FCC RF Exposure Assessments

August 2021

SARA

SILVERCREEK AMATEUR RADIO ASSOCIATION
W8WKY.ORG

Disclaimer

Note: This is a summary and walkthrough of the FCC RF Exposure rules and is not intended to be a complete or comprehensive explanation of the FCC RF Exposure rules. For questions contact the ARRL.

Follow this information at your own risk and liability.

Change Timeline

FCC rules for RF Exposure changed effective May 3, 2021

- Categorical exemption based on emitted power per band listed in §97.13(c) – but note hams were still liable for overexposure
- After May 3, 2021 – Any new station or modified station must complete and save an RF Exposure Assessment should one be asked for by the FCC
- After May 3, 2023 – Any unmodified station existing on May 2, 2021 must have a completed assessment saved

Note: It's expected the FCC is going to ask for this if they ever field a complaint about your station.

Controlled / Occupational Exposure

For FCC purposes, applies to human exposure to RF fields when persons are exposed as a consequence of their employment and in which those persons who are exposed have been made fully aware of the potential for exposure and can exercise control over their exposure. Occupational/controlled exposure limits also apply where exposure is of a transient nature as a result of incidental passage through a location where exposure levels may be above general population/uncontrolled limits (see definition above), as long as the exposed person has been made fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Definitions from FCC OET Bulletin 65 pgs 3-4

Key Points for Hams

- You are the only person who is “fully aware” of potential exposure and controls the exposure
- If your family, even if informed of risks and your operating schedule, can’t leave the area affected, they aren’t necessarily able to “exercise control” over their exposure alone

General Population / Uncontrolled Exposure

For FCC purposes, applies to human exposure to RF fields when the general public is exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Therefore, members of the general public always fall under this category when exposure is not employment-related.

Definitions from FCC OET Bulletin 65 pgs 3-4

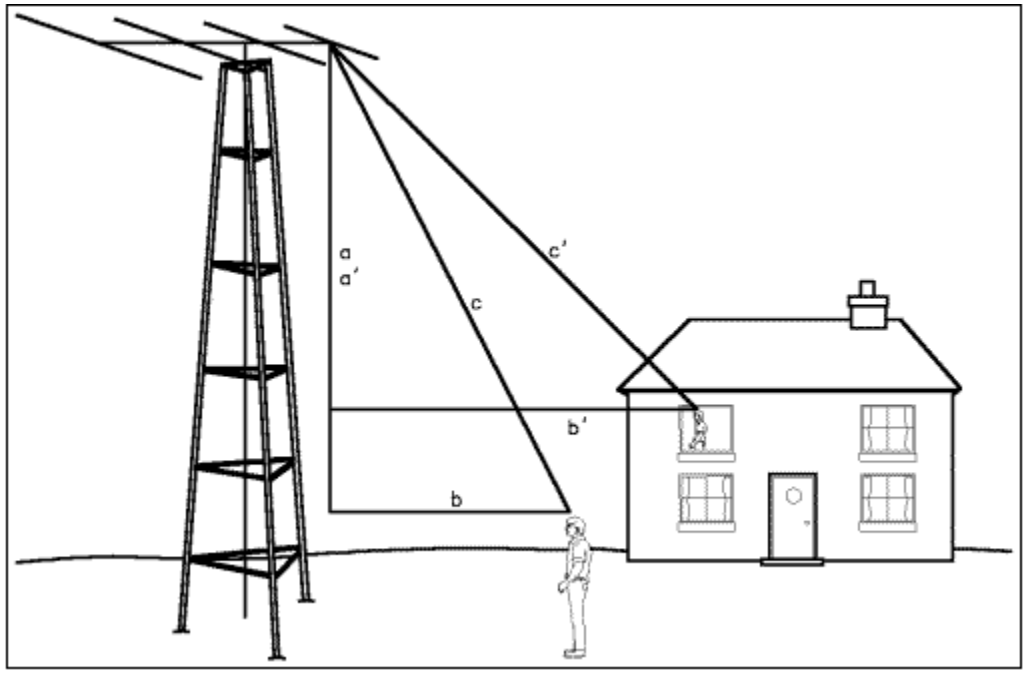
Key Points for Hams

- Safest course of action and maximizing ability to operate would be to consider everyone but yourself as “general population”
- Invisible boundaries such as property lines or non-RF-containing structures like walls (e.g., apartments, fences, etc.) where it’s reasonable the general public may be near or cross do not provide an alternative control to the distance requirements

What is exposure?

