Welcome to AntennaSelect™ Volume 27 – August 2016

Welcome to Volume 27 of our newsletter, AntennaSelect™. Every two months we will be giving you an "under the radome" look at antenna and RF Technology. If there are subjects you would like to see covered, please let us know what you would like to see by emailing us at: info@micronetixx.com

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Repack Space Squeeze - How Long is That FM Antenna?

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The Re-Packing will affect many FM users who are co located with a TV station. Available space may tighten up, which could mean going with a lower gain FM antenna, or moving to another tower.

We've included a Comparison Table, (on the next page), of popular bay-count FM antennas. Models from 2 to 12 bays are included. The minimum clear vertical space is listed at 5 frequencies, 88.1, 93.1, 98.1, 103.1 and 107.9 MHz. Antenna length is shown in five bay to bay spacings: 0.50, 0.70, 0.75 0.875 and 1 wavelength. The gain of the antenna with each bay count and spacing is also given. (The gain figures given are without any beam tilt or null fill added.)

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FM antenna length and gain table

2 Bay

Spacing	0.50 (180)	0.70 (252)	0.75 (270)	.875 (315)	1.0 (360)
88.1	**15.7**	**17.9**	**18.5**	**19.9**	**21.3**
93.1	**15.4**	**17.5**	**18.2**	**19.4**	**20.6**
98.1	**15.1**	**17.1**	**17.7**	**18.9**	**20.2**
103.1	**14.9**	**16.8**	**17.3**	**18.5**	**19.6**
107.9	**14.7**	**16.5**	**16.9**	**18.1**	**19.1**
Gain (C/P)	**0.68**	**0.89**	**0.92**	**0.96**	**0.99**

4 Bay

Spacing	0.50 (180)	0.70 (252)	0.75 (270)	0.875 (315)	1.0 (360)
88.1	**26.8**	**33.5**	**35.2**	**39.4**	**43.5**
93.1	**26.0**	**32.2**	**33.8**	**37.8**	**41.7**
98.1	**25.1**	**31.1**	**32.6**	**36.4**	**40.1**
103.1	**24.4**	**30.1**	**31.6**	**35.1**	**38.7**
107.9	**23.7**	**29.2**	**30.6**	**34.0**	**37.4**
Gain (C/P)	**1.30**	**1.75**	**1.84**	**2.05**	**2.10**

6 Bay

Spacing Freq.	0.50 (180)	0.70 (252)	0.75 (270)	0.875 (315)	1.0 (360)
88.1	**38.0**	**49.2**	**52.0**	**58.9**	**65.9**
93.1	**36.7**	**47.2**	**49.7**	**51.8**	**62.9**
98.1	**35.1**	**45.2**	**47.7**	**54.0**	**60.2**
103.1	**34.0**	**43.5**	**45.9**	**51.9**	**57.8**
107.9	**32.8**	**42.0**	**44.3**	**50.0**	**55.6**
Gain (C/P)	**1.90**	**2.57**	**2.72**	**3.10**	**3.22**

8 Bay

Spacing	0.50 (180)	0.70 (252)	0.75 (270)	0.875 (315)	1.0 (360)
88.1	**49.2**	**64.8**	**68.7**	**78.5**	**88.2**
93.1	**47.4**	**61.9**	**65.6**	**74.8**	**84.1**
98.1	**45.2**	**60.0**	**62.7**	**71.5**	**80.2**
103.1	**43.5**	**56.9**	**60.2**	**68.5**	**76.9**
107.9	**42.0**	**54.7**	**58.0**	**65.9**	**73.9**
Gain (C/P)	**2.50**	**3.60**	**3.65**	**4.15**	**4.30**

10 Bay

Spacing Freq.	0.50 (180)	0.70 (252)	0.75 (270)	0.875 (315)	1.0 (360)
88.1	**60.4**	**80.4**	**85.5**	**98.0**	**110.5**
93.1	**58.0**	**76.7**	**81.4**	**93.4**	**105.1**
98.1	**55.2**	**73.2**	**77.8**	**89.0**	**100.3**
103.1	**53.0**	**70.2**	**74.5**	**85.3**	**96.0**
107.9	**51.1**	**67.5**	**71.6**	**81.9**	**92.1**
Gain (C/P)	**3.10**	**4.28**	**4.52**	**5.22**	**5.60**

