FCC RF Exposure Assessment Requirements

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I am a little late in writing on this topic as new FCC requirements for amateur radio operators to perform station evaluations for RF exposure went into full effect in May of this year. The rules were adopted in May 2021 with a 2-year transition period for stations operating under the exemptions included in the old rules. Ed Hare wrote an article detailing the process for determining if your station was exempt from a detailed assessment (see Table 1 in QST Article 2021). Stations not under exemption or stations which made changes to operating frequencies, power level, antenna type, antenna location, etc. are subject to assessment before transmitting with such changes. The Hare article described an early version of the ARRL RF Exposure Calculator. A more recent article which describes the most recent ARRL calculator ARRL RF Calculator appeared in the May 2023 issue of QST by Greg Lapin, N9GL (see Figure 1 in QST Article 2023). In the rest of this article, I will summarize information the referenced articles and give an example using the ARRL RF Calculator.

It is important to note that the new FCC rules did not change the RF exposure limits, the rules simply made all licensed radio services subject to the assessment rules. Previously, the amateur radio service was categorically excluded from certain aspects of the exposure rules. The easiest way to assess your station is to use an online calculator. These calculate power density, electric field strength and magnetic field strength to provide a minimum distance from the antenna where people can approach. Two numbers are provided, one for "controlled" environments and another for "uncontrolled" environments. Controlled environments typically apply to the amateur's family who are aware of the location of antennas and potential dangers of RF exposure. (The FCC has not defined what constitutes training for family members in these regards.) Uncontrolled environments are those where people are not aware of the potential for exposure. For example, if your antenna is close to a neighbor's property or home and they have not been advised of the potential. The cases are differentiated by exposure time. If the neighbor is unaware, they may tend to stay in proximity to the antenna longer.

The online calculators are typically conservative so if you pass with those calculations, you are most likely operating safely. In addition, you should make conservative assumptions with regard to power levels, operating frequencies, duty cycle, etc. Again, if those calculations give acceptable results, you are probably well within RF exposure guidelines. If these calculations indicate a potential problem, then you can "sharpen your pencil" by incorporating feedline losses, actual duty cycles, etc. to more accurately reflect power at the antenna and how you operate. For example, you may only use your amplifier for SSB which is a relatively low duty cycle mode, so if you evaluated using 100% duty cycle and full amplifier power, this may be too conservative. Just be sure that your revised assumptions match how you actually operate. Other options are to model your specific antenna installation (for example including nearby conductors) for more accurate near-field electric and magnetic field strengths or performing actual field-strength measurements. These options require a level of specialist knowledge or expensive, calibrated test equipment and are usually not necessary.

Currently, I have three antennas: a an 80M sky-loop, and 80M EFHW and a 6M – 20M hexbeam. I will use the hexbeam to illustrate use of the ARRL RF Calculator. Since the RF exposure limits are more stringent at higher frequencies, I chose 100W on 6M for the initial evaluation. My current amplifier only

goes operates up to 10M, so I also need to do an evaluation for that band at higher power. The first screenshot below shows the 6M 100W results. I chose a 100% duty cycle for continuous transmission. This is an absolute worst-case scenario and the minimum distance is 8.3-feet for a controlled environment. Since the hexbeam is 16-feet above the ground and 10-feet from the house, a person cannot come within 8.3-feet unless they were on a ladder under the antenna. This could only become an uncontrolled environment (18.3-feet minimum distance) is if someone came onto my property without my knowledge while I was operating since the antenna is hundreds of feet from my property boundaries. It is not near where visitors would park or come to the door. The A/C repairman working on the compressor may be at risk and I would not operate if he was working on the compressor.

This calculator should not be used for antennas that are less than 20 cm (8 in) from a person.

View detailed instructions for each parameter. (opens in new tab/window)

Parameters

- Power at Antenna: (Need help with this?) 100 (watts)
- Mode duty cycle:
  Carrier Always On, i.e., for Tuning Up (duty cycle=100%)
- Transmit duty cycle: (time transmitting)
  You transmit for 5 minutes then receive for 0 minutes (and repeat).
- Antenna Gain (dBi): (Need help with this?) 5
- Operating Frequency (MHz): 54

☑ Include Effects of Ground Reflections

If you would like to receive future announcements of any FCC news related to RF-exposure or the requirements for amateurs to evaluate their stations, you may **optionally** provide an email address.

Email Address: (optional)	
Comments: (optional)	

Calculate

This calculator should not be used for antennas that are less than 20 cm (8 in) from a person.

Results for a controlled environment:

Maximum Allowed Power Density (mW/cm^2): 1.0000
Minimum Compliance Distance (feet): 8.3272
Minimum Compliance Distance (meters): 2.5381

For an uncontrolled environment:

Maximum Allowed Power Density (mW/cm^2): 0.2000
Minimum Compliance Distance (feet): 18.6202
Minimum Compliance Distance (meters): 5.6754

Print Results

At 10M and below, I can use my amplifier which produces up to 700W for SSB / CW or 500W for continuous duty modes. Calculations for 10M will over-estimate the minimum distances for the lower bands, so these results will cover all other bands of the hexbeam. Using the SSB parameters in the screenshot below, the minimum distance for controlled environment has increased to 12.6-feet. Given the height of the hexbeam above the ground, a 6-foot-tall person should keep more than 7.7-feet from the base of the mast (using some triangle geometry calculations). Repeating the calculations using 500W, 100% duty cycle and 1 minute transmit / 1 minute receive (digital scenario); the minimum distance increases slightly to 13.0-feet. Informing my family to stay more than 10-feet away from the periphery of the hexbeam at all times will protect them from excessive RF exposure.

This calculator should not be used for antennas that are less than 20 cm (8 in) from a person.

View detailed instructions for each parameter. (opens in new tab/window)

Parameters

- Power at Antenna: (Need help with this?) 700 (watts)
- Mode duty cycle:
  Conversational SSB, heavy speech processing (duty cycle=50%)
- Transmit duty cycle: (time transmitting)
  You transmit for 2 minutes then receive for 2 minutes (and repeat).
- Antenna Gain (dBi): (Need help with this?) 5
- Operating Frequency (MHz): 29.7

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Email Address: (optional)	
Comments: (optional)	

Calculate

This calculator should not be used for antennas that are less than 20 cm (8 in) from a person.

Results for a controlled environment:

Maximum Allowed Power Density (mW/cm^2): 1.0203
Minimum Compliance Distance (feet): 12.5928
Minimum Compliance Distance (meters): 3.8383

For an uncontrolled environment:

Maximum Allowed Power Density (mW/cm^2): 0.2041
Minimum Compliance Distance (feet): 25.1857
Minimum Compliance Distance (meters): 7.6766

Print Results

It’s that simple to do the calculations and links in the calculator form provide helpful information on antenna gain, etc. to help you do the calculations more accurately. There are no filing requirements, so it is recommended to do calculations for all of your antennas and operating modes, print out the results (on paper or as a pdf file) and retain them in case of any future questions. It would also be a good idea to document any communications with your family or other affected people. Any changes to your station such as new antennas, moving antennas, purchasing an amplifier or a more powerful amplifier, using new modes, etc. necessitate another round of calculations to make sure you are still in compliance or take appropriate mitigation measures.