

# RF Safety Calculator

*(Version 2.0.0 -- Revised December 4, 2012)*

## Introduction

The Federal Communications (FCC) Rules & Regulations require that each amateur radio station meet RF exposure safety guidelines mandated by the Telecommunications Act of 1996. These rules went into effect for the Amateur Radio Service on January 1, 1998. Consequently, all amateurs must evaluate their station to determine whether they meet the Maximum Permissible Exposure (MPE) limits specified in the rules.

***RFSafetyCalculator.exe*** is a utility to determine whether or not an amateur radio station meets the MPE limits. The regulations require that you perform the calculations multiple times, once for each combination of band, mode, and antenna that you will be using.

**NOTE:** ***RFSafetyCalculator.exe*** is designed for the typical home amateur radio station. It is not to be used for evaluating a repeater installation, or any site where multiple transmitters may be operating simultaneously.

## Installation & Setup

Run the setup file, ***RFSafetyCalculatorSetup.exe***. This will install ***RFSafetyCalculator.exe*** and all required supporting files on your computer. The installer will suggest a default location for the program file. You may change the location or leave it at the default, it does not matter. However, the ***RFSafetyCalculator.rtf*** file must be located in the same directory as the ***RFSafetyCalculator.exe*** file.

## Program Operation

On startup, *RFSafetyCalculator.exe* displays one of the screens shown in Figure 1 & Figure 2.

RF Safety Evaluation Calculator by K9DUR -- Version 2.0.0

? Help | About | Exit

# RF Safety Evaluation Calculator

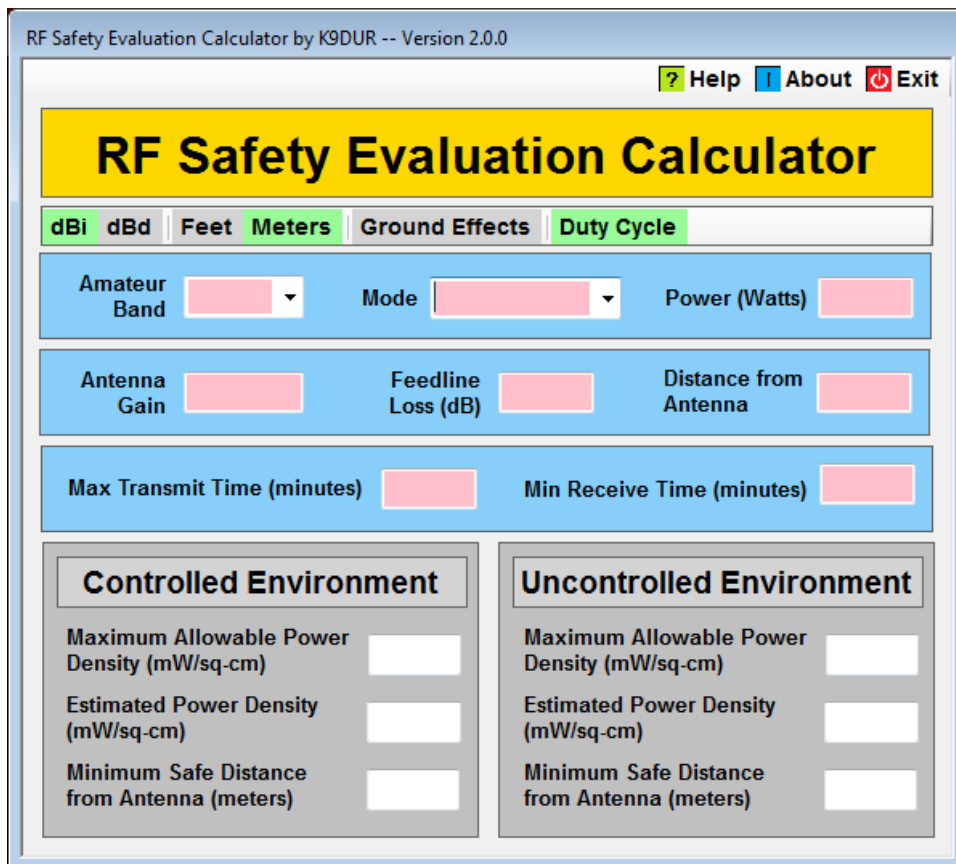
dBi | dBd | **Feet** | Meters | Ground Effects | Duty Cycle

