

Ham RF Safety Requirements

New rules from FCC

New RF Safety Rules

- Rules became effective May 3, 2021
- What is changing
 - No more power exemptions
 - All stations must have exposure evaluations by May 3, 2023
 - New/modified stations fall under new rule now
 - If you change power, change antenna, etc.

What is not changed

- Existing stations good to May 3, 2023
- No changes to the exposure limits

Old Exemptions¹

TABLE 1.1

Wavelength Band

***Evaluation Required if
Power* (watts)
Exceeds:***

<i>Wavelength Band</i>	<i>Evaluation Required if Power* (watts) Exceeds:</i>
<hr/>	
MF	
160 m	500
<hr/>	
HF	
80 m	500
75 m	500
40 m	500
30 m	425
20 m	225
17 m	125
15 m	100
12 m	75
10 m	50
VHF (all bands)	50
<hr/>	
UHF	
70 cm	70
33 cm	150
23 cm	200
13 cm	250

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- Enough heat will break molecules into simpler ones

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- Radio waves can heat up molecules
- Enough heat will break molecules into simpler ones
 - Scientific term: COOKING



Why is RF Cooking So Dangerous

- RF can penetrate and heat and destroy internal tissue
 - Internal tissue is very sensitive to temperature
 - Our body temperature is very well regulated
- You have few nerve endings except on the surface
 - Internal heating will usually go undetected
- You may not feel the damage until it is too late!
- See Insert in [1] at end of chapter 3 for more details

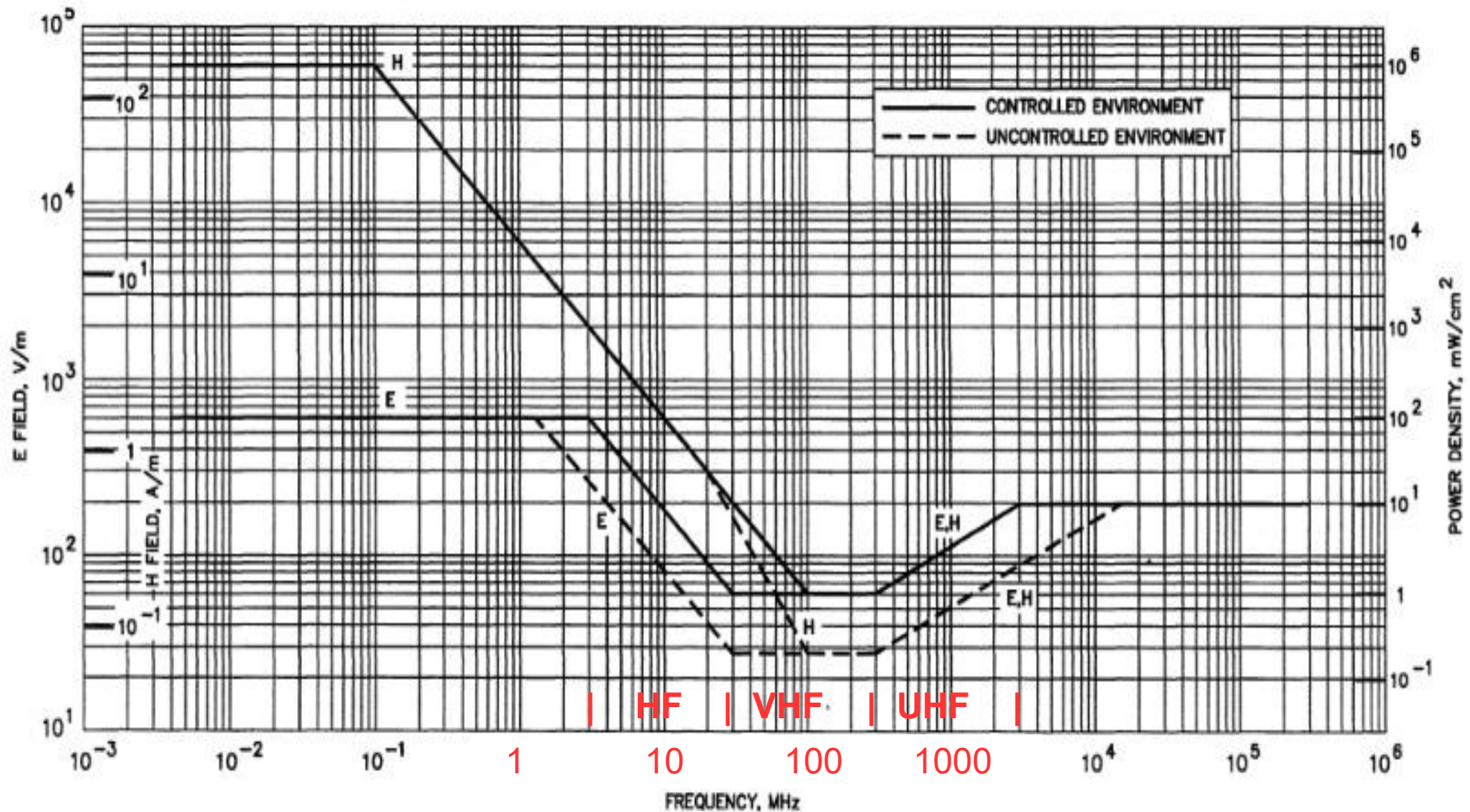
FCC (IEEE) Standard

- Deals only with thermal heating
 - Athermal effects required in some locations
- Field measurement requires expensive instruments
 - Frequent recalibration needed
- Programs can estimate far field strength
 - Or use worksheets in (1)
- Try VP9KF's calculator at
 - http://hintlink.com/power_density.htm²

