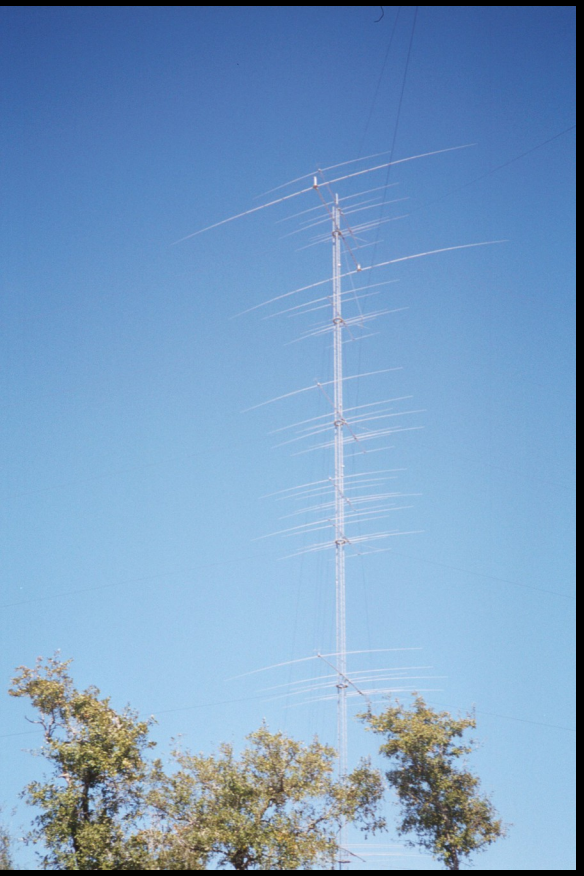
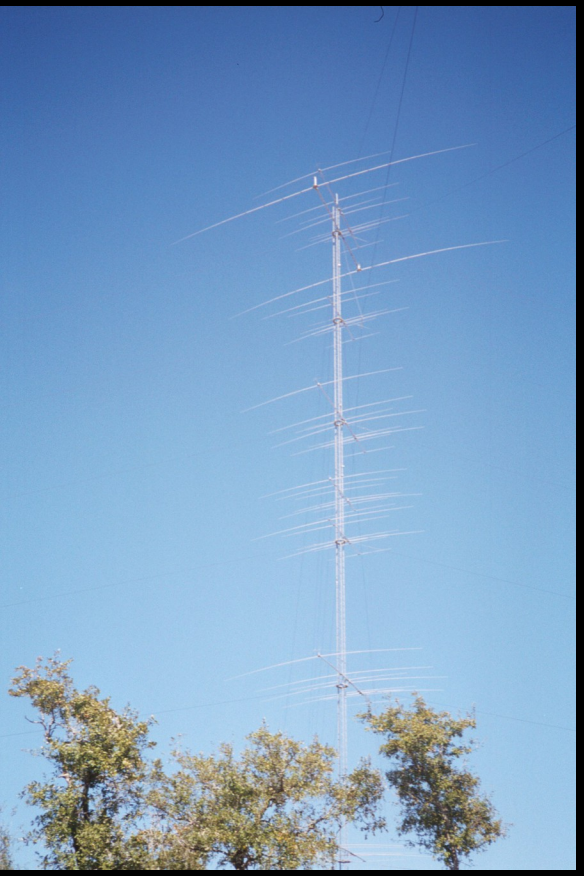
RF Safety for the Radio Amateur



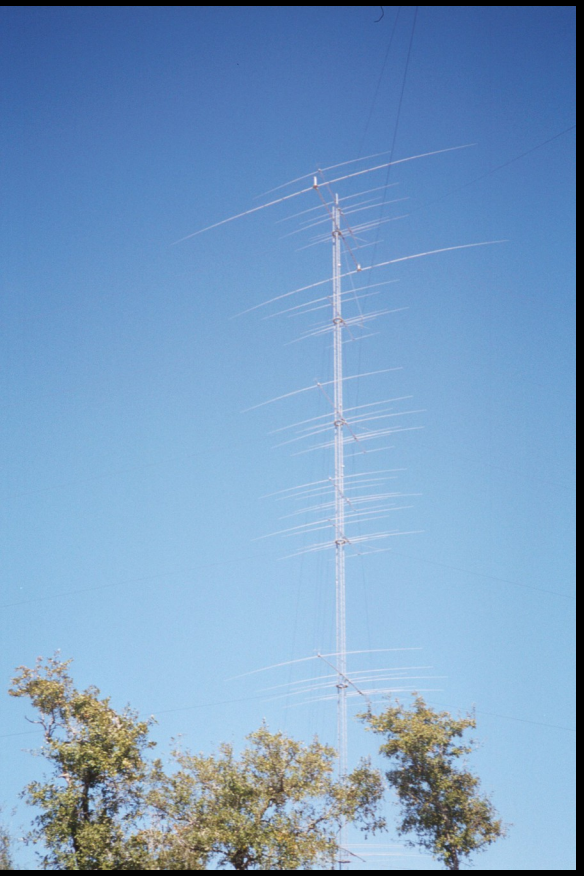
- History
- RF Safety Objectives
- FCC Regulations
- Tools for Compliance
- Additional Resources

