Part 15.219(b) Rule Making Petition

Page

Comments by advocates and other interested parties should be placed on separate pages. The original text may not be modified in any way. Since Part 15 rule making is not a base or platform for political issues such as visions of and for commercial content and media content, no comments or suggestions on those issues are a part of this vision of Part 15 rule making.

Part 15.219(b) Rule Making Petition

Drafted by Dannie Jackson 2007
On Behalf of all Part 15.219 Unlicensed Broadcast Stations

Regarding Specialized Intentional Radiator Applications:

As the use of Part 15 applications takes on new meanings with new and innovative technology applications. And the world of Wi Fi and broadband applications, as well as, broadband over power line concepts. All move forwards in the realms of innovation and technology. I, along with those who may come to sign onto, and support this petition. Want to bring to the attention of the FCC that there is a long standing need for a technical review of Part 15.219(b). And that as the future proceeds forth, this need should be looked at and thus be considered for the purposes of augmenting the rules of 15.219(b). Wherein this petition for rule making suggestions, will be for use only in the 1600 to 1700 kHz Regional Band segment only. And thus confining this suggested application in the field, to this band segment. And hence not for use all over the Medium Wave Band. The unlicensed stations using these rules then will be unable to interfere with a clear channel station's nighttime sky wave, or daytime ground wave. Hence 91.45% of the channels of the Medium Wave band spectrum, will not be effected by these suggestions. *Based upon using 10 channels only; out of the 117 channels.*

Wherein: from 530kHz to 1700kHz

(1700khz – 530kHz)/10kHz spacings = 117 broadcast channels

100% - ((10 channels /117 channels)*100) = 91.452991452991% ... channels un~effected by these suggestions.

As we look at the "in the field," technical means to achieve what this petition for Rule Making suggest. *It will all be in light of demonstrating why such changes to the rules would not result in licensed stations receiving increased harmful interference.* Not only from the unwanted emissions; but also from the increased emission level of the unlicensed fundamental signal. Wherein the increased fundamental energy emission increase, will only be made such, in a passive, and not by way of a active electronic means. *By an alternative antenna radiator rule.* Where the unlicensed Part 15.219(b) station does not have it's current level of 100 milliwatt input to the radiator changed in anyway. Hence we will not alter the power input herein at all. But retain always that specified Part 15, 100 mW level.

These technical specifications will be looked at along with their means of technical implementation a little further in this text.

Reasons For The Needed Change In The Section 15.219(b) Rule:

These rule making suggestions are the results of a long study of antenna radiators for use in the Medium Wave Band. Where the study was devoted at first to low height radiators for conventional licensed broadcast stations. Where the the effects of height versus radiation resistance was studied and compared. And further, was compared to the losses due to the near electrical field area ground resistance. These were software analysis studies using NEC and MMANA as well as GAL~ANA softwares. And with the aid of VERTILOAD.EXE by R.J. Edwards which is the more important software used.

The next reason for this petition for rule making suggestions. Is the interest of those in the Part 15 broadcast community. Who have long desired for an antenna radiator rule change be made. Only for those Part 15 devises as defined in 15.219 in, and where, these emissions are within the limits of 15.209. But are expected to be more on average with the limit, but due to losses in the system; are not expected to exceed the emission level of 24000/F(kHz) at 30 meters. Since a perfectly well made radial ground system will be rare in most cases. Though somewhat of a minimally effective ground system will be employed by most users. The more effective ground system perhaps on average being in the rural areas where there is more room. And on average where there are fewer licensed stations.

Efficiency data versus losses of the most efficient antenna design will be provided within, as well as a discussion of the means and methods suggested for rules that will be used by the users to prevent unwanted interference.

In 15.219(b) the antenna radiator for use with a 100mW unlicensed broadcast transmitter naturally is not, and never could become an efficient radiator. And improvements on the radiator can be made without changing the radiators height. And still it would never become an efficient radiator. There is however a sort of radiator that will perform better at the 3 meter height than the one in 15.219(b). Yet it's bandwidth is not very wide and thus attenuates the the fundamental signal's sidebands. Which technically is a good thing, since this would filter down the bandwidth in terms of adjacent channel interference. This key point should not be forgotten as this topic progresses. Keep in mind that the antenna I will make mention of herein is narrow on bandwidth. And is of the same height (not length) as 3 meters, I say not length because it has a coil element in it's design. The coil helps to resonate the antenna and make it better on it's energy and also acts to define it's bandwidth which is useful in making the antenna also serve as a single channel filtering element.

Before I progress with this technical discussion, I want to say that what I am proposing for review herein. Is of interest to those who support Licensed Low Powered AM Broadcasting concepts. And before we consider in any future rule making petitions those things that have been proposed for LPAM such as 10 watt RMS transmitters and 50 foot high antennas. Let us see if we can meet with a compromise and maybe for the time being, if not for a long while. Aid the LPAM concept with my technical recommendations for 15.219(b) and make the Part 15 unlicensed radio station concept a little more friendly.

Interpretation of the current version of 15.219(b):

The vision of the current rule of 15.219(b) appears to be for limiting the radiation and for limiting the interference.

Quoting John A Reed, Senior Engineer, FCC Technical Rules Branch in a forwarded response to me from December 21, 2007. He said: "The unlicensed standards were not established based on the operating range of the unlicensed transmitter. Rather, these standards were established to limit the potential for unlicensed transmissions to cause harmful interference to licensed stations. We are concerned not only with harmful interference to the ground wave coverage of licensed AM stations but also to their sky wave coverage which can allow AM broadcasts to be received at locations many hundreds of miles distant. "

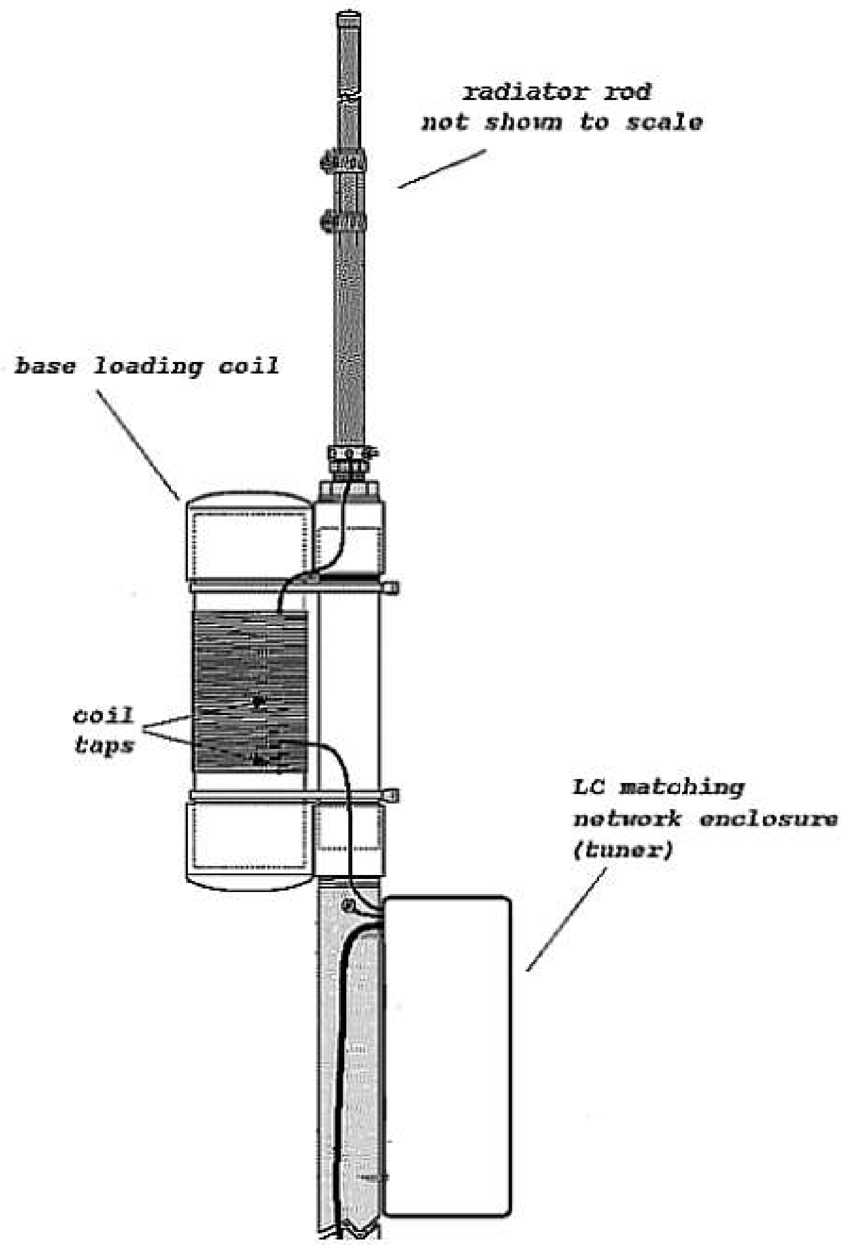
Having then studied Medium Wave Antennas and their concepts as well as losses. It is thus the reality that the antenna recommendations I make herein will not adversely effect the Part 15 unlicensed radio station in Section 15.219 and make it into something that would not conform to the FCC's vision.