Exposure distance is based on distance from ANY part of an antenna from ANY part of the body

Any radiation closer than 20cm to the body require SAR testing by a manufacturer.

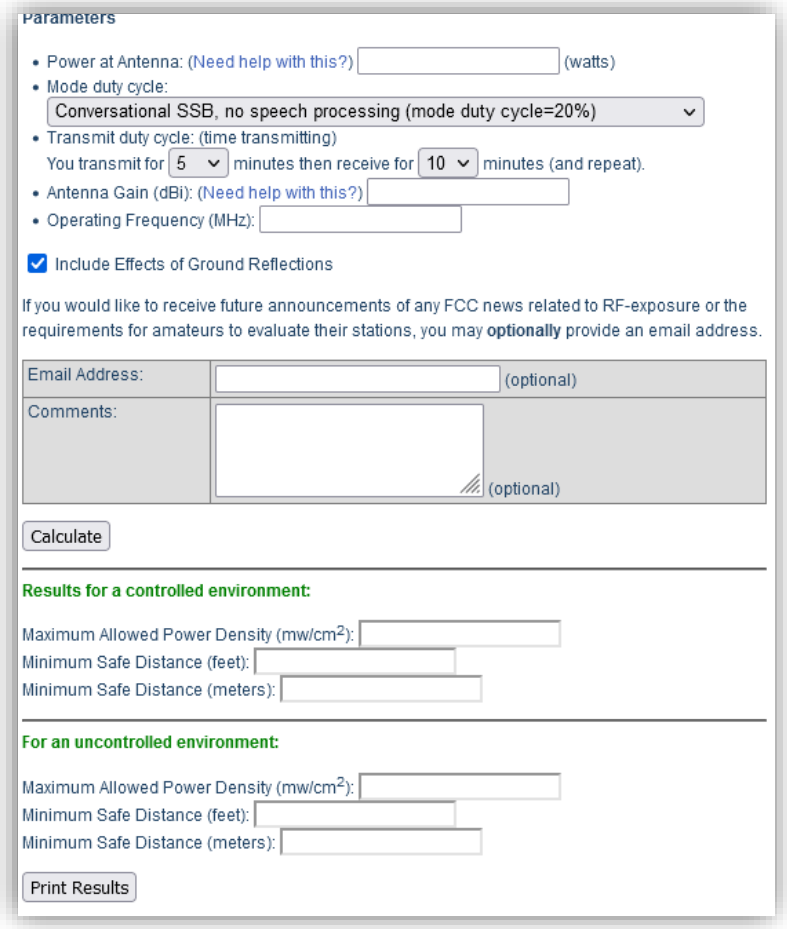


FCC-Required RF Exposure Assessment

There is still an exemption process based on

- Frequency
- EIRP
- Distance of people from antenna within reactive near field

However, it's not that much more work with the ARRL calculator to calculate the full exposure assessment - so it's easier to just use the calculator rather than trying to apply the exception first.