Early History of RF Safety



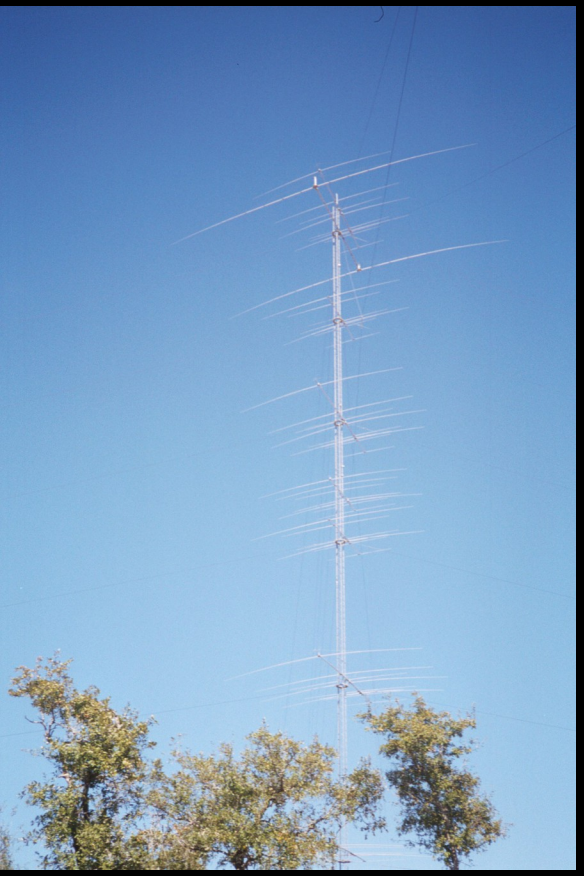
- 1982: IEEE Standard C95.1-1982 describes appropriate limits for human exposure to RF energy.
- FCC adopts RF safety regulations based on this standard.
- Unlike other services, the FCC categorically exempts the ARS from any specific regulations regarding station evaluations.

More Standards on RF Safety



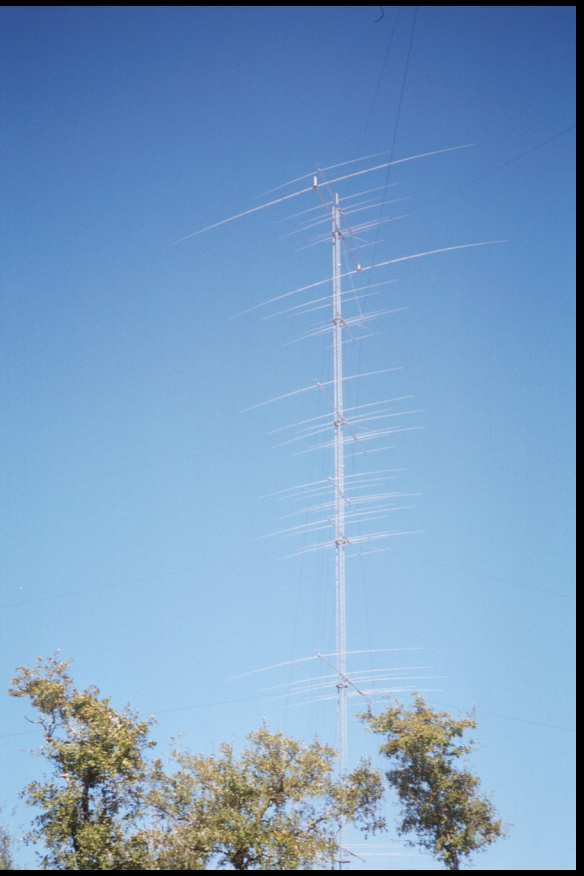
- 1991: IEEE Standard C95.1-1991 decreased the maximum permissible levels of the 1982 standard and extended the frequency ranges considered.
- 1993: An NPRM to include the ARS in RF safety regulations based on the new standard is introduced, but is not acted upon.