First of all these suggestions for 15,219(b) stands on the following merits that as long as a transmitter does not have a 5 element or more low pass rf filter at it's output and some means of modulation peak limiting as in peak sampling and limiting circuitry (or automatic level control circuitry). As well as having the audio input filtered with a specified bandpass filter. Along with a low pass rf filter at the transmitter's output. The alternative herein can not be used. And the recommendation herein can not be used with any other Part 15 device not intended to act as a small low powered unlicensed 100mW broadcast station.

Borrowing views from people experimenting and reporting things on the Internet: The following realizations where obtained about the ....

suggested special application radiator herein.

I have studied some comments I have found in numerous Internet based blog and forum articles on the matter of the SSTRAN and similar antenna designs. This is a 3 meter high antenna that is being built by numerous people. I however do not see that it conforms to current Rules in that it uses a base loading coil. Most of us understand that the Part 15.219(b) antenna radiator is a straight length of wire or rod who's length includes the feed line and grounding wire.



I do however want to refer to the comments made by those who posted the blogs and articles. That the 3 meter high base loaded antenna with a good ground radial system was on average well heard out to a 0 .7 to 1 mile radius. And in the articles more often then not, this was the reported performance and those who were experimenting with these designs seemed very happy with them. I personally am curious about them yet, since I can see these do not fit the current vision of Part 15.219(b), I am not recommending people use them. Nor do I have one myself. I however want to discuss their feasibility of use. And that the antenna can be used with safety in terms of not being a problem. In software designs I know that such antenna types as mentioned above, are narrow banded at resonance and can act as narrow channel bandpass filters with the signal. And this is good for minimizing adjacent channel interference and can offer some out of band attenuation. An coupled with a transmitter that is utilizing alc control of the modulation, as well as audio bandpass filtering and double Pi network low pass rf output filter. The emissions should remain narrow with regard to adjacent channels. And limit out of band emissions down by 50 dB at the design cutoff frequency of a low pass rf filter.

The Body Of 15.219(b) Rule Making Suggestions:

And Their Technical Requirements:

Following then are some suggestions I offer to be studied for possible Rules to be made or changed. I will offer theses in the format as if they are already the Rules so you can see how they will look and what they specify and that they require no other rules to be changed or made. This will be the way Part 15.219(b) can be made:

"A petition for rule making also needs to demonstrate why such changes to the rules would not result in licensed stations receiving increased harmful interference not only from the unwanted emissions but also from the increased emission level of the unlicensed fundamental signal." John A. Reed

The following discussion of technical requirements for use, when using these suggested rules in the field. Demonstrate the methods whereby the following things will be satisfied. In terms of meeting with specifications for demonstrating how, these suggested rules would not result in licensed stations receiving increased harmful interference, not only from the unwanted emissions but also from the increased emission level of the unlicensed fundamental signal. The following defines some refined concepts for running a clean signal, free of extended side band content levels and spurious emission byproduct levels. With audio bandwidth filtering and rf low pass filtering. All backed up with ....

modulation control through automatic level control or alc output sampling.

This vision of a rule change within Part 15.219(b), is for a certain type of Part 15 unlicensed community station set up. That must have certain requirements of type acceptance met with. In order to utilize the alternative rules suggested herein. Otherwise, as will be stated in the final viewing of these suggested rules, the existing rendering of 15.219(b) will apply to Part 15 transmitters who do not meet with these technical requirements to abide by the existing 3 meter long antenna radiator rule as it is currently in 15.219(b). Hence the following is an augmentation and alternative.

Further: the acceptable augmented Part 15 station set up, shall be a more technologically advanced type of Part 15 unlicensed station, that meets with numerous important requirements to minimize the effects of interference. And to limit it, so that interference to existing high powered stations shall be low in level. **And, the unlicensed station shall not operate on or near a frequency adjacent to a regional licensed station in the Medium Wave Service.**

The following specifications are required: for use with a 100mW unlicensed Part 15 intentional transmitter only in regards to using the specified alternative radiator system in the Regional Band Segment only of 1600 to 1700 kHz.

The technical requirements are as specified:

These rules will not be in the same order at then end of this petition's text. So for reasons seen later, the numberings then will be different.

(1) The type accepted 100 milliwatts transmitter for this class of use (as an Augmented 15.219(b) Intentional Radiator). Must have it's signal generated by a crystal controlled oscillator, or a phase lock loop. Or by a digitally stabilized VFO, or a direct digital synthesizer (DDS) if the later is filtered. And hence must be stable; and well filtered if the signal generation method requires filtering. And can be either solid state and, or, vacuum tube technology. And hence can include a solid state/vacuum tube hybrid design..

(2.) The audio input bandwidth must be filtered down by 48 dB @ 20 kHz via a low pass audio filter after the audio peak limiting controlled stage.

(A three to four or more element CR filter can be designed with LT Spice software that works well in this case.)

This is for limiting the modulation channel bandwidth and minimizing the adjacent channel interference. And hence preventing the fundamental signal from becoming a unwanted extended sideband problem wherein a slightly higher emission level will be realized by the intended radiator type. The -48 dB design is the one most often achieved with Spice design software without numerous tweaking of the design. Based upon resistor~capacitor filter designs. And so, other filter types will work even better with better specifications.

(3) The modulation peaks must be limited either by a automatic level control (alc) sampling circuit in the rf output, or a sampling control in the modulation stage, or audio compressor. And the sample must go back to control the level of the audio input stage before the audio bandwidth filter section. The filter must be after the controlled section. And the filtered output is used for the final stage modulation amplification or may directly go to the final amplifier. Performance of the filter is however best if placed before a last stage of modulation amplification where constant audio change of the circuit load is not as critical. The station in this section of 15.219 must not use an audio expander; only a compressor if that is the method of modulation peak limiting used.

