

RF EXPOSURE LIMITS

Understanding the limits and how to calculate

KR3L

UPDATED RADIO FREQUENCY EXPOSURE RULES BECOME EFFECTIVE ON MAY 3, 2023

- The new rules do not change existing RF exposure (RFE) limits but do require that stations in all services, including amateur radio, be evaluated against existing limits, unless they are exempted.
- For stations already in place, that evaluation must be completed by May 3, 2023.
- After May 3 of this year, any new station, or any existing station modified in a way that's likely to change its RFE profile — such as different antenna or placement or greater power — will need to conduct an evaluation by the date of activation or change.

UPDATE CONTINUED

- The Amateur Service is no longer categorically excluded from certain aspects of the rules, as amended, and licensees can no longer avoid performing an exposure assessment simply because they are transmitting below a given power level.
- The new FCC limits for exposure incorporate two tiers of exposure limits.
 - Exposure occurs in an occupational or "controlled" situation.
 - General population is exposed or exposure is in an "uncontrolled" situation.
- Every Radio Amateur is responsible for determining that their station does not cause exposure that exceeds the FCC Maximum Permissible Exposure (MPE) limits to any persons.
- This is required for base, mobile, and portable operations.

DOCUMENTATION

- The good news is that there's no paperwork.
- When you complete your evaluation, you've fulfilled the rules requirement.
- Unless specifically requested by an agent of the FCC, you aren't required to submit any paperwork to them.
- FCC does not require a station's exposure analysis be submitted.
 - It is advisable to keep a record of the analysis so if there is ever an exposure complaint about the station, the calculations can be shown.
- The FCC also added a certification statement to Form 605 that had to be affirmed by every radio amateur who was issued an FCC license, renewed their license, or changed their station address, since 2008.
- Every licensed radio amateur in the US had certified that they would comply with the FCC's rules for RF safety.

ARRL RF CALCULATOR

- Enter power at Antenna
- Select Mode duty cycle
- Select time for Transmit duty cycle
- Enter Antenna Gain (dBi)
- Enter Operating Frequency (MHz)
- Click Calculate

Parameters

- Power at Antenna: (Need help with this?) (watts)
- Mode duty cycle:
 ▼
- Transmit duty cycle: (time transmitting)
You transmit for minutes then receive for minutes (and repeat).
- Antenna Gain (dBi): (Need help with this?)
- Operating Frequency (MHz):

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)	<input type="text"/>
Comments: (optional)	<input type="text"/>

POWER AT ANTENNA

- This is the transmitter power minus feedline losses.
- At VHF/UHF frequencies, the feedline loss can result in significantly less power applied to the antenna compared to the transmitter power.
- Example - Transmitting 100W into 80 feet of RG-8X coax to an antenna with an SWR of 1.4:1 at 146.52 MHz will result in only 46W of actual power at the antenna.

MODE DUTY CYCLE

- Based on usage. This affects the average output power.
- Mode duty cycles are:
 - Conversational SSB with no speech processing, uses a 20% duty cycle which includes voice characteristics and syllabic duty factor.
 - Conversational SSB with heavy speech processing, uses a 50% duty cycle which includes voice characteristics and syllabic duty factor.
 - Voice FM, uses a 100% duty cycle.
 - FSK or RTTY, uses a 100% duty cycle.
 - AFSK SSB, uses a 100% duty cycle.
 - Conversational CW, uses a 40% duty cycle
 - Carrier always on (e.g. commonly used for tune-up purposes), uses a 100% duty cycle.
- For all others, or if unknown, uses a 100% duty cycle as a worst case catch-all.

CONTROLLED VS UNCONTROLLED

- Takes into account whether or not individuals are aware of the RF exposure or not.
- A Controlled Environment is an area where the persons exposed to RF are aware of the exposure and its effects.
- An Uncontrolled Environment is an area where the persons exposed to RF are unaware of the exposure and its effects.

EFFECT FOR GROUND

- For the Effect of ground: parameter, when checked, the effects of signals reflecting off the ground are included in the calculation.
- Use this setting for low or non-directional antennas.
- This is a more conservative way of estimating RF exposure.

ANTENNA GAIN

Use manufacturer's free space gain figures in dBi when available.

You could use a detailed antenna model. If so, along each lobe of the model, or direction of interest, use the dBi gain of the antenna derived from the model.

If you have no idea what your antenna's radiation pattern looks like, use the information in the chart as a first approximation.

Antenna Type	Approx. Gain (dBi)
Half wave dipole	2.15 dBi
10 element Yagi	15.1 dBi
2 element Yagi	5.9 dBi
3 element Yagi	8.1 dBi
4 element Yagi	9.1 dBi
5 element Yagi	10.1 dBi
6 element Yagi	11.1 dBi
8 element Yagi	13.1 dBi
Delta Loop	5.2 dBi
Four Square	5.2 dBi
G5RV	1.0 dBi
Hex Beam	5.0 dBi
Moxon	6.0 dBi
Quarter Wave Vertical	1.5 dBi
Windom (OCD)	2.0 dBi

EXAMPLE VHF HT

- A HT using 5 watts and a Diamond SRH77CA
- Power to antenna is 5 watts
- Mode duty cycle is FM (100%)
- Transmit duty cycle – 2 min transmit and 5 min receive
- Antenna gain – 2.15 dBi (manufacture claim)
- Frequency 147.195
- Minimum safe distance in controlled environment – 10 inches
- Minimum safe distance in uncontrolled environment – 1' 9"

EXAMPLE UHF HT

- A HT using 5 watts and a Diamond SRH77CA
- Power to antenna is 5 watts
- Mode duty cycle is FM (100%)
- Transmit duty cycle – 2 min transmit and 5 min receive
- Antenna gain – 2.15 dBi (manufacture claim)
- Frequency 443.250
- Include effects of ground reflection
- Minimum safe distance in controlled environment – 7.62 inches
- Minimum safe distance in uncontrolled environment – 17 inches

ADDITIONAL INFORMATION

- ARRL RF Exposure information - [RF Exposure \(arrl.org\)](#)
- ARRL RF Exposure Calculator - [RF Exposure Calculator \(arrl.org\)](#)
- ARRL Station Evaluation - [FCC RF-Exposure Regulations -- the Station Evaluation \(arrl.org\)](#)
- Coax Line Loss Calculator - [Coax Calculator \(qsl.net\)](#)
- VP9KF RF Exposure Calculator - [Enter parameters - RF Exposure Calculator - VP9KF/Hintlink](#)
- Antenna Modeling Software - [EZNEC Antenna Software by W7EL](#)