

```

10 REM THIS RF EXPOSURE CALCULATOR WAS WRITTEN BY WAYNE OVERBECK, N6NB
20 REM IN 1996 AND REVIEWED FOR ACCURACY BY DR. ROBERT F. CLEVELAND, JR.
30 REM OF THE OFFICE OF ENGINEERING AND TECHNOLOGY, FEDERAL
40 REM COMMUNICATIONS COMMISSION. IT WAS UPDATED IN APRIL, 2021.
50 REM
60 REM INSTRUCTIONS FOR USING THIS PROGRAM:
70 REM
80 REM Download the pdf of the program into Adobe Acrobat Reader, then
90 REM select and copy the entire file. Paste it into Notepad and save it
100 REM as RFSAFETY.BAS (the file name should be 8 or fewer characters).
110 REM Then download PC-BASIC (free) and right-click the PC-BASIC icon.
120 REM Click properties to see where it starts (i.e., where it looks for
130 REM files). Put RFSAFETY.BAS in that folder. Open PC-BASIC and type:
132 REM RUN "RFSAFETY
140 REM
150 REM
160 COLOR 15, 1, 4: CLS: PRINT: PRINT: PRINT: REM REV. 3.0 - 4/30/21
170 PRINT " MAIN BEAM POWER DENSITY ESTIMATION PROGRAM, REV 3.0"
180 PRINT " FOR ROUTINE EVALUATION OF R.F. SAFETY COMPLIANCE"
190 PRINT: PRINT
200 PRINT "This program uses the formulas given in FCC OET Bulletin No.
65"
210 PRINT "to estimate power density in the main lobe of an antenna,
with"
220 PRINT "use of the EPA-recommended ground reflection factor as an
option."
230 PRINT: PRINT "This program is intended for far field calculations. It
may"
240 PRINT "overestimate the actual field strength of high-gain antennas
in"
250 PRINT "the near field (within several wavelengths of the antenna)."
260 PRINT "However, it may also underestimate the strength of fields that
may"
270 PRINT "be encountered in `hot spots' in the near field. No computer"
280 PRINT "program can predict where wiring or reflective objects may
create"
290 PRINT "hot spots in your particular installation.": PRINT
300 PRINT "This is a public domain program by Wayne Overbeck, N6NB":
PRINT
310 INPUT "WHAT IS THE POWER AT THE ANTENNA (IN WATTS)"; WATTSORG
320 PRINT: PRINT "Power is averaged over 6 minutes in 'controlled
environments'"
330 PRINT "(like your home or car) and over 30 minutes in 'uncontrolled"
340 PRINT "environments' (places accessible to others)."
```

$$350 \text{ PRINT "WHAT PERCENT OF THE TIME DO YOU TRANSMIT (e.g., 50 or 100)"}
360 \text{ INPUT "(ENTER 50 FOR WSJT MODES OR TYPICAL AMATEUR QSOs)"; TAVG}
370 \text{ WATTS} = \text{WATTSORG} * (\text{TAVG} / 100)
380 \text{ PRINT: PRINT "The FCC standard also considers the 'duty cycle' of}
\text{various modes"}
390 \text{ PRINT "(100 percent for key-down modes like FM or digital or 40 for}
\text{CW or SSB)."}
400 \text{ INPUT "ENTER 40, 100 OR ANY NUMBER BELOW 100 THAT YOU CAN JUSTIFY";}
\text{DUTY}
410 \text{ WATTS} = \text{WATTS} * (\text{DUTY} / 100)$$

```

420 PWR = 1000 * WATTS
430 PRINT: PRINT "WHAT IS THE ANTENNA GAIN IN DBI?"
440 INPUT "(Enter 2.2 for dipoles; add 2.2 for antennas rated in DBD): ",
GAIN
450 REM NOW CALCULATING EIRP IN MILLIWATTS
460 EIRP = PWR * (10 ^ (GAIN / 10))
470 PRINT: INPUT "WHAT IS THE DISTANCE TO AREA OF INTEREST FROM ANTENNA
CENTER IN FEET"; FT
480 REM NOW CONVERTING TO CM
490 DX = FT * 30.48
500 PRINT: INPUT "WHAT IS THE FREQUENCY IN MHZ"; F
510 IF F < 1.34 THEN STD1 = 100: STD2 = 100: GOTO 580
520 IF F < 3 THEN STD1 = 100: STD2 = 180 / ((F) ^ 2): GOTO 580
530 IF F < 30 THEN STD1 = 900 / ((F) ^ 2): STD2 = 180 / ((F) ^ 2): GOTO
580
540 IF F < 300 THEN STD1 = 1: STD2 = .2: GOTO 580
550 IF F < 1500 THEN STD1 = F / 300: STD2 = F / 1500: GOTO 580
560 IF F < 100000! THEN STD1 = 5: STD2 = 1: GOTO 580
570 PRINT "THE FCC DOES NOT HAVE EXPOSURE LIMITS ABOVE 100 GHZ": GOTO 500
580 PRINT: PRINT "NOW, DO YOU WISH TO INCLUDE EFFECTS OF GROUND
REFLECTIONS?"