12 Bay

Spacing	0.50 (180)	0.70 (252)	0.75 (270)	0.875 (315)	1.0 (360)
88.1	**71.4**	**96.0**	**102.2**	**117.5**	**132.9**
93.1	**68.7**	**91.5**	**97.3**	**111.8**	**126.3**
98.1	**65.2**	**87.7**	**92.8**	**106.6**	**120.3**
103.1	**62.6**	**83.6**	**88.8**	**101.9**	**115.1**
107.9	**60.2**	**80.3**	**85.3**	**97.8**	**110.3**
Gain (C/P)	**3.70**	**5.15**	**5.45**	**6.30**	**6.60**

The lengths shown in the table are calculated with 5 feet above the top bay and 5 feet below the bottom bay. If possible an extra 5 feet of space on each end will ensure better operation if there are any nearby antennas (dish, other FM and TV antennas) .

Let's consider an example and run some calculations. We'll start out with a 12-bay antenna, on 98.1 MHz, with inter-bay spacings of 1 wavelength. The ERP is 100 kW and the station uses circular polarization. A 500 foot run of 3 inch air flex line with a 0.70 dB (85.11 % efficiency) loss will also be used.

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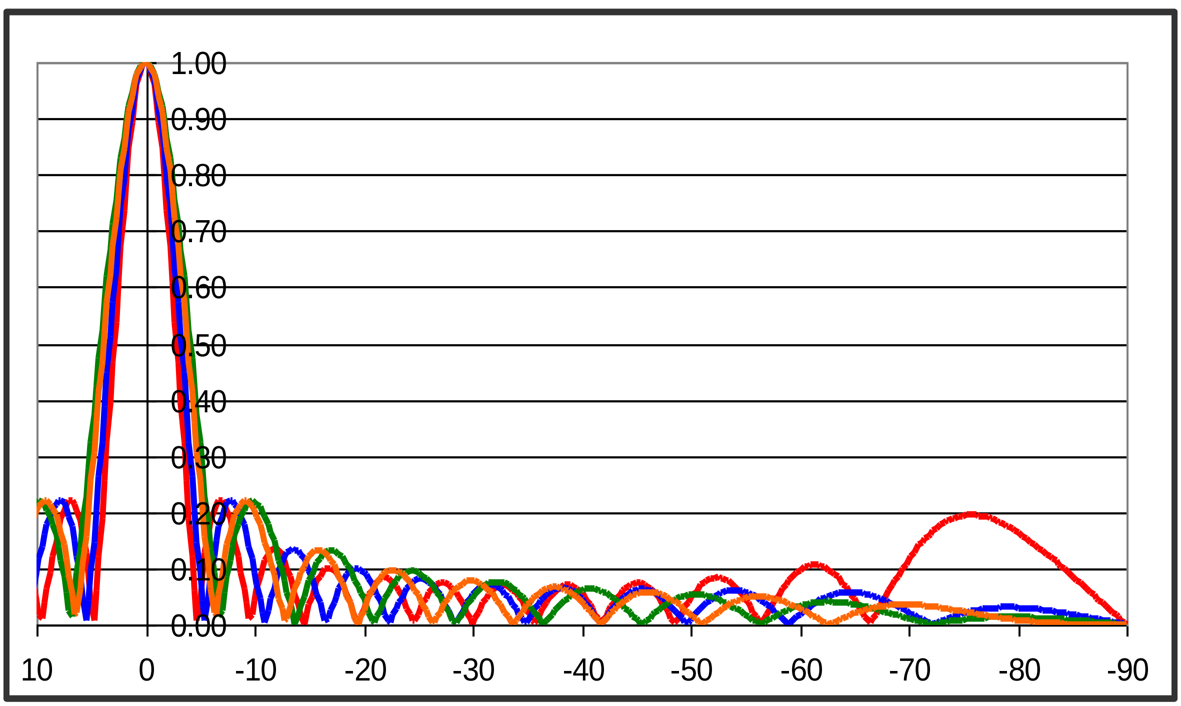
The antenna has a gain of 6.6 (8.19 dB). The input power to the antenna would be 15.15 kW. With the transmission line loss of 0.70 dB, the transmitter output would be 17.80 kW. If we try a 12-bay antenna with shorter inter bay spacings of 0.875 wavelength (315 electrical degrees), the gain drops to 6.30 (7.99 dB). The TPO increases to 18.65 kW. The 0.875 wavelength antenna is 13.7 feet shorter than the full wave spaced antenna.