Congress Gets Involved



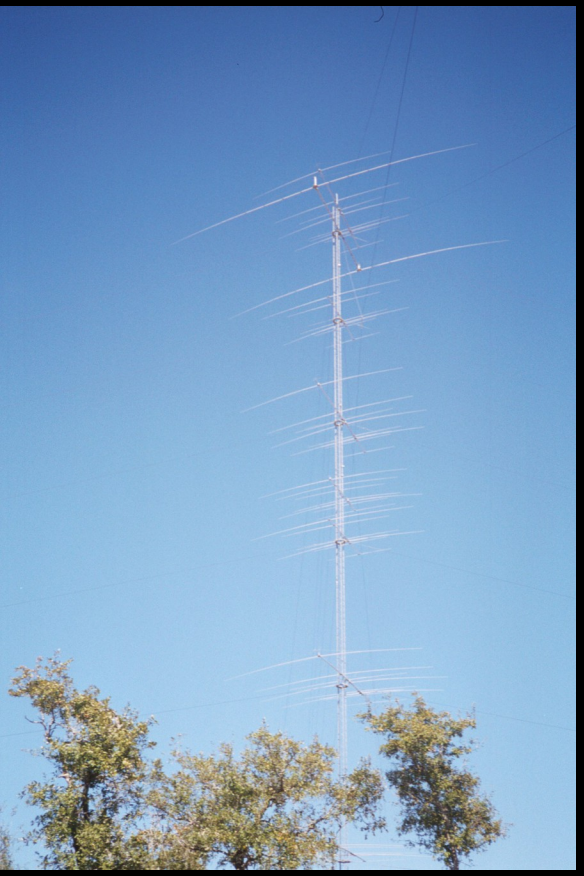
- 1996: The Telecommunications Act passed by Congress instructs the FCC to complete overhaul of RF safety regulations.
- 1996: FCC R&O Docket 96-326 includes the Amateur Radio Service in the RF Safety Regulations, ending our categorical exemption.

Ionizing vs. Non-Ionizing Radiation



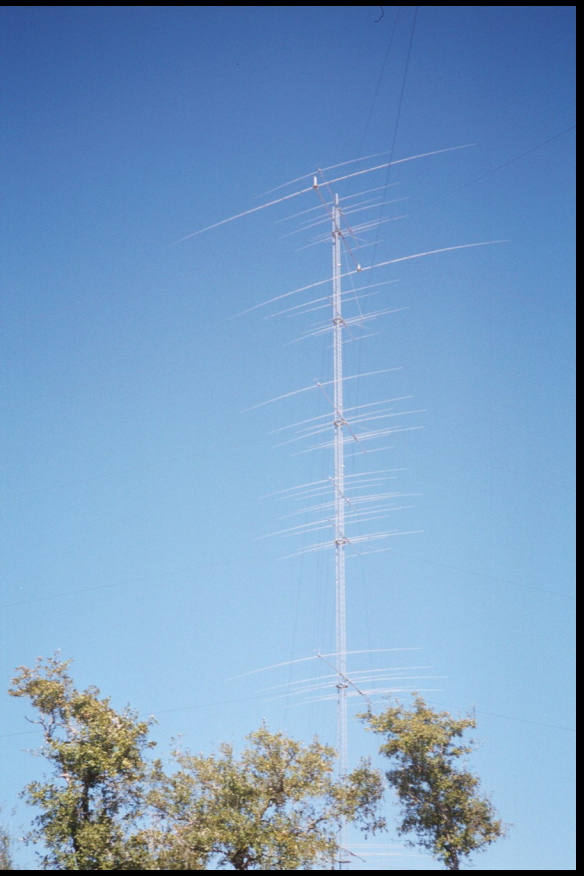
- Ionizing radiation is responsible for “radiation sickness.” RF is non-ionizing.
- Non-ionizing radiation may have both thermal effects and athermal effects.
- RF Safety regulations concern only the thermal effects of non-ionizing radiation.