Maximum Limits of Exposure

- Different for controlled & uncontrolled environment
 - Your property vs. property of others
 - You are aware of danger, neighbors are not
 - You accept the danger, they don't
 - Limits tighter for uncontrolled environments
- Frequency affects maximum allowed exposure
 - Body most sensitive to VHF 30-300 MHz
 - Eyes are most sensitive to GHz
 - Don't watch food cook in the microwave
 -

1991 IEEE Standard Exposure Limits



Near Field vs. Far Field

- Near field strength varies with antenna geometry
 - Generated by antenna currents and voltages
- Far field independent of antenna type
- Smooth transition typically at $1/3$ to $1/2$ wavelength
- Most of concerns are with far field
 - Exception: Being Close (HT, SOTA, POTA, etc.)
- Near field computations very difficult
 - Avoid being in the near field
 - Near field may be full of hot spots and nulls
 - No fixed relationship between E and H, do both

How to Evaluate

- Must evaluate each antenna, band, power combo
- In far field: only E field needs to be calculated
- Start with worst case for this antenna and band
 - Maximum power key down
 - Major lobe of antenna
 - No loss in coax
- If you pass, you are good for that combination
- If you fail, evaluate with duty cycle, coax loss, etc. on each mode to see if you pass
- If you still fail, make changes to your station

RF Exposure Calculator Results

Calculation Results

Average Power at the Antenna	50 watts
Antenna Gain in dBi	2.2 dBi
Distance to the Area of Interest	5 metres 16.4 feet
Frequency of Operation	50 MHz
Are Ground Reflections Calculated?	Yes
Estimated RF Power Density	0.0677 mW/cm ²



Input Data

	Controlled Environment	Uncontrolled Environment
Maximum Permissible Exposure (MPE)	1.01 mW/cm ²	0.21 mW/cm ²
Distance to Compliance From Centre of Antenna	1.32 metres 4.32 feet	2.92 metres 9.59 feet
Does the Area of Interest Appear to be in Compliance?	Yes	Yes

Distance to Compliance

Are you OK?

RF Exposure Calculator

- Use average power to antenna (over minutes)
 - Allow for loss in coax (3dB = 1/2 power)
 - Allow for duty cycle over 5-6 minutes
 - FT8 = 50%, FM=100%, RTTY 100, CW 40%
 - see table 5.4 in (1)
- Distance in meters, not feet!
- Antenna gain in dBi
 - add 2.2 to dBd

Operating Mode	Duty Factor
Conversational SSB, no processing	20%
Conversational SSB, with processing	40%
[Voice] FM	100%
FSK or RTTY	100%
AFSK [SSB]	100%
FT4/FT8	50%
Conversational CW	40%
Carrier	100%

Is Your HT Safe to Use? (It's only 5 W)

Calculation Results

Performed on: _____ By: _____

Average Power at the Antenna	5 watts
Antenna Gain in dBi	2.0 dBi
Distance to the Area of Interest	.3 metres 0.98 feet
Frequency of Operation	144 MHz
Are Ground Reflections Calculated?	Yes
Estimated RF Power Density	1.7938 mW/cm ²

	Controlled Environment	Uncontrolled Environment
Maximum Permissible Exposure (MPE)	1.01 mW/cm ²	0.21 mW/cm ²
Distance to Compliance From Centre of Antenna	0.42 metres 1.37 feet	0.91 metres 3 feet
Does the Area of Interest Appear to be in Compliance?	No	No

Changing Your Station

- Lower power (Part 97: use lowest power needed)
- Move antenna to safer location
- Move people to safer distance
- Do not point main lobe at neighbors or you
- Lower duty cycle (keep transmissions short)
- Remote control your station from safer distance
- Use remote microphone on HT
- Use external antenna on HT

Other Considerations

- Make sure antenna is the only radiator
 - Don't open doors or panels
 - Use a choke or current balun near antenna
- Never get near an active (transmitting) antenna
 - Magnetic loop antennas for example
- Be careful with multiple transmitters (field day?)
 - It is cumulative

Credits

- 1) “RF Exposure and You” Ed Hare W1RFI on arrl.org
- 2) VP9KF, Paul Evans “RF Exposure Calculator” at http://hintlink.com/power_density.htm
- 3) ke0og.net/ask-dave Lesson 11.2 RF exposure on “Ham Radio Answers” Channel Video (youtube.com)