So let's try a shorter antenna with 0.75 (270 degrees) wave inter-bay spacing. The gain of this antenna is 5.45, so a TPO of 21.19 kW is needed. This antenna is 27.5 feet shorter than the 1-wavelength-spaced model. (A 10 to 12 bay UHF slot antenna vertical space.)

…One more comparison: This time the inter-bay spacing will be reduced to 0.70 wavelength. The gain of this antenna is 5.15, which will raise the TPO to 22.35 kW. This option frees up 32.6 feet of space as compared to the 1-wavelength model.

So how about the elevation pattern performance?



Red plot is 1 wavelength, Blue plot is 0.875 wavelength, Orange plot Is 0.75 wavelength and Green is 0.70 Wavelength.

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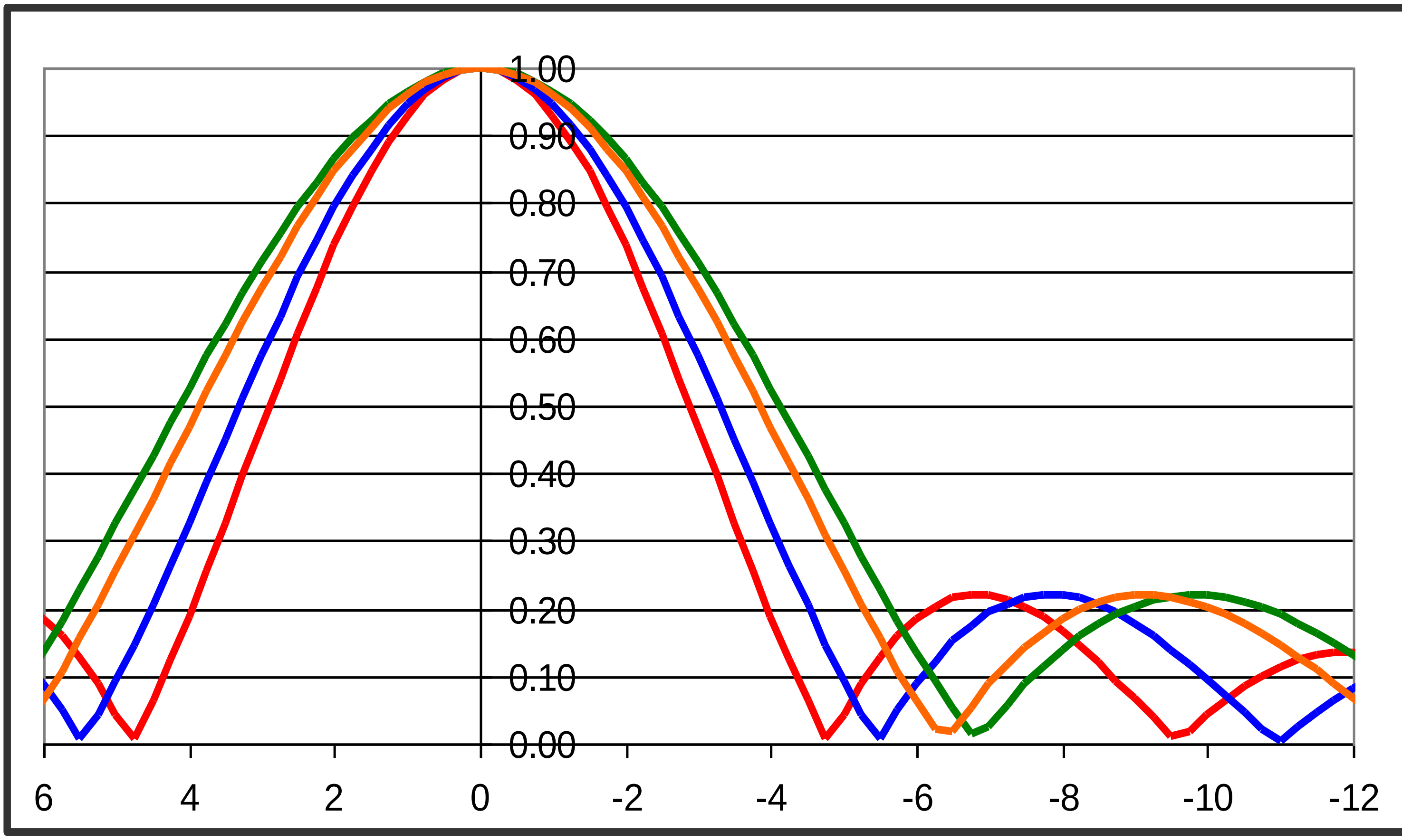