Amateur Band  Mode  Power (Watts)

Antenna Gain  Feedline Loss (dB)  Distance from Antenna

Controlled Environment	Uncontrolled Environment
Maximum Allowable Power Density (mW/sq-cm) <input type="text"/>	Maximum Allowable Power Density (mW/sq-cm) <input type="text"/>
Estimated Power Density (mW/sq-cm) <input type="text"/>	Estimated Power Density (mW/sq-cm) <input type="text"/>
Minimum Safe Distance from Antenna (meters) <input type="text"/>	Minimum Safe Distance from Antenna (meters) <input type="text"/>

Figure 1 -- Main screen with Duty Cycle not Included in Calculations



**Figure 2 -- Main Screen with Duty Cycle Included in Calculations**

### **Control Toolbar Buttons**

The row of buttons at the top of the screen is called the control toolbar.

**? Help** -- Clicking on this button will display the on-screen help (this document).

**! About** -- Clicking on this button will display basic information about the program.

**⏻ Exit** -- Clicking on this button will close the program.

### **Settings Toolbar Buttons**

The row of buttons located just below the main program title is called the settings toolbar. These buttons set the various options for the program.

When active, a button will have a light green background. Otherwise, the background will be gray.

**dBi** -- Click this button if the antenna gain figures you enter will be referenced to an isotropic radiator.

**dBd** -- Click this button if the antenna gain figures you enter will be referenced to a standard half-wave dipole.

**Feet** -- Click this button to enter/display distances in feet.

**Meters** -- Click this button to enter/display distances in meters.

**Ground Effects** -- Click this button to include ground effects in the calculations. Ground effects can significantly increase the actual exposure. Ground effects can be ignored if the antenna is mounted several wavelengths above the ground.

**Duty Cycle** -- Click this button to include the operating duty cycle in the calculations. When the duty cycle is included, an additional pair of values must be entered before the results can be calculated. If not included, calculations will be made assuming that you will be transmitting during the entire exposure averaging time (6 minutes for the controlled environment, 30 minutes for the uncontrolled environment).

### **Transmitter Data**

These 3 boxes are filled in with the band, mode, & transmitter power data. You must enter values into all 3 of these boxes.

**Band** – Select the amateur band from the dropdown list.

**Mode** – Select the operating mode from the dropdown list. The choices are: CW, SSB, SSB w/proc, FM, AM, RTTY/Digital, & Other. Select “SSB” if you operate single-sideband without any speech processing. Select “SSB w/proc” if you will be using a speech processor. If in doubt, select “SSB w/proc” since that will provide the more conservative results.

**Power** – Enter the maximum transmit power (in Watts) that you will be using on the selected band.

### **Antenna System Data**

These 3 boxes are filled in with information about the antenna system. You must enter values into all 3 of these boxes.

**Antenna Gain** – Enter the gain of the antenna. The gain can be referenced either to a half-wave dipole (dBd) or to an isotropic radiator (dBi). Select the desired gain reference by clicking on one of buttons near the top of the screen.

**Feedline Loss** – Enter the loss (in dB) of your feedline and of any other devices connected between the transmitter or amplifier & the antenna.

**Distance from Antenna** -- Enter the distance from the center of the antenna to the position of the person being exposed. This may be the distance from the antenna to

your operating position (controlled environment) or to your neighbor's property (uncontrolled environment). The distance may be entered either in meters or in feet. Select the desired unit of measurement by clicking on one of the buttons near the top of the screen.

### **Duty Cycle Data**

These 2 boxes are filled in with information about your operating duty cycle. You must enter values into both of these boxes.

**Max Transmit Time** – Enter the maximum length (in minutes) of any one transmission.

**Min Receive Time** – Enter the minimum length (in minutes) of the time between transmissions.

**Include Ground Effects** – Reflections from the ground may increase the actual exposure level up to double the level without reflections. To include ground effects in the calculations, click on the button on the settings toolbar.

### **Calculating the Results**

Once all of the required data has been entered, the program will immediately calculate the exposure levels for both the controlled and the uncontrolled environments. If you change any of the data or settings, the program will automatically recalculate the exposure levels.