This is required to prevent over modulation and hence clipping or flat topping of the modulation sine wave form peaks. Which if not limited. Would create extended sideband byproducts and other unwanted spurious content. And so, there are requirement provisions herein for automatic control of the signal to keep it nice and clean. Requirements (1.) and (2.) are for preventing the in band fundamental signal from being a source of interference in the band and for suppressing the generation of out of band products. In the following requirements below, there are a few more requirements that aid in reducing further, both in band and out of band interference.

(4) The modulation must be capable of being monitored, via a modulation level meter. And the rf output should be monitored, however it is required that the swr ratio be monitored often, so that a condition of mismatch can be corrected. The station type accepted transmitter will have both a modulation meter and a swr meter either within the 100 milliwatt transmitter or external to it in the rf output transmission line.

(5) The rf output to the antenna must pass through an acceptable low pass rf filter of at least 5 elements minimum (a double Pi network filter) with cutoff at -50 dB or more at or before 1780 kHz (and preferably if possible at 1750 kHz or below). Any manufacture of kits or fully assembled transmitters must have the low pass filter built into the transmitter's output to be able to be type ......

accepted for this Augmented Class of operation with the intended alternative radiator. (Along with an alc circuit for limiting the modulation and an acceptable bandpass audio filter. Otherwise the type acceptance is only applicable for use with the antenna system in the first part of the first paragraph of this section 15.219(b).)

Here is the requirement for suppressing up frequency band rf spurious byproducts and rf harmonics.

(6) The feed point of the alternative antenna radiator herein must be fed with a LC matching network at the antenna feed point to prevent mismatch and possible coax cable outer shield radiation. And to offer another (medium) level of attenuation of in band and out of band spurious products.

The antenna radiator for use in this application will be made to resonate and have a narrow channel bandwidth. This bandwidth, as was analyzed in antenna design software, will effectively be such that it will act as a filter to attenuate the in band extended sidebands and minimize further the out of band products. This type of antenna will then be of aid in limiting both the adjacent channel interference of the unlicensed fundamental signal and other unwanted emissions. Coupled with the previously mentioned technology to prevent clipping or flat topping of the modulated carrier and thus reducing in band and out of band spurious products. Along with the acceptable low pass rf filtering of the output for further reduction of harmonic and other spurious rf content.)

It should be noted here that the most efficient antenna design possible in software analysis models, that fits within these suggested rules definitions, will not have more than 15.79% efficiency with an antenna ground radial system of 1 ohm. And that the other possible types analyzed, would not achieve this level of efficiency. In another section of this petition for rule making suggestions, those other types will be mentioned and how that they compare to this most efficient model and all of the antenna model data will be analyzed mathematically.

15.79% of 100mW = 15.79mW radiated rf energy emission
(from this most efficient software aided design)
This seems to be a very small emission level. And one reasonable to live with.

(7) To suppress radiation from the coaxial transmission line. The coax will be buried in the ground out to the radiator by a minimum depth of 12 inches. And may be of any length required "only" to reach the radiator. The coax on the antenna end shall not protrude more than 1 meter out of the ground to the feed

point. Type accepted coax for use herein shall be a coax that utilizes 95% copper shield braid rated for underground use, or 100% foil shield with copper shield braid. (This coax specifications shall not apply to coax used in the leaky coax carrier current methods of Part 15.221 unlicensed stations.)

This is to prevent the coax from being a source of radiation and hence extending the length of the radiator. And in addition as stated above, the LC matching network at the antenna feed point will help to keep the coax from becoming a radiator. Coax has been known to have some harmonic content on it's outer shield if mismatched. The under ground requirement will prevent this from being the case. And the frequency range of operation is less likely to have underground rf propagation as compared to the lower end of the Medium Wave Band, in it's lower frequency range. Where at the lower frequencies, rf signals can be more easily propagated through the earth. Hence we will keep all of this in the 1600 to 1700 kHz range.

(8) **The antenna radiator for this alternative Augmented Class of Part 15.219 shall be made to resonate in the region of 1600 kHz to 1700 kHz. And made to resonate on the intended frequency of use.**

(9) The antenna radiator shall not exceed 3 meters in height above ground, and must have either a base loading coil, or a mid section loading coil or be made into a 3 meter length helical resonator (which would define the entire length of the antenna when formed into a helix). The base or midsection loading coil shall not exceed a diameter of (1 meter) 1000 mm wide. A 1 meter diameter capacitance hat may be used with the radiator. Of the toroid or flat aluminum disc types. And may be adjusted up to the radiator's far end. Or down the main radiator upper rod length, to effect coil resonance if so required. The main radiator diameter must be 5 mm or greater for strength. The feed point at the base will be either an end feed arrangement or a coil tapped arrangement. The antenna shall not be mounted any place other than upon the ground, and may not be mounted up high on a mast or tower or upon a building. Exceeding the height limit is forbidden and having a unshielded (refer to (12) below) length of coax above ground, up mast or building is likewise forbidden.

This small sized capacitance hat will help the designers of such antennas to effect resonance mostly; and is not a sufficient enough amount of capacitance to effectively raise the field strength of the antenna for use herein. And the capacitance will help the current distribution of the coil section.

*In addition, since the radiator type herein is the main reason for these rules suggestions. The advantage of the radiator will help both the user and ....

their vision for needing some changes in the Rules to allow them a little more effective range. And will help the FCC and the over all band. In that the nature of these antennas is such that when designed correctly by skilled people and submitted for building by others from plans or are manufactured for resale. The antennas will have bandwidths that act to provide adjacent channel filtering.

Competition will result in numerous studies and publication of specifications on bandwidth and effective range.

Likewise, although some software analysis shows that these sorts of antennas can be made to achieve low angles of radiation elevation in the far field plots. Which I can see examples of as I do plots in MMANA software. The software also shows me that there is no horizontal radiation associated with these antennas. Horizontal radiation is more likely to reflect back down as a skywave as compared to all vertical radiation. This will be looked at more at the end of this text document.

Please note this specifically: the antenna's low height will mean that the radiation resistance of the antenna will be low as compared to the ground resistance. The nature of which will be that the efficiency of the radiator to effectively radiate the input power will be in the 15.79% range. In software analysis a Medium Wave antenna of a 15.24 meter (50 foot) height when optimized for best performance will have a radiation resistance of 10 ohms or less. At this 3 meter height (9.84 foot) the radiation resistance is less than 0.3 ohms. And the natural ground resistance can be from 20 to 100 ohms or more.

However we are basing the 15.79% efficiency in this text later on herein, upon a very good ground radial system of 1 ohm as a standard reference.

Thus even with a very good ground radial system. The efficiency is not expected to be above the lower 15.79% as based upon the most efficient software aided design referenced to a ground system resistance of 1 ohm. We can not expect to radiate into the atmosphere more than 15.79 milliwatt of rf energy from the 100mW input at best radiator efficiency. This should satisfy numerous concerns about the nature of this alternative part 15.219(b) radiator suggestion. These mathematical antenna matters will be analyzed in another section of this text.

(1 0) An antenna base grounding wire must be used of no longer than 1 meter.

(11) A ground wire will be used at the transmitter end to ground it so long as it is kept as short as possible. See the next rule for protecting the ground wire from emitting radiation.