1 WL RED, **0.875 WL BLUE**, **0.75 WL ORANGE**. **0.70 WL GREEN**

Here are the same four elevation plots zoomed in. On the previous page, we showed the gain of the 12-bay antenna, and other inter-bay spacings. As the spacing between bays is reduced, the elevation gain of the array drops. Two things were happening; the width of the main lobe becomes wider, and the high angle grazing lobes decrease, (always a good thing).

If the core of your coverage area was at -4 degrees, the 0.70 wavelength spaced antenna would provide an ERP of 27.45 kW, versus, 2.78 kW for the full wave spaced antenna – just under a 10 dB increase of signal strength in that high-density zone. If your station is up on a ridge not that far from where your listeners are, that 9.98 dB increase of signal is worth its weight in gold. Your far fringe listeners still get close to 100% of peak RF field. Now: how does this affect the loads on the tower?

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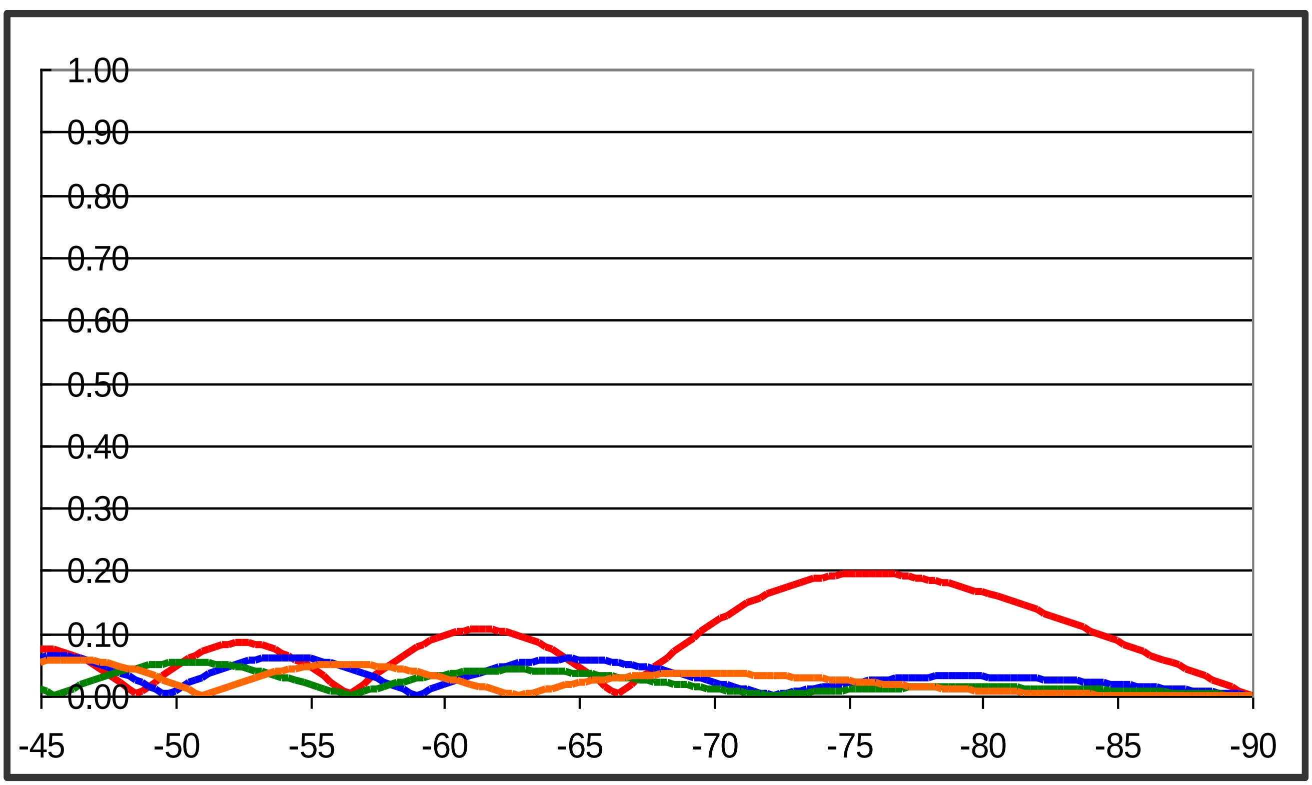
The shorter antenna does drop the loading on the tower, however not that much. There are still 12 antenna bays, and they present the same loads, full wave or short-spaced. The only difference (using the 0.70 WL spaced bay numbers) is the total length of the inter bay feed line. Since we have shortened the antenna by 32.6 feet, all of that weight is from a shorter feed system. So applying a 2.5 pound per foot of feed-system times 32.6 feet is a 81.5 pound decrease in antenna weight, and about 10 square feet of wind load area. However if you are leasing vertical space on the tower by the foot, that may be the main savings driver.