The program calculates the following three values for both the controlled environment and the uncontrolled environment:

**Maximum Allowable Power Density** – This value represents the MPE (in  $\text{mW}/\text{cm}^2$ ) for that band.

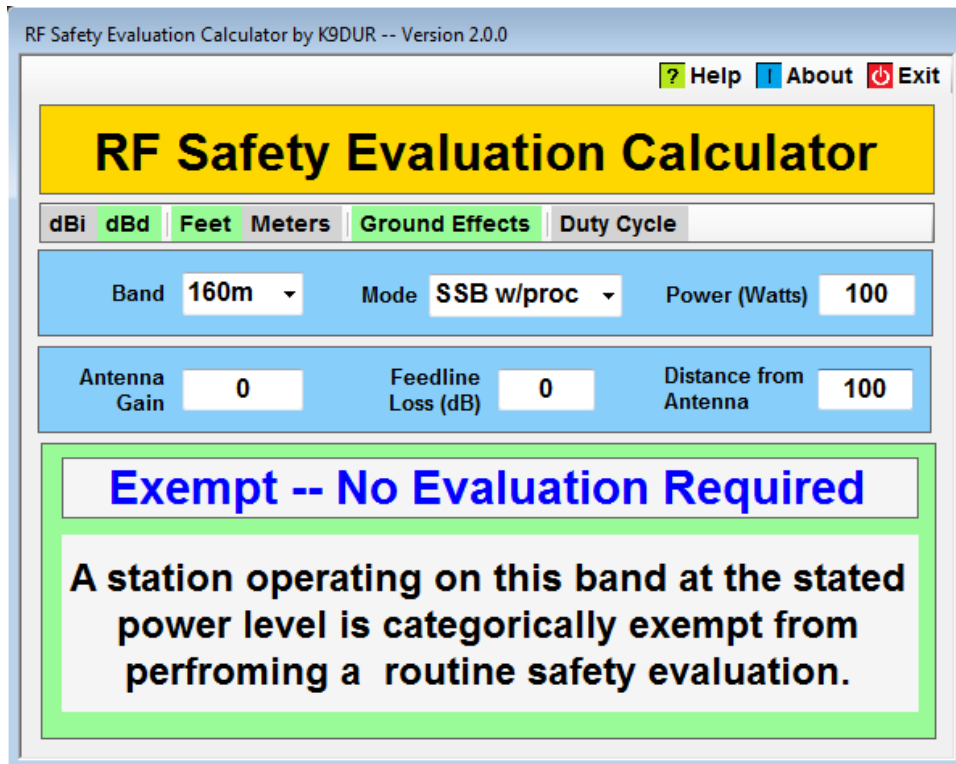
**Estimated Power Density** – This value represents the estimated exposure level (in  $\text{mW}/\text{cm}^2$ ) at the specified distance from the antenna.

**Minimum Safe Distance from Antenna** – This value represents the closest that a person can be to the antenna and still be below the MPE. The distance is displayed in the same unit of measurement that was selected for the "Distance from Antenna" value.

## **Categorically Exempt Stations**

For each amateur band, there is a power level below which an evaluation is not required. If you enter a transmit power level that is below the threshold for the selected band, then the station is categorically exempt from performing a station evaluation.

In that case, the program will display the screen shown in Figure 3.



**Figure 3 -- Main Screen for Categorically Exempt Stations**

### **About the Author**

***RFSafetyCalculator.exe*** was written by Ray Andrews, K9DUR.

Ray holds an Amateur Extra class license and was first licensed in April 1960. He currently resides in West Terre Haute, IN, and is a retired electronic design engineer and software developer. He operates a small custom software consulting business just to keep him out of mischief between camping trips.

For more information, visit Ray's web pages:

<http://k9dur.info>

<http://www.rnaconsultingservices.com>

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## Revision History

v2.0.0 – Dec 4, 2012 – Major rewrite. Replaced menu strip with 2 tool strips. Added option to include operating duty cycle in calculations or not.

v1.0.1 – Dec 9, 2010 – Fixed bug resulting in infinite loop when calculating duty cycle if transmit time equals 0.

v1.0.0 – Nov 26, 2010 – Initial Release.



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