(12) If a length of coax going into the building must be longer than 5 foot going up the outside wall. A Faraday Cage made up of something such as poultry wire netting (chicken wire mesh fencing). Must be formed into a 1 foot diameter (minimum) cylinder of a length required to cover the length of exposed coax. And the coax situated in the very middle of it's central length area within. Running up inside the middle of the cylinder of the cage. And the cage must be well grounded. And the ground wire to the transmitter shall go up inside the Faraday Cage likewise. This ground wire is separate form that which grounds the Faraday Cage and does not touch the cage within it. Though the ground for both comes from the same source. Hence this transmitter ground wire must be insulated from touching any part of the cage. And it should be insulated going a few inches into the ground as to prevent any part of the possible rf energy on this line from touching the cage.

(13) This alternative type of station, that operates at 100mW input to the antenna. Will only operate in the band spectrum of 1600 to 1700 kHz. And only on the existing channels spaced every 10 kHz apart, and not between channels. Since these small stations are local (small region) they will be authorized only for use in the Regional Band Segment. And, the station shall not operate on a frequency of, or adjacent to, a regional licensed station in the Medium Wave Service.   A careful channel search should be done of the area for many days, using as sensitive a broadcast receiver as possible, perhaps with a long wire for greater listening. This search should be done, so that the intended station will not operate on a frequency a occasional distant licensed station can often be heard on. It is recommended that the FCC website be consulted as an aid in doing a search for stations in the users area. The search should go out as far as 250 miles radius as a good guide to the possible stations that might regularly be heard in the Augmented Class Section 15.219 unlicensed station's region.

(14) The station owner may build their own transmitter and use it if it meets with the above requirements. Kits and or fully assembled transmitters for this augmented 15.219(b) use. That have been certified by the FCC, must come with a complete technical servicing manual for the user. For servicing of the equipment themselves or via a qualified electronics technician in their area if they prefer the later.

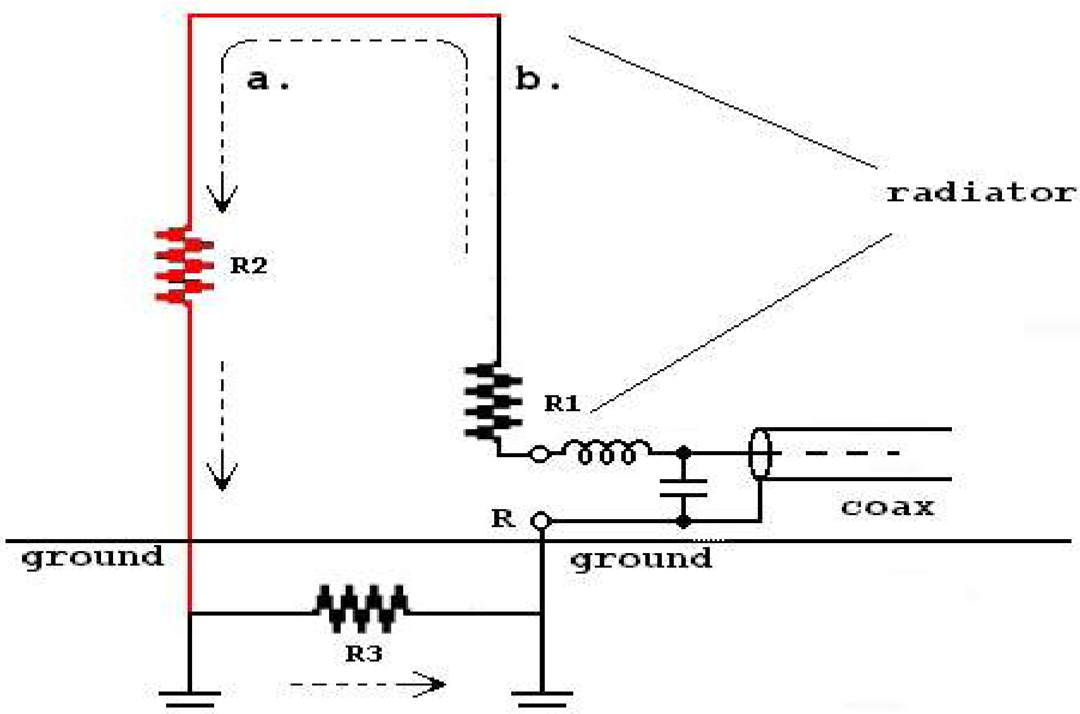
This is the means whereby long lengths of above ground exposed coax will be suppressed from radiating using the Faraday Cage concept. If other wise reports prove this to the contrary, upon technical review, this part of the suggested rules can be modified.

This ends the review of the suggested rules and the requirements for complying with them to meet type acceptance for this special Part 15.219(b) ....

application. At the end of this text the rules have be simplified as the format for using as written for passing into existence if so chosen to become rules. And there will be a few extra wordings to tie in these rules with the rest of those of 15.219 (a) and ©.

Next will be a discussion of the most efficient radiator design possible as analyzed in concept and with software aided design and analysis data provided for review.

A Technical Look At The Efficiency Of The Suggested Type Special Radiator:



R1 = radiator mast
R2 = radiation resistance
R3 = ground resistance

R feedpoint = R1+R2+R3

1/4 wavelength

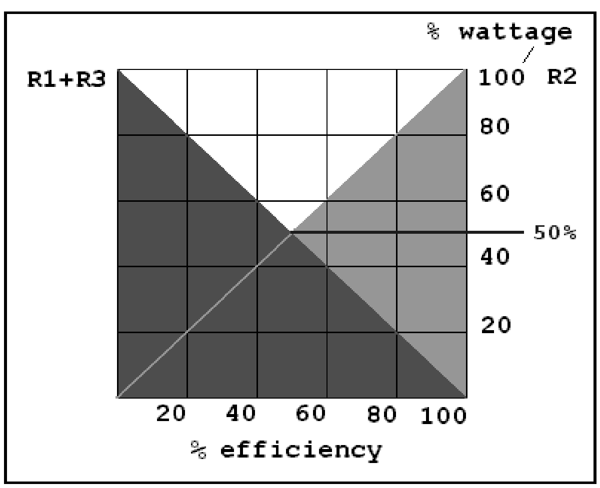
This is the typical equivalent circuit of an antenna. And R1 = the ohmic resistance of the radiator plus it's coil ohmic resistance if there is a coil in the radiator section. Not to be confused with the a coil's reactance jX (+XL). R2 = the radiation resistance. R3 = the ground resistance. The radiation resistance is high in the case of a ¼ wavelength radiator. As compared to the short height antenna of less height than the ¼ wavelength.

As mentioned in these suggestions for rule making for a 15.219(b)(9.) rules. The radiation resistance will be low, nearly 0.3 ohms or under in these types of antennas and the feed point impedance will have a reactance of jX L in nature. Some models have very low radiation resistance of around 0.075 ohms. The feed point impedance then will be the ground resistance with the coil reactance for the most part. The ground's ohmic resistance via a ground rod or so, will be from 20 ohms (extremely rare) to on average 100 ~ 500 ohms or more without a ground radial system. Though a reasonably good 16 radial, ground radial system may accomplish 4 ohms. And 2 down to 1 ohms may on occasion come to be designed by some stations, in terms of a good ground system.

If for instance we have an antenna of these designs herein that has a radiation resistance of 7 ohms, and the natural ground resistance in an area is a rare 10 ohms. And the radiator resistance is 0.1 ohm. The following will be the efficiency:

$$(7 \text{ ohms}/(10 \text{ ohms} + 0.1 \text{ ohms})) * 100 = 69 . 307\%$$

However the reality of these suggested antennas is that the efficiency is more like 15% at best and less. With a radiation resistance at nearly 0.3 ohms and under.