Now what if you have limited options with only a number of short towers up on a ridge? Here is your short spaced antenna bonus: Lower **RFR**. You can place your antenna closer to the ground. The short-spaced models of the 12-bay antenna have much lower high depression angle grazing lobes. All three short spaced models have less than 7% of peak field from -45 to -90 degrees, up to 15 dB less than the full wave spaced antenna (RED PLOT).

We would love to design your next FM antenna! …Give us a call!



Multi-Bay Antennas and AM Translators

With the higher power level of AM translators, there is 2-1/2 times more RF energy than the maximum LPFM ERP. Proper installation of multi-bay antennas becomes even more important. Many of the translators are planning on two or even four bay FM antennas. The feed point for these antennas is in the center of the array, with the feed lines being under a foot away from the antenna bay, along with the support monopole (outrigged pole). With the antenna bays being very close, any metallic object will be excited with a lot of RF energy. These metallic objects become part of the antenna. As their electrical relationships change due to weather, the antenna array itself can start to detune.

All of our multi-bay FM antennas are tested outdoors on one of our test stands. The antenna bays are mounted on a 3-1/2” pipe and the cut-to-frequency feed harness is connected. The antennas are then final-tuned to frequency, and are checked for a proper phase and amplitude relationship.

When the antenna is installed at the user’s location, an outrigged pole, 3-1/2 inches O.D. should be installed off the leg of the tower, by a minimum of 18 inches, with 36 inches being ideal. Going out to 36 inches also help reduce pattern scatter through the tower. The outrigged pole should be well grounded to the tower, for both optimal lightning protection and a steady RF path. Also the length of the outrigged pipe extend 5 feet above the top bay and 5 feet below the bottom bay. This will ensure the optimal launch of a C/P signal.

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The feeder cables need to be installed exactly per factory instructions. This means wrapping the feeders from the input tee to the bays tightly around the outrigged pole. By wrapping the feeders around the pole, currents flowing on the outside of the mounting pole do not couple as well with the coax feeders (remember when we used twin lead on TV antenna connections and were told to twist the line?). The current flows are altered as the outside jacket of the coax becomes wet during rain. The net capacitance between the outer conductor of the coax and the pole changes. Since the feed line is part of the antenna array, this can slightly detune the antenna as moisture comes and goes. Tightly wrapping the coax around the pole reduces the currents in the outer conductor and minimizes capacitive change. Hence less detuning.

Also it is important to bond the input tee connector to the support pole. This grounds excited RF energy on outer conductor surface of the coax. A ground kit with a short, flat lead wire can be used. A number of installers also use stainless steel hose clamps. With the feed system now being at RF ground, detuning is greatly reduced since there is much less re-radiation from the outer conductor of the coax.

If you are building a translator, or LPFM station, our applications engineering staff would be happy to answer questions, or look at what your site constraints are. Give us a call; we're all here for you!

Be on the lookout for the next volume of AntennaSelect™ coming out in October

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