MPEs and SARs



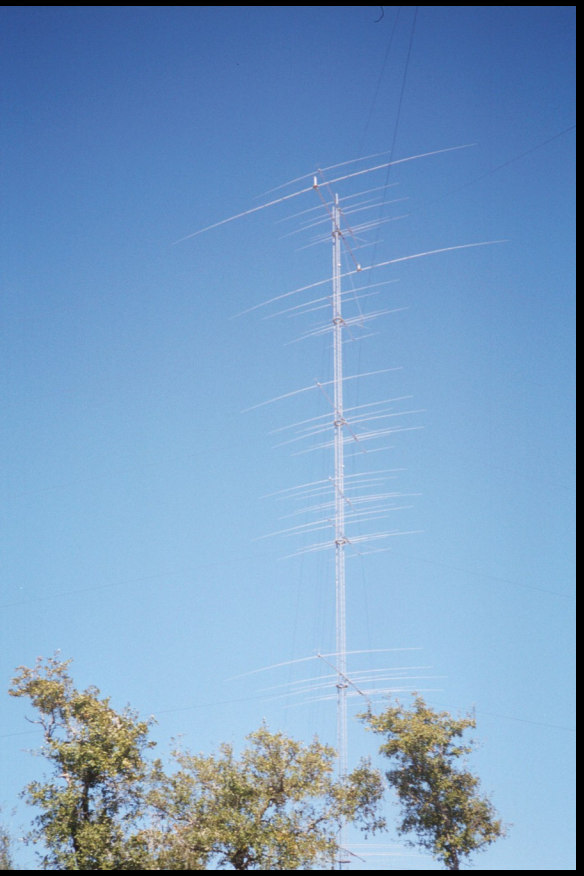
- The Specific Absorption Rate (SAR) measures the rate at which tissue absorbs RF energy.
- The Maximum Permissible Exposure (MPE) is based upon the SAR, and differs at various frequency ranges.
- The most stringent requirements are at 30 MHz to 300 MHz.

Exposure Environments



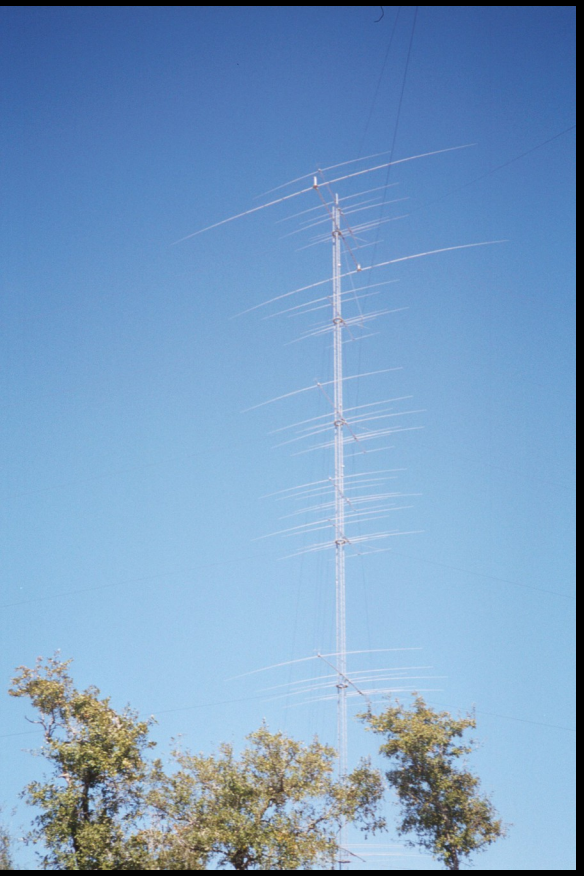
- A “controlled” environment is one in which people are aware of the RF and can control their exposure.
- An “uncontrolled” environment is one in which people would not normally be aware of the RF exposure.
- FCC Regulations treat these two environments differently.

FCC Regulations



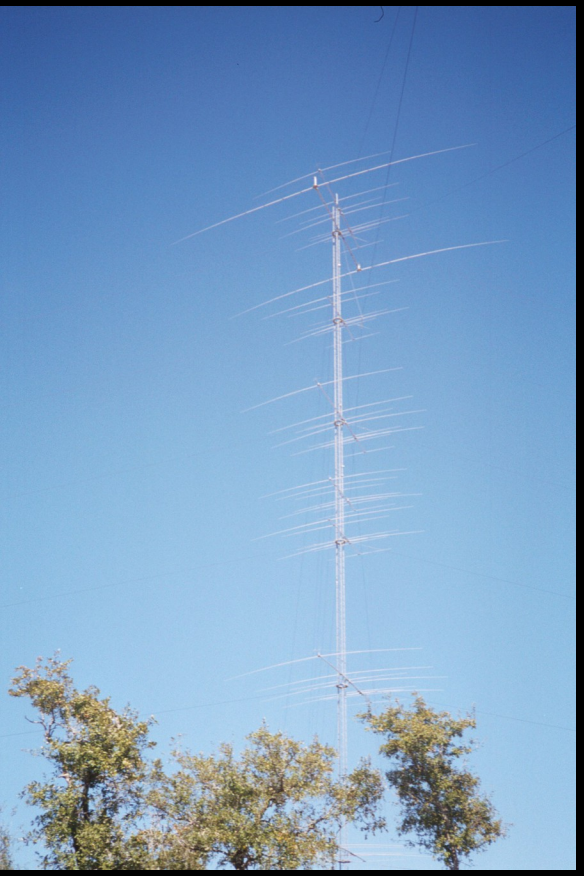
- All Amateur Service stations must comply with MPE levels.
- Regulations allow us to consider duty cycle and average power in the calculations.
- A routine station evaluation is required of most ARS stations.
- ARS stations are not required to file or record any paperwork.