Parameters

- Power at Antenna: (Need help with this?) (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 10 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)
Comments:	(optional)

Calculate

Results for a controlled environment:

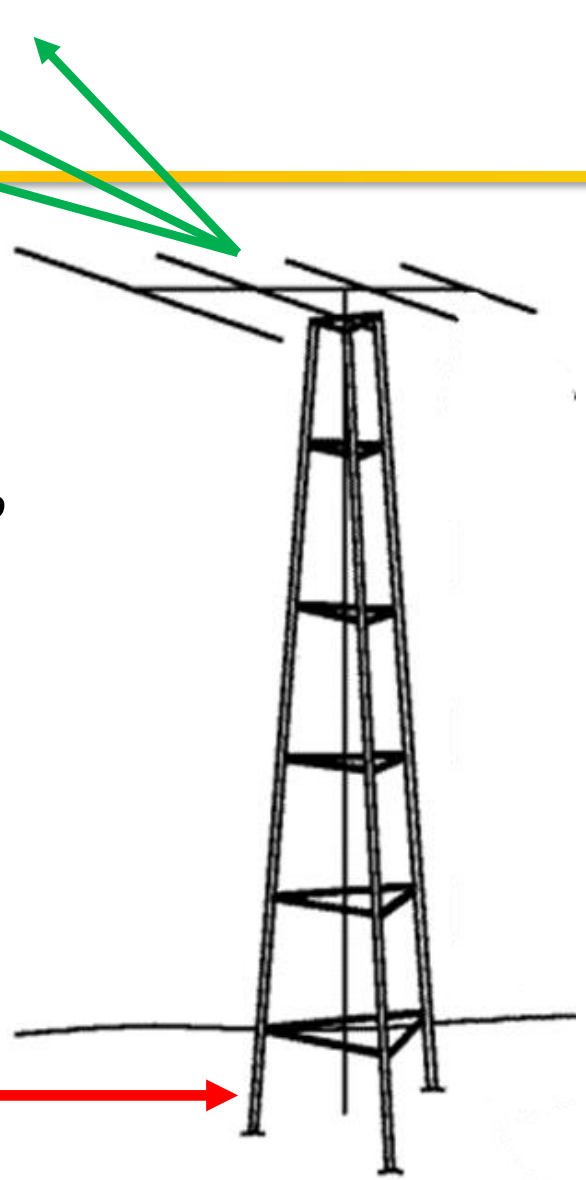
Maximum Allowed Power Density (mw/cm^2):
Minimum Safe Distance (feet):
Minimum Safe Distance (meters):

For an uncontrolled environment:

Maximum Allowed Power Density (mw/cm^2):
Minimum Safe Distance (feet):
Minimum Safe Distance (meters):

Print Results

System Gains and Losses



Regardless of your radio's power, your Effective Radiated Power (ERP) out of your antenna is a function:

$$dBW\ Out\ -dB\ Feed\ Loss + dB\ Antenna\ Gain = dbW\ ERP$$

dBW Out – Radio's max output power in dBW
dB Feed Loss – Loss created by feedline, connectors, other
dB Antenna Gain – Gain of your antenna

Radio Power (dBW) - Feedline Loss (dB) + Antenna Gain (dB)

FCC-Required RF Exposure Assessment

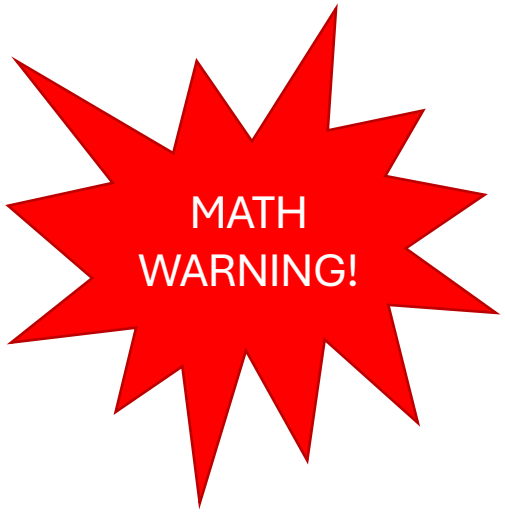
Convert Watts to dBW

$$dBW = 10 \cdot \log_{10}(W)$$

For a 50W example:

$$17 \approx 10 \cdot \log_{10}(50)$$

$$50W \approx 17\ dBW$$



Convert dBW to Watts

$$W = 10^{\frac{dbW}{10}}$$

For a 17 dbW example:

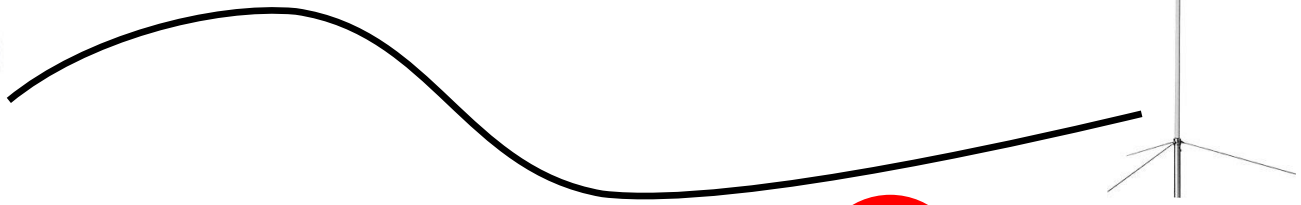
$$50 \approx 10^{1.7} = 10^{\frac{17}{10}}$$

$$17\ dBW = 50$$

FCC-Required RF Exposure Assessment

Step 1 - Calculate your Effective Radiated Power (ERP) TO antenna (don't include antenna gain!)

$$10 \cdot log_{10}(50W) \approx 17\ dbW$$
$$17\ dbW\ - 0.6\ dB = 16.4\ dbW$$
$$10^{\frac{16.4}{10}} = 43.65W$$



Icom ID-4100
TX Power 50W @ 144 Mhz

50' LMR-400
1.8 dB loss @ 100'
50' = 0.6 dB

Diamond V2000A
2m Gain = 6.2 dB

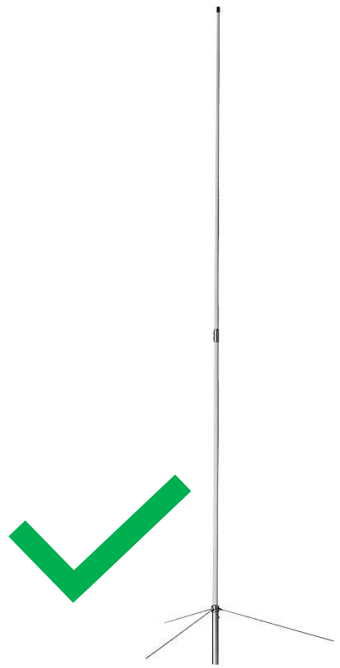
FCC-Required RF Exposure Assessment

Step 2 – Understand your antenna gain or estimate with the table

Specifications:

Bands:	6m/2m/70cm
Frequency (MHz):	52-54/144-148/440-450
Gain:	2.15dBi/6.2dB/8.4dB
Impedance (nominal):	50W
VSWR:	1.5:1 (typical)
Power Rating:	150 watts
Element Phasing:	1/2l/2-5/8l/4-5/8l
Max Wind Rating:	112 m.p.h.
Mast Dia. Acceptance:	1.2 to 2.4 inches
Length/Weight	8.3 ft./2.6 lbs.
Connector:	SO-239 Female

