

FCC Exposure Rules Soon to Affect Every US Radio Amateur

As the 2-year transition period comes to an end, the ARRL RF Safety Committee Chair discusses the rules and how to evaluate your station's RF exposure to ensure compliance.

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On May 3, 2021, new FCC rules governing RF exposure went into effect. A 2-year transition period was implemented to allow existing stations to make any necessary changes. On May 3, 2023, the transition period ends, and all transmitters operating in the US are expected to comply with the exposure rules.

A Brief History

FCC RF exposure rules aren't new to radio amateurs. In 1996, the FCC enacted the first exposure regulations that affected the Amateur Radio Service, and all amateur radio stations were expected to comply by 1998. In addition to rules governing Maximum Permissible Exposure (MPE) for amateur radio stations, some procedural rules were applied. For the FCC to be assured that radio amateurs understood the important aspects of RF exposure to humans, they required that every amateur radio examination contain at least one question related to exposure. In order to correctly answer that question, the entire question pool had to be studied and, in doing so, every licensed amateur radio operator would be assumed to have knowledge about the subject.

The FCC also added a certification statement to Form 605 and Form 610 that had to be affirmed by every radio amateur who was issued an FCC license, renewed their license, or changed their station address. Due to the 10-year license period, by 2008, every licensed radio amateur in the US had certified that they would comply with the FCC's rules for RF safety.

Many radio amateurs determined that their stations complied with the FCC exposure regulations by 1998. However, a provision of the rules at that time — Categorical Exemptions in FCC Part §97.13(c)(1) — made it possible for some to avoid evaluating their stations.

Parameters

- Power at Antenna: (Need help with this?) 100 (watts)
- Mode duty cycle: Conversational SSB, no speech processing (mode duty cycle=20%)
- Transmit duty cycle: (time transmitting)
You transmit for 5 minutes then receive for 5 minutes (and repeat).
- Antenna Gain (dBi): (Need help with this?) 8
- Operating Frequency (MHz): 14.2

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

Results for a controlled environment:

Maximum Allowed Power Density (mw/cm²): 4.4634

Minimum Safe Distance (feet): 2.2730

Minimum Safe Distance (meters): 0.6928

For an uncontrolled environment:

Maximum Allowed Power Density (mw/cm²): 0.8927

Minimum Safe Distance (feet): 3.9369

Minimum Safe Distance (meters): 1.2000

Print Results

Figure 1 — The ARRL RF Exposure Calculator, showing a sample analysis for a 100 W transmitter with no feed-line loss and normal (non-compressed) SSB modulation into a 20-meter Yagi. The closest that any part of a person can be to any part of the antenna is 0.7 meter (2.3 feet) for the occupational population, or 1.2 meters (3.9 feet) for the general population. Note that this calculator is not valid for exposure distances less than 20 centimeters (8 inches) from a person.

To simplify the determination of human exposure compliance for many radio amateurs, the FCC set up some operating conditions that would preclude amateurs who operated under those limits from being required to assess their stations. For instance, if a transmitter produced less than 225 W on 20 meters, no further assessment would be required for that band. The conditions for categorical exemption were based on power and frequency. In addition, all mobile

and handheld radios were categorically exempted from performing exposure assessments, as were repeaters that transmitted less than 500 W effective radiated power.

Recent Rule Adjustments

In April 2020, the FCC proposed a major reorganization of their exposure rules for all services. Even though they were not proposing changes to the MPE limits, they strove to harmonize exposure rules for all services. Unlike previously, where some services had special rules to follow, under the newly proposed changes, the same rules would apply to all licensed transmitters in the US. This affected the Amateur Radio Service in several ways. The categorical exemptions that applied only to radio amateurs were eliminated. A different method of exposure analysis, called *specific absorption rate*, became required for all radios with antennas that were less than 20 centimeters from a person.

Another change was what the FCC calls *positive access control* (PAC), which becomes the responsibility of all affected radio amateurs under the new rules. If a location is identified as causing excessive exposure to people within it, the FCC expects every station, including amateur stations, to prevent access by unauthorized persons to that location and to post warning signs about potential high RF exposure.

The FCC delayed implementation of their new rules until May 3, 2021, and allowed all stations that operated under the previous rules to have a 2-year transition period before being required to comply. The FCC was clear that only stations that had complied with the previous rules as of May 3, 2021, could avail themselves of the transition period. After the implementation date, if a station was changed in such a way as to affect exposure, such as changing antennas or power, the exposure assessment had to be performed immediately. As of May 3, 2023, every station must be assessed for exposure before it is operated.

Simple Exposure Assessment Methods

The new rules still include distinctions for people who know about their exposure and are trained on how to control it, and those who do not. The *occupational exposure* (also referred to as *controlled exposure*) designation applies to amateurs and members of their households, with the expectation that they be trained about RF exposure. A separate *general population exposure* designation applies to everyone else. Their