FCC Regulations



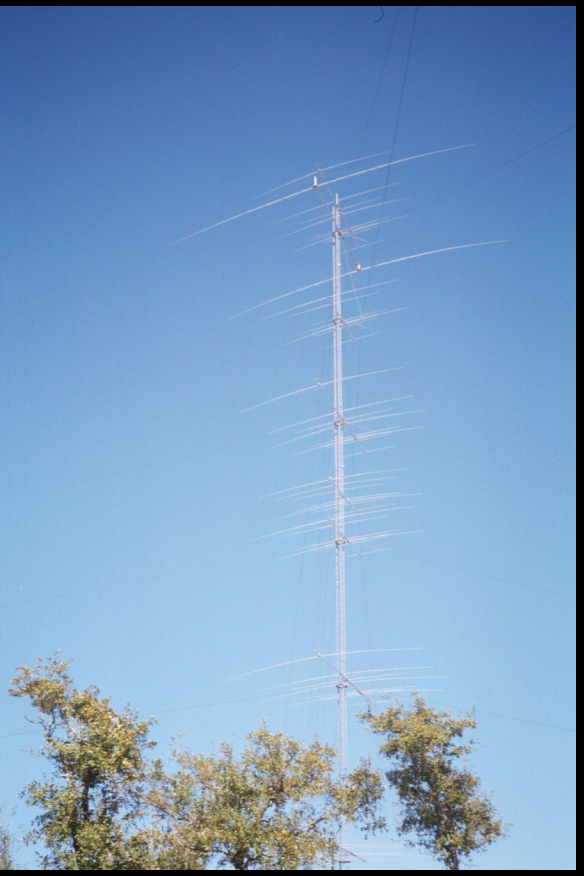
- While they must continue to be in compliance with MPE levels, stations using less than specified levels of PEP output, and mobile or portable stations using PTT, are exempt from routine station evaluations.
- 1997: An amendment to Docket 93-62 specifies a sliding scale of exempt power levels for fixed stations.

Tools for Compliance



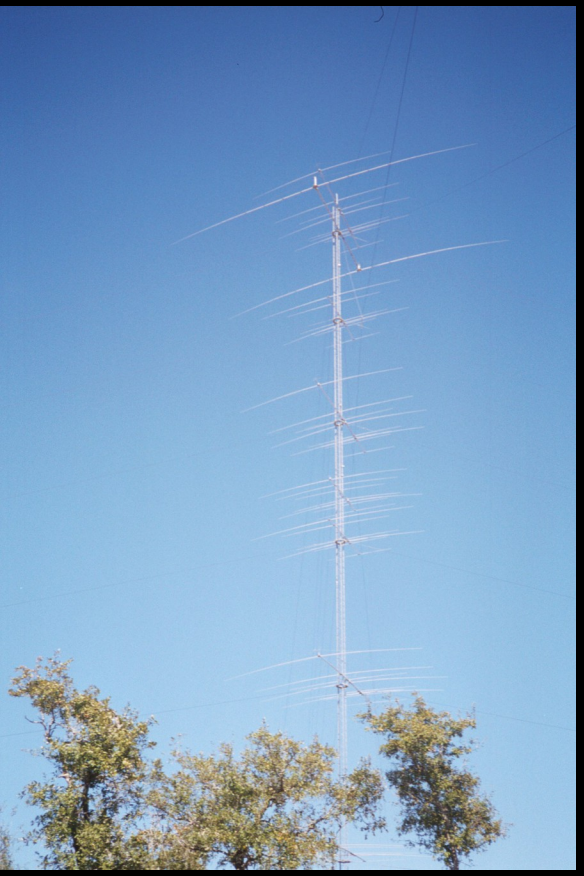
- FCC OET Bulletin 65 contains all the formulas and details.
- FCC OET Bulletin 65 Supplement B contains a station evaluation worksheet.
- “FCC RF-Exposure Regulations – the Station Evaluation” by Ed Hare W1RFI, *QST*, January 1998, pp. 50-55.
- Amateur Radio RF Safety Calculator at the N5XU web site.