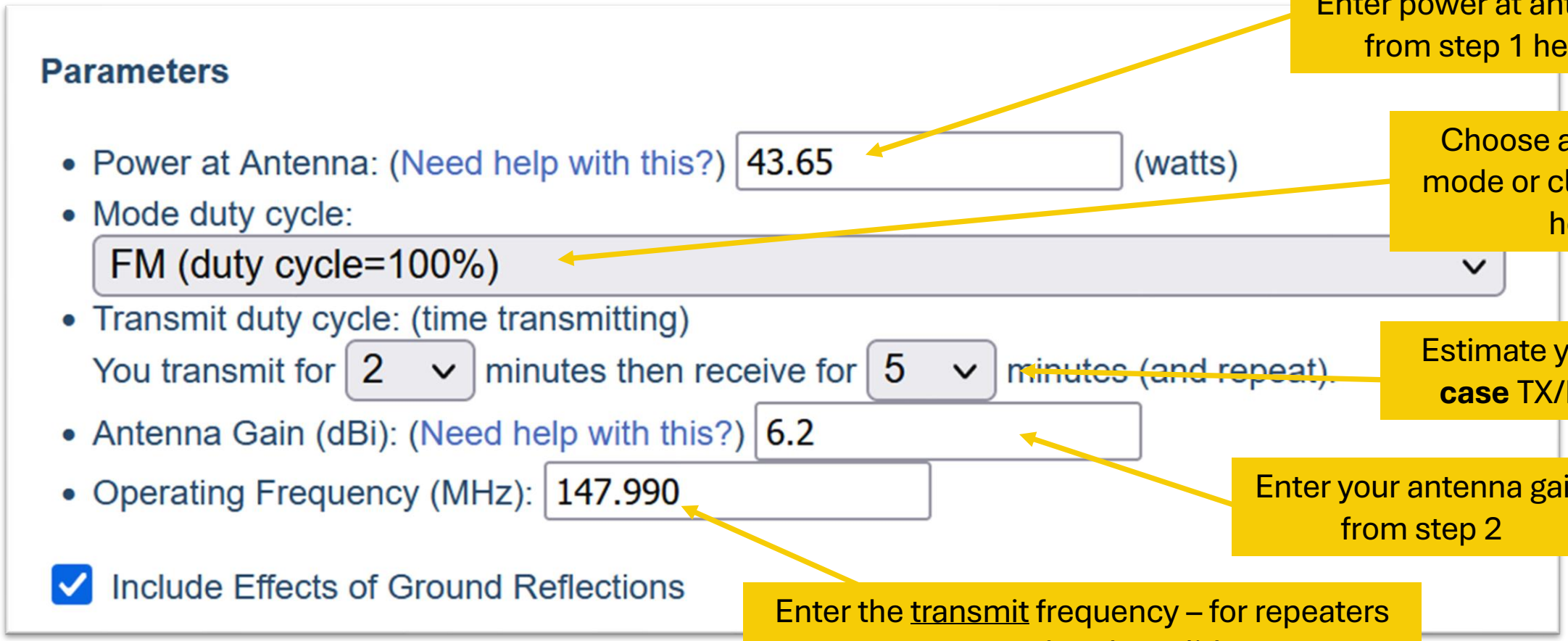
Antenna Type	Approx. Gain (dBi) *	Directionality
Half wave dipole	2.15 dBi	Slightly
10 element Yagi	15.1 dBi	Highly
2 element Yagi	5.9 dBi	Moderately
3 element Yagi	8.1 dBi	Highly
4 element Yagi	9.1 dBi	Highly
5 element Yagi	10.1 dBi	Highly
6 element Yagi	11.1 dBi	Highly
8 element Yagi	13.1 dBi	Highly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



Diamond V2000A
2m Gain = 6.2 dB

FCC-Required RF Exposure Assessment

http://www.arrl.org/rf-exposure-calculator



Enter power at antenna from step 1 here

Choose appropriate mode or closest mode here

Estimate your **worst-case** TX/RX profile

Enter your antenna gain from step 2

Enter the transmit frequency – for repeaters remember the split!

FCC-Required RF Exposure Assessment

Distance you (maybe family?) must stay away during transmitting activity

Results for a controlled environment:

Maximum Allowed Power Density (mw/cm^2):	1.0000
Minimum Safe Distance (feet):	3.6470
Minimum Safe Distance (meters):	1.1116

Distance from any reasonable approach by anyone else

For an uncontrolled environment:

Maximum Allowed Power Density (mw/cm^2):	0.2000
Minimum Safe Distance (feet):	8.1549
Minimum Safe Distance (meters):	2.4856

FCC-Required RF Exposure Assessment

Amateur HTs manufactured before May 3, 2021 are grandfathered into the new roles

Amateur HTs manufactured after May 3, 2021 must have a Specific Absorption Rate (SAR) test performed by the manufacturer

Going create an interesting situation for the “budget” radio makers.