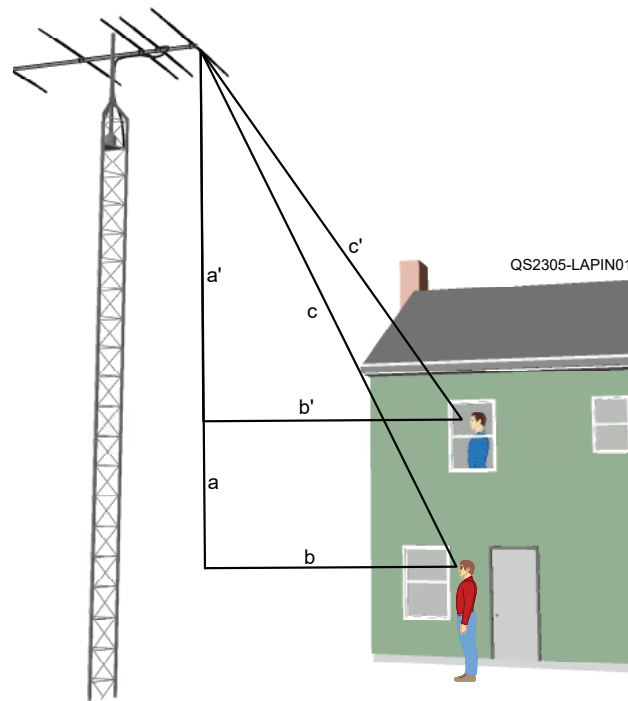


Figure 2 — In determining the compliance distances between the antenna and the location of people, consider the antenna height, the nearest point of the person being exposed, and the horizontal distance between the antenna and the exposure point. This drawing, originally published in *RF Exposure and You* by Ed Hare, W1RF1, illustrates the exposures of a person standing on the ground and on the second-story level of a nearby house. The formula $c = \sqrt{a^2 + b^2}$ is used to determine if the person meets the compliance distance.

exposure is deemed *uncontrolled*, and they have more restrictive MPE limits.

Most stations can be assessed with little effort. In place of the categorical exemptions, the FCC developed a table of exemption formulas based on power to the antenna, antenna gain, and minimum distance between a person and the antenna. With a simple calculation, this could exempt an amateur from having to perform further analysis of a station to help ensure compliance with the FCC MPEs. The FCC exemption treats every exposed person as if they were in the general population, and thus applies more restrictive MPE limits.

ARRL provides an RF Exposure Calculator at <http://arrl.org/rf-exposure-calculator> (see Figure 1). The calculator requires values to be entered for the power transmitted minus the feed-line loss, the antenna gain, the type of modulation used, the approximate transmit and receive times, and the frequency of operation. There is a checkbox to enable calculations with ground effects, and in the interest of conserva-

tism, this should be selected. From these values, the calculator generates the minimum distance from any part of the antenna that a person in the occupational and general populations may be located. See Figure 2 for how to calculate direct distances to the antenna. This evaluation must be repeated for every frequency band, antenna, and the maximum power level that's used to obtain a complete environmental analysis of a station.

The disadvantages of the simple methods of performing exposure assessments are that they can be overly conservative. The FCC exemption applies a perfect ground reflection factor, which makes it seem like people are being exposed to higher fields than they usually are. The FCC exemption and the online calculator assume that the fields produced by directionality of an antenna are present at all locations around the antenna, rather than only in the main beam. This often overestimates the exposure of people located out of the main beam of a directional antenna mounted on a tower or rooftop.

More complex analysis methods are available for stations that need them. If the simple assessment methods show that PAC will be needed to prevent excessive exposure, a more exact method of analysis may show that this is not the case. Computer modeling or calibrated measurement can be used to give more exact determinations of exposure.

Most radio amateurs will want to avoid applying the PAC principles. Permanent high fences and warning signs are not what most amateurs want. It's generally more desirable to modify a station's operation or antenna positions so that no publicly accessible locations could cause overexposure. This can be done in many ways, which include lowering transmitter power, raising antennas, and operating with lower operational and modulation duty cycles.

Moving Forward

The FCC plans to publish updates to *OET Bulletin 65* and *OET Bulletin 65 Supplement B*, but the current versions can still be found online. Those documents provide more details about performing exposure assessments and ways to mitigate when locations are determined to cause excessive exposure. Sections in the 2023 revisions of *The ARRL Handbook*

for *Radio Communications* and *The ARRL Antenna Book for Radio Communications* also provide up-to-date information about exposure assessment. More information can be found on the ARRL RF Exposure web page, at <http://arrrl.org/rf-exposure>.

As before, the FCC does not require that the results of a station's exposure analysis be submitted. However, it is advisable to keep a record of the analysis so that if there's ever an exposure complaint about that station, the calculations can be shown to the FCC.

Under the updated FCC rules, every radio amateur is responsible for determining that their station does not cause exposure that exceeds the FCC MPE limits to any person, either within their homes or outside of them. This is also required for portable and mobile operations.

Help show the FCC and the public that we're responsible users of RF energy by carefully considering exposure from your station and performing any required evaluations.

Gregory Lapin, N9GL, has been a radio amateur for 53 years, earning his license at a young age. He received his PhD in electrical engineering, specializing in biomedical imaging techniques, from Northwestern University. Greg studied drug delivery methods for brain tumors before becoming involved with RF exposure effects. He is a Life Senior Member of IEEE, serves on the IEEE Committee on Man and Radiation, and co-chairs the subcommittee that develops the C95.1 EMF safety standard for the IEEE International Committee on Electromagnetic Safety. Greg has been the Chairman of the ARRL RF Safety Committee since 1998 and represents ARRL on the FCC Technological Advisory Council. His other radio interests include propagation effects, software-defined radio, and hiking through parks to operate POTA and SOTA. Greg can be reached at n9gl@comcast.net.

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