The majority of the impedance, of the feed point resistance, will be due to R3 or the ground resistance, and the inductive reactance of the extra large coil portion. The feed point impedance will be mostly defined as R3 jX +XL

Actual software analysis data from a PC monitor screen shot, is included in this text. To show the analysis of the entire radiator and it's various loss resistances versus efficiency at resonance.

In the previous chart we can see visually the effects of the power lost across R1 + R3 is, as compared to power across the radiation resistance of R2. If R1 + R3 = R2 then the efficiency = 50%. If R1+ R3 > R2 the efficiency is less than 50%. In these antennas the efficiency is way less than 50%.

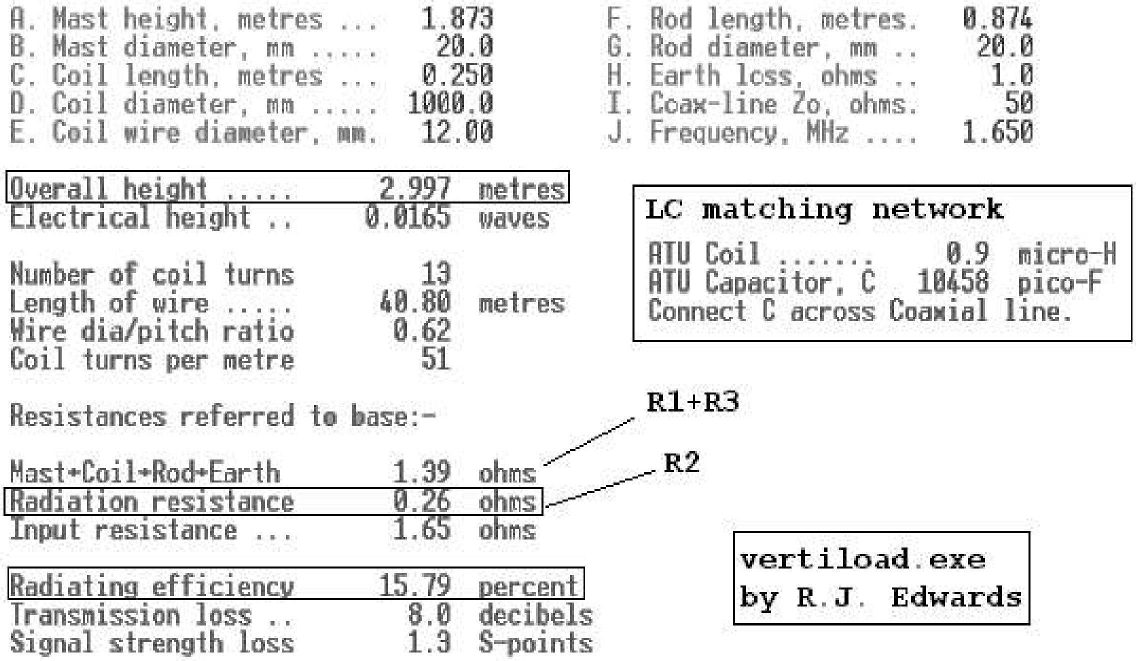
Ground Systems:

As mentioned before herein, most users of this application will try to have a minimal ground system. Famous R.J. Edwards (G4FGQ) who was a antenna specialist. Who wrote many of the early antenna analysis and design softwares. Wrote the following: "Assuming ordinary garden/pastoral soil with a typical resistivity of 100 ohms/meter, a crude estimate of the ground connection resistance for a vertical antenna may be obtained from the following example:-

Sixteen buried radial wires, 10 meters long, 2 mm dia., 10 mm depth = 4 ohms (for the ground radial system)." However this is for an ideal soil. In many cases it would take many more radials than this to obtain 4 ohms due to the variations in the soils resistivity per meter.

Actual Software Analysis Of The Radiator:

On the following page is data taken from vertiload.exe, a famous MS-Dos software by R.J. Edwards. This is a maximized mid section loaded vertical radiator of 2.997 meters height. R.J. Edwards mentions that the software limitations where only in lengths and diameters of the scale of .001 meter and was accurate in analysis down to a frequency of 5O kHz.

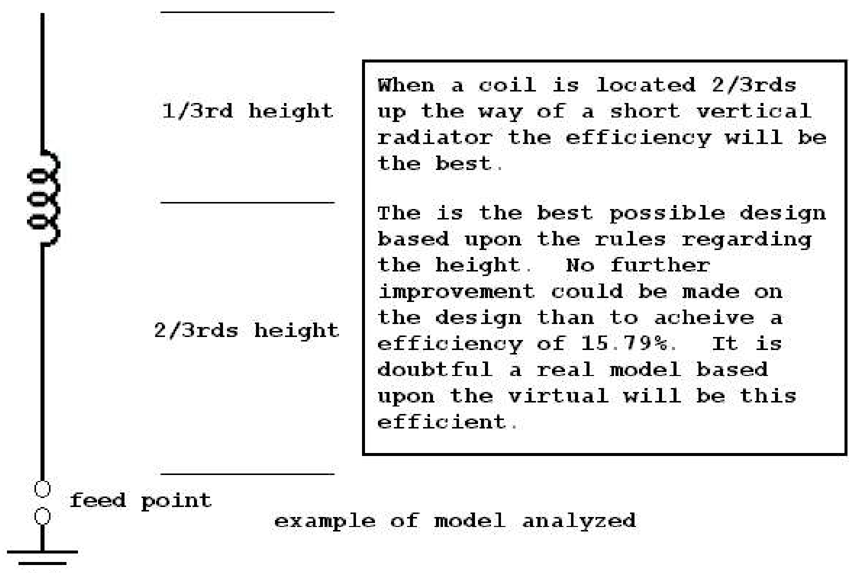


Several models of antenna based upon the 3 m height were analyzed to find those factors that when modified would maximize the efficiency. The thing that made the most difference was using 12 mm wire (tubing) as the coil wire. Which is equal to 48.8 meters (160.1050 foot) of 12 mm tubing or wire in the coil. And making the coil diameter 1000 mm. As well as moving the coil from the base to the mid section.

Base loaded radiators and those that where made into a full helical resonator over the entire length of the radiator, did not approach the above efficiency as the this version, which contains a mid section located coil 2/3rds the way up the antenna.

For reference reasons. The following design analysis is based upon an excellent ground system resistance (R3) of 1 ohm across the feed point. The analysis will then be based upon a 1 ohm standard. The software used, analyzes a 1/4 electrical wavelength of vertical radiator wound up into a short loaded vertical of 3m height, resonate @ 1650 kHz. This happens to be the most efficient version of radiators that can be envisioned from the suggest radiator height rules. And as mentioned previously, the coil is located 2/3rds up the length of the radiator, which is the most efficient coil location. Where the coil diameter is limited to 1 meter which is also the capacitance hat diameter limitation. Wherein this design, the coil diameter serves also as a capacitance. The analyzed efficiency = 15.79% @ 1 ohms for R3. As will be seen, this radiator model will be the standard model to reference other similar height models to.

The following antenna is end fed at the bottom with a LC matching network. "No capacitance hat is used with this radiator." Based upon the previous software defined data .



Where: R feed point = R1 + R2 + R3

R1 = radiator ohmic resistance
R2 = radiation resistance
R3 = ground system resistance (1 ohm)

resonant frequency = 1.650 MHz

mast length = 1.873 meters @ 20 mm dia (fed at the bottom)
coil length = 0.25 meter
coil dia = 1 meter
length of coil wire = 48.8 meters
coil wire diameter = 12 mm (tubing)
space between coil turns = 7.2308 mm
top rod length = 0.874 meters @ 20 mm dia
overall radiator height = **2 . 997 meters**

total electrical wire length (meters):
= 1.873m mast radiator + 48.8m coil + 0.874m top rod radiator
approx = to 1/4 wavelength (plus some)

Resonance is defined here also by the distributed capacitance and inductance of the radiator and coil.