590 PRINT "(Ground effects need not be included in most main-beam
calculations)"
600 PRINT "but including them may yield more accurate results with very
low"
610 PRINT "antennas, non-directional antennas, and calculations below
the"
620 INPUT "main lobe of directional antennas.) INCLUDE GROUND EFFECTS
(Y/N)"; G$
630 GF = .25: GR$ = "WITHOUT": IF G$ = "Y" THEN GF = .64: GR$ = "WITH"
640 IF G$ = "y" THEN GF = .64: GR$ = "WITH"
650 PWRDENS = (GF * EIRP) / (3.14159 * (DX ^ 2))
660 PWRDENS = (INT((PWRDENS * 10000) + .5)) / 10000
670 DX1 = SQR((GF * EIRP) / (STD1 * 3.14159)): DX1 = DX1 / 30.48: DX1 =
(INT((DX1 * 10) + .5)) / 10
680 DX2 = SQR((GF * EIRP) / (STD2 * 3.14159)): DX2 = DX2 / 30.48: DX2 =
(INT((DX2 * 10) + .5)) / 10
690 STD1 = (INT((STD1 * 100) + .5)) / 100: STD2 = (INT((STD2 * 100) +
.5)) / 100
692 PRINT:INPUT "PRINT A HARD COPY OF THE RESULTS (Y/N)"; LPRT$
700 CLS: PRINT "HERE ARE THE RESULTS. PRINTED AT "; TIME$; " ON "; DATE$:
PRINT
710 PRINT "WITH"; WATTSORG; "WATTS AVERAGED FOR TRANSMITTING"; TAVG;
"PERCENT OF THE TIME"
720 PRINT "AND A MODE-BASED DUTY CYCLE OF"; DUTY; "PERCENT"
730 PRINT "WITH"; GAIN; "DBI GAIN "; GR$; " GROUND REFLECTIONS, AT"; FT;
"FEET"
740 PRINT "FROM THE ANTENNA CENTER THE ESTIMATED POWER DENSITY IS";
PWRDENS; "MW/CM2.": PRINT
750 PRINT "AT"; F; "MHZ, THE MAXIMUM PERMISSIBLE EXPOSURE (MPE) IN
`CONTROLLED"
760 PRINT "ENVIRONMENTS' (SUCH AS YOUR OWN HOUSEHOLD OR CAR) IS"; STD1;
"MW/CM2."

```

```
770 PRINT "THE MPE IN `UNCONTROLLED ENVIRONMENTS' (PLACES ACCESSIBLE TO
OTHERS)"
780 PRINT "IS"; STD2; "MW/CM2. THIS INSTALLATION WOULD MEET THE
CONTROLLED MPE"
790 PRINT "LIMIT AT"; DX1; "FEET AND THE UNCONTROLLED LIMIT AT"; DX2;
"FEET."
800 PRINT: PRINT "ALTERNATE CALCULATION FOR EXPOSURE OUTSIDE AN ANTENNA'S
MAIN LOBE:"
810 PRINT "If you wish to estimate the power density at a point outside
the main"
820 PRINT "lobe of a directional antenna and if the antenna's pattern is
known "
830 PRINT "or can be estimated, recalculate using the antenna's gain in
the relevant"
840 PRINT "direction. Example: for a Yagi with 7 dBi forward gain and a
front-to-back"
850 PRINT "ratio of 20 dB, run the program again and enter the antenna
gain as"
860 PRINT "-13 to estimate exposure off the back of the antenna."
880 IF LPRT$ <> "Y" THEN END
890 PRINT "IF YOU ARE USING PC-BASIC, IT WILL PRINT THIS REPORT WHEN YOU
EXIT."
900 LPRINT:LPRINT
902 LPRINT "THE RESULTS OF THIS RF EXPOSURE CALCULATION ARE AS FOLLOWS:"
910 LPRINT
920 LPRINT "THIS WAS PRINTED AT "; TIME$; " ON "; DATE$: LPRINT
930 LPRINT "WITH"; WATTSORG; "WATTS AVERAGED FOR TRANSMITTING"; TAVG;
"PERCENT OF THE TIME"
940 LPRINT "AND A MODE-BASED DUTY CYCLE OF"; DUTY; "PERCENT"
950 LPRINT "WITH"; GAIN; "DBI GAIN "; GR$; " GROUND REFLECTIONS, AT"; FT;
"FEET"
960 LPRINT "FROM THE ANTENNA CENTER THE ESTIMATED POWER DENSITY IS";
PWRDENS; "MW/CM2.": LPRINT
970 LPRINT "AT"; F; "MHZ, THE MAXIMUM PERMISSIBLE EXPOSURE (MPE) IN
`CONTROLLED"
980 LPRINT "ENVIRONMENTS' (SUCH AS YOUR OWN HOUSEHOLD OR CAR) IS"; STD1;
"MW/CM2."
990 LPRINT "THE MPE IN `UNCONTROLLED ENVIRONMENTS' (PLACES ACCESSIBLE TO
OTHERS)"
1000 LPRINT "IS"; STD2; "MW/CM2. THIS INSTALLATION WOULD MEET THE
CONTROLLED MPE"
1010 LPRINT "LIMIT AT"; DX1; "FEET AND THE UNCONTROLLED LIMIT AT"; DX2;
"FEET."
1020 LPRINT: LPRINT "ALTERNATE CALCULATION FOR EXPOSURE OUTSIDE AN
ANTENNA'S MAIN LOBE:"
1030 LPRINT "If you wish to estimate the power density at a point outside
the main"
1040 LPRINT "lobe of a directional antenna and if the antenna's pattern
is known "
1050 LPRINT "or can be estimated, recalculate using the antenna's gain in
the "
1060 LPRINT "relevant direction. Example: for a Yagi with 7 dBi forward
gain "
```

```
1070 LPRINT "and a front-to-back ratio of 20 dB, run the program again  
and "  
1080 LPRINT "enter the antenna gain as -13 to estimate exposure off the  
back"  
1090 LPRINT "of the antenna."  
1100 LPRINT: LPRINT CHR$(12)  
1110 END
```