) greater than the Manufacturer's specification (Spec) are indicated by "X".

Calibration Performed By:		Authorized by:	
Christensen, Rick	Technician	Javier Estrada	03/28/2019
Name	Title	Managers Supervisor	Certificate Date

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