R1 radiator resistance loss = 0.39 ohms
R2 radiation resistance = **0.26 ohms**
R3 earth loss = 1.0 ohm
feed point = **1.65 ohms**

efficiency = **15.79%**

15.79% of 100mW = 15.79mW radiated rf energy emission
(from this most efficient software design)

This does not appear to be a very efficient source for high enough levels of energy that would become a skywave problem. Particularly when other losses are factored in.

It then should be noted that since the coil diameter is limited to 1 meter diameter in these suggested rules. The efficiency at best is 15.79% if can be accomplished at all in a real example of this radiator as compared to this virtual model. ~ Where the ground system resistance is 1 ohm. ......It is possible that a few rare stations, may build a ground system that will result in R3 being less than 1 ohm. This however as mentioned elsewhere herein, will be rare out in the field in use.

Note: increasing the diameter of the coil will increase the efficiency slightly more but, incrementally and the matter starts to become tiresome and time consuming. And there needs to be a limit to which the design must conform to for good reasons. To limit the fundamental emission to within reasonable levels. Hence the coil diameter is specified with a maximum limit of 1 meter.

As can be seen here, the specialized radiator suggested for use herein is not anywheres near being an efficient radiator. Although it will work with more emission strength than the current rule of 15.219(b) antenna radiator. Hence, coupling this little bit better arrangement with the more technically advanced Part 15 intentional transmitter for unlicensed community broadcast. With the circuit features required for this specialized application. The class of operation then herein specified is not expected to be a problem in terms of interference.

Adding the requirements previously recommended for keeping the station's fundamental emission energy clean from spurious as well as adjacent channel and harmonic emission. Limiting the sidebands bandwidth both by preventing the modulation from clipping or flat topping the sine waves, and via an audio low pass filter. To keep the fundamental emission energy within the channel for adjacent channel reasons. Coupled with a good low pass rf filter at the transmitter's output. And keeping the coaxial cable all under ground out to the the radiator. And limiting this class of operation to the spectrum of 1600 to 1700 kHz for use on those 10 channels only. The impact of this class of operation within the band will be kept within reasonable technical specifications. Which are good technical specifications.

In addition since the class of operation is confined to use only in the spectrum of 1600 to 1700 kHz, 91.453% of the Medium Wave Broadcast band is left un effected by these suggestions and hence is protected from this specialized methods and class of unlicensed service. Hence this class of unlicensed station application is for use only within 8.547% of the band.

Earlier I made an example of a radiator with an efficiency of 69.306930693069%. To show that this was not much of an issue in terms of the level of emissions. Yet, the reality of the data in analysis shows us that this is not ever going to be the case. I would not say that with development the radiators could not reach 16% or more efficiency. Efficiency is expected to only be in incremental terms and would not be worthwhile to pursue in a manufacturing research program. And I would say that the vision I see of this, is that the efficiency will always be under 15% in most cases. A manufacturer would only be dealing with the antenna in terms of the design herein, and as I said it would be difficult to turn the virtual model into a real model in practice.

I perceive that the reports of those who have experimented with antennas such as I have detailed herein. Are experiencing the advantage of more wire in the radiator that will allow more electrons in the wire to move within in the extend length; by way of the coil's mass. And so, the greater mass of the coil. Allows more of a mass of electrons to move in vibratory fashion. All lined up more end to end. The advantage is only slight, over the current version of the Part 15.219(b) radiator. The antenna herein analyzed is a little different than the SSTRAN plan based model found on the Internet, mentioned earlier. In that it is a resonant wound up ¼ wave device. And is not imagined to ever be something that can ever get out of hand in practical use due to it's calculated realm of efficiency.

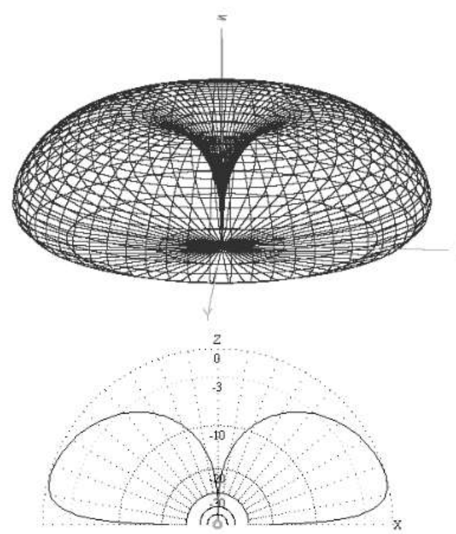
Attempted Far Electrical Field Pattern Plot:

Those Microsoft platform based softwares available to us out here in the public for antenna design that calculate the E and H far field pattern plots do not handle the gain calculations well on vertical antennas less than .2 lambda in height. So following with looking at the other plotted data, such as feed point resistance and reactance at feed point. Models that conform close to the design data of MS-Dos software such as was previously used, where examined for the interpretation of the field pattern of antennas such as we are discussing herein.

The softwares used for this section where MMANA, MMANA~GAL, GAL~ANA, and MININEC. Which are the ones known not to handle vertical radiator designs below .2 lambda height very well but we will look at what the software could interpret as the field pattern.

I should mention that the MS Dos software of R.J. Edwards I used for the data of the antenna analysis in the previous section "**Actual Software Analysis Of The Radiator:"** mentioned that the software limitations where only in lengths and diameters of the scale of .001 meter and was accurate in analysis down to frequencies of 5O kHz.

The MS Dos software of R.J. Edwards was designed for the use I used it herein. And so I trust it much better.



This software graphical snap shot is believed to be the far field pattern; as best as the softwares can interpret the short 3 meter height antennas herein. And this is an actual model of such 3 meter antennas. Not just a ....

convenient example. All models tried; all resulted in this pattern. It can be assumed then, that if the software got the far field patten right. That regardless of the type of radiator designed, base loaded, helical or mid section loaded, the mere height of the radiator will result in this being the field pattern.

Although this seems to indicates these antenna's are low angle radiators, the analysis seems to indicate also that no or at least no discernible horizontal radiation appears to be plotted in the field patterns when the H field is selected for viewing.

Skywave Concerns:

Since there seems to be no horizontal radiation plotted for these antennas. If the software has interpreted things the best it can. And the power level radiated is low, around 15.79 milliwatts max at best, based upon a ideal virtual antenna model. And since vertical radiation is more likely to be lost in the upper layers of the atmosphere to more degree, than horizontal radiation. The sky wave factor at night should be minimized by the low power and the lack of horizontal radiation being associated with the signal; where horizontal radiation would more likely cause sky wave propagation. Though we do know vertical radiation can become a reflected skywave, it however is more likely to suffer losses and absorption, and can even go out into space and thus be lost to space more so than horizontal. And so, with this very small radiated power level and low radiator efficiency. We should not have problems with this type of operation in terms of night time skywave phenomena.

To end the technical discussion of the radiator. The particulars of these suggestions so far contain numerous technical specifications for protecting the existing Medium Wave Radio Broadcast Band from unwanted interference. Which is the complete focus of the technical rules suggested for this application. And which has been focused upon all the way down to demonstrating the very low efficiency of the suggested radiator. All of which work hand in hand to maintain those things needed to make the application reasonable with certain defined limitations to keep the interference way down.