Additional Resources



- *RF Exposure and You* by Ed Hare W1RFI
- ARRL RF Safety Page (http://www.arrl.org/rfsafety/)
- FCC RF Exposure FAQ (http://www.fcc.gov/oet/rfsafety/rf-faqs.html)
- N9GL's RF Safety Articles (http://www.arrl.org/rfsafety/lapin/)

Amateur Radio RF Safety Calculator



Amateur Radio RF Safety Calculator - Mozilla

File Edit View Go Bookmarks Tools Window Help

http://n5xu.ae.utexas.edu/rfsafety/

Amateur Radio RF Safety Calculator | Central Texas DX & Contest Club | ARDF: IARU Region II

Amateur Radio RF Safety Calculator

English | French

Calculate Radio Frequency Power Density

What is the average power at the antenna:
In watts

What is the antenna gain in dBi:
Enter 2.2 for dipoles; add 2.2 for antennas rated in dBd

What is the distance to the area of interest:
From the center of the antenna, in feet

What is the frequency of operation:
In MHz

Ground Reflection Effects

In most cases, the ground reflection factor is needed to provide a truly worst-case estimate of the compliance distance in the main beam of the antenna. Including the ground reflection effects may yield more accurate results especially with very low antennas, non-directional antennas, and calculations below the main lobe of directional antennas.

Do you wish to include effects of ground reflections? (•) Yes ( ) No

Calculate RF Power Density | Reset Values

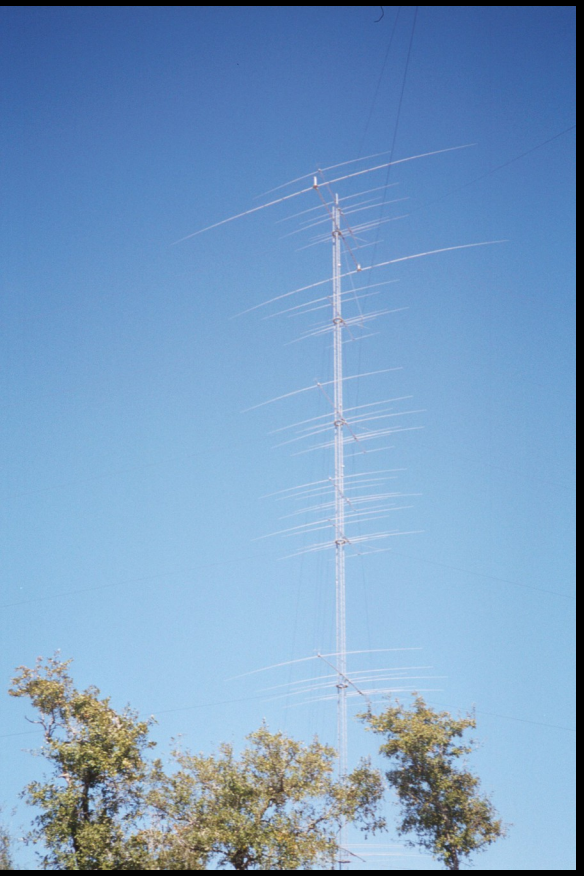
This is a main beam power density estimation program intended for use as part of a routine evaluation of RF safety compliance with FCC regulations. Amateur Radio operators licensed by the Federal Communications Commission of the United States of America are required to do a "routine evaluation" of the strength of the RF fields around their stations, subject to certain exemptions. These rules can be found in the FCC's ET Docket No. 93-62. More information can be found at the ARRLWeb's RF Safety page.

This program uses the formulas given in FCC OET Bulletin No. 65 to estimate power density in the main lobe of an antenna, with use of the EPA-recommended ground reflection factor as an option. This program is intended for approximate far-field calculations. It may overestimate the actual field strength of high-gain antennas in the near field (within several wavelengths of the antenna.) However, it may also underestimate the strength of fields that may be encountered in *hot spots* in the near field. No computer program can predict where wiring or reflective objects may create hot spots in your particular installation.

This is a World Wide Web front end for a public domain C program written by Ken Harker WM5R using the cgic library. This program has been derived directly from a public domain BASIC program written and published by Wayne Overbeck N6NB in the January, 1997 issue of *CQ VHF*, p. 33.

University of Texas Amateur Radio Club N5XU
Send comments to: ***utarc@www.utexas.edu***
Last updated: 22 October 2004

Entering Computation Values



Amateur Radio RF Safety Calculator - Mozilla

File Edit View Go Bookmarks Tools Window Help

http://n5xu.ae.utexas.edu/rfsafety/

Amateur Radio RF Safety Calculator | Central Texas DX & Contest Club | ARDF: IARU Region II

Amateur Radio RF Safety Calculator

English | French

Calculate Radio Frequency Power Density

What is the average power at the antenna:
In watts — 600

What is the antenna gain in dBi:
Enter 2.2 for dipoles; add 2.2 for antennas rated in dBd — 4.4

What is the distance to the area of interest:
From the center of the antenna, in feet — 50

What is the frequency of operation:
In MHz — 28

Ground Reflection Effects

In most cases, the ground reflection factor is needed to provide a truly worst-case estimate of the compliance distance in the main beam of the antenna. Including the ground reflection effects may yield more accurate results especially with very low antennas, non-directional antennas, and calculations below the main lobe of directional antennas.