Summarized and Final Draft of The Rules:

The previous sections reviewed the technical ideas and their advantage. In the format of suggested rules to be placed within 15.219(b).

The next section will list the rules in their shortened form and will be read as they are suggested to appear as an official body of rules if chosen to be added to 15.219(b). And if the words herein are left as they are, or modified by the FCC. ~I however want to *make them such that they already coin the terms and specifications. And thus can be used in the body of rules as these words herein are. If the FCC agrees with their vision and stipulations. And believes they sufficiently define all things important to the user of the rules.*

I would say that the FCC should consider my recommendations for the filters I have herein and check their adequacy, and if needed, can modify the filter specifications if the FCC so chooses, to conform more to a vision the FCC would rather see in the audio bandwidth filter and the rf low pass filter suggestions. However coupled with the rest of the technical scheme and the low level of transmission power, the specifications should be well within good levels as they are here within.

We shall now begin with the the start of Section 15.219 and read the entire section of "suggested rules" as they may appear if enacted into the body of official FCC rules. And please note here in this portion of this text, how they are made to compliment the rest of the body of 15.219 rules. There are 16 technical rules added to subsection (b) of Section 15.219.

* *

Section 15.219 Operation in the band 510 - 1705 kHz.

* *

(a) The total input power to the final radio frequency stage (exclusive of filament or heater power) shall not exceed 100 milliwatts.

(the above subsection (a) wording is not effected by the following suggested rules)

...New rule suggestions begin now in subsection (b) where the first paragraph maintains the original radiator rule for use with non Augmented Class transmitters...

(b) The total length of the transmission line, antenna and ground lead (if used) shall not exceed 3 meters. Wherein the 100 milliwatt transmitter does not comply with the following alternative antenna radiator rules below: otherwise, only use of an antenna radiator system as specified in this paragraph is allowed when the transmitter does not comply with the following specifications.

(1) Those transmitters as defined above in 15.219 (a) who do not meet with the specifications of those things listed below are subject to the specification of 15.219 (c). Whereas the following alternative application and Augmented Class ....

of operation will more than conform to 15.219 (c) by reason of better devise specifications. These rules for an alternative antenna radiator system, are for use only with a Part 15 unlicensed community station of 100 milliwatts, as a small broadcast station only. And shall only apply to such a station and shall not be for use with any other Part 15 device; and herein only applies to this section herein of 15.219. Where the 100 milliwatt type accepted transmitter utilizes the following specific technology features and operates in the Medium Wave "Regional Band" spectrum only as specified herein:

(2) The type accepted transmitter for this class of use (as an Augmented Part 15.219(b) Intentional Radiator). Must have it's signal generated by a crystal controlled oscillator, or a phase lock loop. Or by a digitally stabilized VFO, or a direct digital synthesizer (DDS) if the later is filtered. And hence must be stable; and well filtered if the signal generation method requires filtering. And can be either solid state and, or, vacuum tube technology. And hence can include a solid state/vacuum tube hybrid design.

(3) The audio input bandwidth must be filtered down by 48 dB @ 20 kHz via a low pass audio filter after the audio peak limiting controlled stage.

(4) The modulation peaks must be limited either by a automatic level control (alc) sampling circuit in the rf output, or a sampling and control circuit in the modulation stage, or audio compressor. And the sample must go back to control the level of the audio input stage before the audio bandwidth filter section. The filter must be after the controlled section. And the filtered output is used for the final stage modulation amplification or may directly go to the final amplifier. Performance of the filter is however best if placed before a last stage of modulation amplification where constant audio change of the circuit load is not as critical. The station in this section of 15.219 must not use an audio expander; only a compressor if that is the method of modulation peak limiting used.

(5) The modulation must be capable of being monitored, via a modulation level meter. And the rf output should be monitored, however it is required that the swr ratio be monitored often, so that a condition of mismatch can be corrected. The station type accepted transmitter will have both a modulation meter and a swr meter either within the 100 milliwatt transmitter or external to it in the rf output transmission line.

(6) The rf output to the antenna must pass through an acceptable low pass rf filter of at least 5 elements minimum (a double Pi network filter) with cutoff at -50 dB or more at or before 1780 kHz (and preferably if possible at 1750 kHz or below). Any manufacture of kits or fully assembled transmitters must have the..

low pass filter built into the transmitter's output to be able to be type accepted for this Augmented Class of operation with the intended alternative radiator. (Along with an alc circuit for limiting the modulation and an acceptable bandpass audio filter. Otherwise the type acceptance is only applicable to use with the antenna system in the first part of the first paragraph of this section 15.219(b).)

(7) The feed point of the alternative antenna radiator herein must be fed with a LC matching network at the antenna feed point to prevent mismatch and possible coax cable outer shield radiation. And to offer another (medium) level of attenuation of in band and out of band spurious products.

(8) To suppress radiation from the coaxial transmission line. The coax will be buried in the ground out to the radiator by a minimum depth of 12 inches. And may be of any length required "only" to reach the radiator. The coax on the antenna end shall not protrude more than 1 meter out of the ground to the feed point. Type accepted coax for use herein shall be a coax that utilizes 95% copper shield braid rated for underground use, or 100% foil shield with copper shield braid. (This coax specifications shall not apply to coax used in the leaky coax carrier current methods of Part 15.221 unlicensed stations.)

(9) The antenna radiator for this alternative Augmented Class of Part 15.219 shall be made to resonate in the region of 1600 kHz to 1700 kHz. And made to resonate on the intended frequency of use.

(10) The antenna radiator shall not exceed 3 meters in height above ground, and must have either a base loading coil, or a mid section loading coil or be made into a 3 meter length helical resonator (which would define the entire length of the antenna when formed into a helix). The base or midsection loading coil shall not exceed a diameter of (1 meter) 1000 mm wide. A 1 meter diameter capacitance hat may be used with the radiator. Of the toroid or flat aluminum disc types. And may be adjusted up to the radiator's far end. Or down the main radiator upper rod length, to effect coil resonance if so required. The main radiator diameter must be 5 mm or greater for strength. The feed point at the base will be either an end feed arrangement or a coil tapped arrangement. The antenna shall not be mounted any place other than upon the ground, and may not be mounted up high on a mast or tower or upon a building. Exceeding the height limit is forbidden and having a unshielded (refer to (12) below) length of coax above ground, up mast or building is likewise forbidden.

(11) An antenna base grounding wire must be used of no longer than 1 meter.

(12) A ground wire will be used at the transmitter end to ground it so long as it is kept as short as possible. See the next rule for protecting the ground wire from emitting radiation.

(13) If a length of coax going into the building must be longer than 5 foot going up the outside wall. A Faraday Cage made up of something such as poultry wire netting (chicken wire mesh fencing). Must be formed into a 1 foot diameter (minimum) cylinder of a length required to cover the length of exposed coax. And the coax situated in the very middle of it's central length area within. Running up inside the middle of the cylinder of the cage. And the cage must be well grounded. And the ground wire to the transmitter shall go up inside the Faraday Cage likewise.   This ground wire is separate form that which grounds the Faraday Cage and does not touch the cage within it. Though the ground for both comes from the same source. Hence this transmitter ground wire must be insulated from touching any part of the cage.   And it should be insulated going a few inches into the ground as to prevent any part of the possible rf energy on this line from touching the cage.

(14) This alternative type of station, that operates at 100mW input to the antenna. Will only operate in the band spectrum of 1600 to 1700 kHz. And only on the existing channels spaced every 10 kHz apart, and not between channels. Since these small stations are local (small region) they will be authorized only for use in the Regional Band Segment. And, the station shall not operate on a frequency of, or adjacent to, a regional licensed station in the Medium Wave Service.   A careful channel search should be done of the area for many days, using as sensitive a broadcast receiver as possible, perhaps with a long wire for greater listening. This search should be done, so that the intended station will not operate on a frequency a occasional distant licensed station can often be heard on. It is recommended that the FCC website be consulted as an aid in doing a search for stations in the users area. The search should go out as far as 250 miles radius as a good guide to the possible stations that might regularly be heard in the Augmented Class Section 15.219 unlicensed station's region.

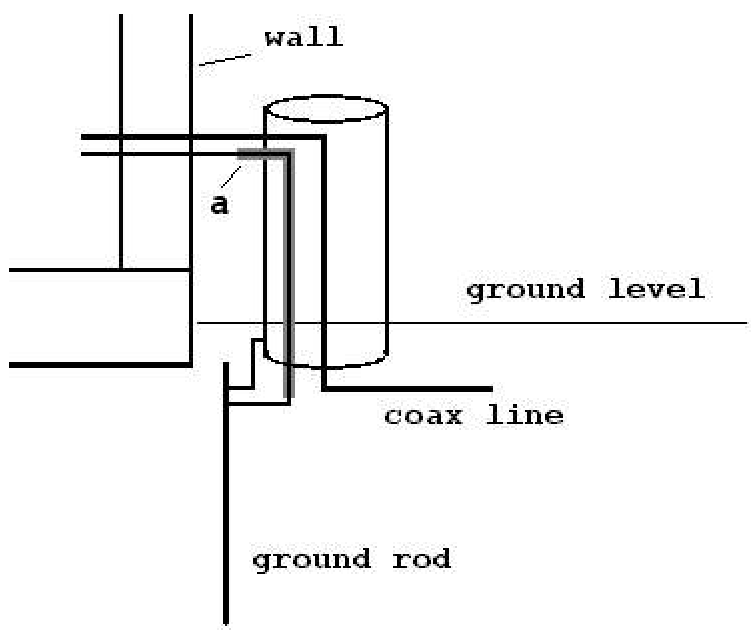
(15) The station owner may build their own transmitter and use it if it meets with the above requirements. Kits and or fully assembled transmitters for this augmented 15.219(b) use. That have been certified by the FCC, must come with a complete technical servicing manual for the user. For servicing of the equipment themselves or via a qualified electronics technician in their area if they prefer the later.

(16) 15.219 (a) transmitters that do not conform to the above Augmented Class of operation requirements are to comply with the antenna radiator in the first.....

paragraph of 15.219(b) and with 15.219(c) Each Augmented Class station in these rules are subject to inspection by the FCC if the FCC so desires. And if the station is not conforming to the standards herein it must abide by the request of the FCC, as the FCC so chooses to impose upon the station. Or if the manufacture of equipment is not type accepted, or altering the equipment design after type acceptance, to conform otherwise as intended in these rules; shall be subject to the FCC's Administrative actions.

(c) All emissions below 510 kHz or above 1705 kHz shall be attenuated at least 20 dB below the level of the un modulated carrier. Determination of compliance with the 20 dB attenuation specification may be based on measurements at the intentional radiator's antenna output terminal unless the intentional radiator uses a permanently attached antenna, in which case compliance shall be demonstrated by measuring the radiated emissions.

Faraday Cage:



This Farady Cage cylinder is partly in the ground. The ground wire going into the cage at a. is insulated so it does not short to the cage. The cage should be located very close to the building wall.

Conclusion:

I hope that what is contained in this is text, provided an interesting view of things for the readers. And I hope that the ideas herein demonstrated numerous well considered applications for protecting the licensed stations in the Medium Wave band from unwanted interference.

The ideas first of all is to clean up the transmitter's fundamental signal and suppress the spurious byproducts. Using well known ideas of filtering and modulation limiting concepts to prevent over modulation that will lead to clipping the peaks of the sine waves and introducing extended side band content and other unwanted content.

Likewise, as was seen herein. The expected maximum level of energy radiated in a virtual model of the radiator at maximum efficiency will only be 15.79% of the 100 milliwatt input. The transmission loss in the system is 8 dB. Or 8 dB of attenuation of the fundamental before radiation. Which is seen in the snap shot of the software analysis chart herein.

Certainly all of this requires close consideration before passing into the body of rules. And something such as this should be built up around numerous safeguards. Of which I believe are demonstrated herein.

In addition this application will only be for use on 10 of the 117 channels in the band. And so the effect and impact will be minimal. Where the impact of the device under question herein, has been minimized in it technical specifications as an over all system.

The author of this text document in the event of the launching of these rules if they are passed. Will continue to provide free and insightful as well as helpful information to the public who are interested in this application. To effect a very good knowledge of the issues and how to properly run such a station as is described herein. And we will try to perfect the technical level of purity of our stations signal, and perfect the concepts herein such as by doing studies of the antennas and Faraday Cage concepts.

The author of this document has in his electrical lab equipment line up, such things as a calibrated frequency selective voltmeter receiver. (Philco Ford Sierra Model 128 A) For use from 3kHz to 15.5MHz. Which can accurately measure the field strength in dB and microvolts. Using a 600 ohm antenna probe input on a 30 uV metered scale. Which is sufficient enough for measuring radiator emissions at a 30 meter distance. If we are allowed to use such antennas in the future. The device can easily measure such emissions at one mile. With an increased +10 or +20 dB adjustment in sensitivity and re calibrated for such with the additional features of the device as are provided. Hence the author will devote some time to the study of the applications after they are passed and provide such useful information to both the public and the FCC for review.

Further the equipment here includes a software defined radio with spectrum analyzer. Which appears to be very accurate on defining the bandpass characteristic of the modulation on a carrier. And the dB scale is quite accurate. Hence allot of signal analysis tools are on the PC here where this text is being prepared. This includes antenna resistance bridges etc.

The author then is well armed for studying the application. And for helping the Part 15 interest community to perfect their stations and make them as clean as can be. And it is certain that many others will come along with the talents such as the author and do s study of this application likewise and many text help materials are expected to come into being before long.

This document is the vision engineered up by Dannie Ray Jackson for those of the Part 15 unlicensed broadcast venues. December 24, 2007. Comments by advocates and other interested parties should be placed on separate pages. The original text may not be modified in any way. Since Part 15 rule making is not a base or platform for political issues such as visions of and for commercial content and media content, no comments or suggestions on those issues are a part of the vision of Part 15 rule making.

Those of you who advocate and support this petition in the public should note that. Issues not relative to the views as where expressed by John A Reed, Senior Engineer, FCC Technical Rules Branch are not within the scope of useful comments you can make on behalf of this cause.

"The unlicensed standards were not established based on the operating range of the unlicensed transmitter. Rather, these standards were established to limit the potential for unlicensed transmissions to cause harmful interference to licensed stations. We are concerned not only with harmful interference to the ground wave coverage of licensed AM stations but also to their sky wave coverage which can allow AM broadcasts to be received at locations many hundreds of miles distant. " John A. Reed

"A petition for rule making also needs to demonstrate why such changes to the rules would not result in licensed stations receiving increased harmful interference not only from the unwanted emissions but also from the increased emission level of the unlicensed fundamental signal." John A. Reed

The issue herein then is devoted purely to the technical feasibility of the application and that is the only issue.