Do you wish to include effects of ground reflections? (•) Yes ( ) No

Calculate RF Power Density | Reset Values

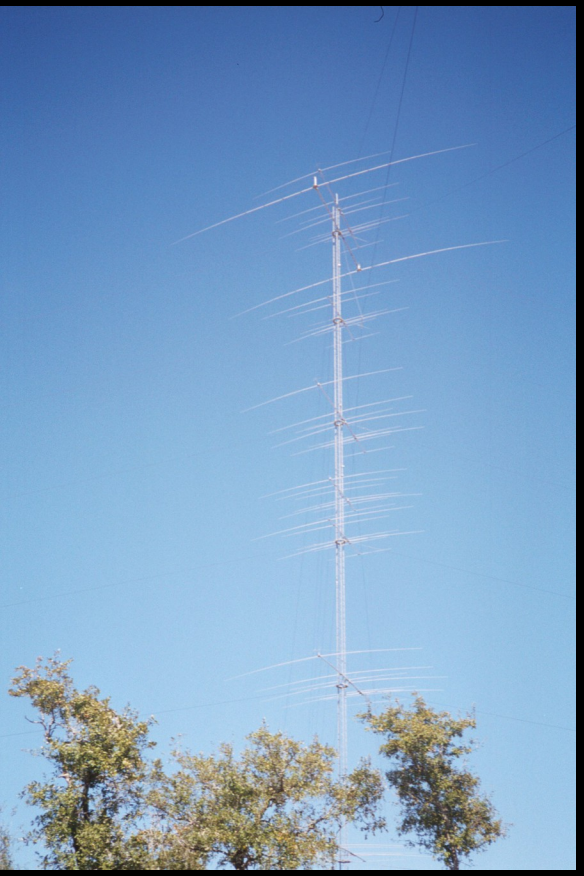
This is a main beam power density estimation program intended for use as part of a routine evaluation of RF safety compliance with FCC regulations. Amateur Radio operators licensed by the Federal Communications Commission of the United States of America are required to do a "routine evaluation" of the strength of the RF fields around their stations, subject to certain exemptions. These rules can be found in the FCC's ET Docket No. 93-62. More information can be found at the ARRLWeb's RF Safety page.

This program uses the formulas given in FCC OET Bulletin No. 65 to estimate power density in the main lobe of an antenna, with use of the EPA-recommended ground reflection factor as an option. This program is intended for approximate far-field calculations. It may overestimate the actual field strength of high-gain antennas in the near field (within several wavelengths of the antenna.) However, it may also underestimate the strength of fields that may be encountered in *hot spots* in the near field. No computer program can predict where wiring or reflective objects may create hot spots in your particular installation.

This is a World Wide Web front end for a public domain C program written by Ken Harker WM5R using the cgic library. This program has been derived directly from a public domain BASIC program written and published by Wayne Overbeck N6NB in the January, 1997 issue of *CQ VHF*, p. 33.

University of Texas Amateur Radio Club N5XU
Send comments to: utarc@www.utexas.edu
Last updated: 22 October 2004

Calculation Results



Amateur Radio RF Safety Calculator - Mozilla

File Edit View Go Bookmarks Tools Window Help

http://n5xu.ae.utexas.edu/cgi-bin/rfsafety.cgi

Amateur Radio RF Safety Calculator | Central Texas DX & Contest Club | ARDF: IARU Region II

Amateur Radio RF Safety Calculator

Calculation Results

Average Power at the Antenna	600.000 watts
Antenna Gain in dBi	4.40 dBi
Distance to the Area of Interest	50.00 feet
Frequency of Operation	28.000 MHz
Are Ground Reflections Calculated?	Yes
Estimated RF Power Density	0.1450 mw/cm^2

	Controlled Environment	Uncontrolled Environment
Maximum Permissible Exposure (MPE)	1.15 mw/cm^2	0.23 mw/cm^2
Distance to Compliance From Center of Antenna	17.82 feet	39.78 feet
Does the Area of Interest Appear to be in Compliance?	yes	yes

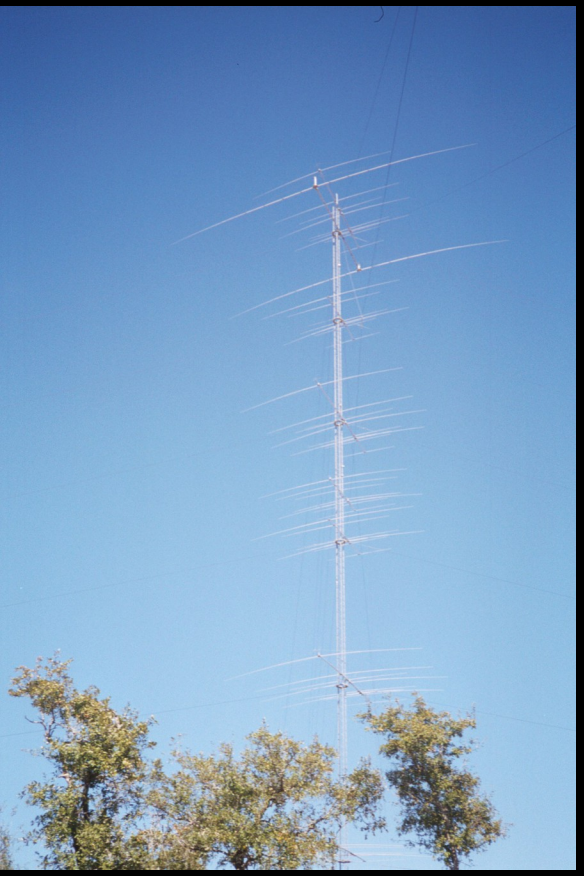
Interpretation of Results

1. Remember that the power value entered into these calculations should be the average power seen at the antenna, and not Peak Envelope Power (PEP). You may also consider feedline loss in calculating your average power at the antenna.
2. If you wish to estimate the power density at a point below the main lobe of a directional antenna, and if the antenna's vertical pattern is known, recalculate using the antenna's gain in the relevant direction.
3. Please also consult FCC OET Bulletin 65 Supplement B, the Amateur Radio supplement to FCC OET Bulletin 65. It contains a thorough discussion of the RF Safety regulations as they apply to amateur stations and contains numerous charts, tables, worksheets, and other data to help determine station compliance.

Perform another computation

University of Texas Amateur Radio Club N5XU
Send comments to: kharker@cs.utexas.edu
CGI script last modified: 22 September 2003

Categorical Exemptions



Amateur Radio RF Safety Calculator - Mozilla

File Edit View Go Bookmarks Tools Window Help

http://n5xu.ae.utexas.edu/rfsafety/exemptions.shtml

Amateur Radio RF Safety Calculator | Central Texas DX & Contest Club | ARDF: IARU Region II

Amateur Radio RF Safety Calculator

Categorical Exemptions
to Routine RF Radiation Evaluations

Frequencies in MHz	Peak Envelope Power in Watts
1.800 - 2.000	500
3.500 - 4.000	500
7.000 - 7.300	500
10.100 - 10.150	425
14.000 - 14.350	225
18.068 - 18.168	125
21.000 - 21.450	100
24.890 - 24.990	75
28.000 - 29.700	50
50.000 - 54.000	50
144.000 - 148.000	50
222.000 - 225.000	50
420.000 - 450.000	70
902.000 - 928.000	150
1240.000 - 1300.000	200
2300.000 and higher	250

With it's August 27, 1997 Second Memorandum and Order, the FCC has adopted a sliding scale for categorical exemption to routine RF radiation compliance testing based on peak envelope power (PEP) at various Amateur Radio operating frequencies. While the RF radiation exposure compliance levels are based on average power, the categorical exemptions from the requirement for periodic station compliance testing are based upon peak envelope power (PEP). Stations operating at or below these respective PEP levels are categorically excluded from having to perform a routine RF radiation evaluation. However, **all stations**, regardless of power level, still must comply with the RF exposure limits.

Please consult FCC OET Bulletin No. 65 for more details on the exemption. Another great source for information is the ARRL Web's RF Safety page.

Return to Amateur Radio RF Safety Calculator

No Warranties: This information is provided "as is" without any warranty, condition, or representation of any kind, either express or implied, including but not limited to, any warranty respecting non-infringement, and the implied warranties of conditions of merchantability and fitness for a particular purpose. In no event shall Kenneth E. Harker, the University of Texas Amateur Radio Club, the University of Texas at Austin, or any directors, trustees, or members thereof be liable for any direct, indirect, special, incidental, consequential or other damages howsoever caused whether arising in contract, tort, or otherwise, arising out of or in connection with the use or performance of the information contained on this web site.

University of Texas Amateur Radio Club N5XU