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

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400 INPUT "(ENTER 50 FOR WSJT MODES OR TYPICAL AMATEUR QSOs)"; TAVG
410 WATTS = WATTSORG * (TAVG / 100)
420 PRINT: PRINT "The FCC standard also considers the 'duty cycle' of
various modes"
430 PRINT "(100 percent for key-down modes like FM or digital or 40 for
CW or SSB)."
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440 INPUT "ENTER 40, 100 OR ANY NUMBER BELOW 100 THAT YOU CAN JUSTIFY";
DUTY
445 WATTS = WATTS * (DUTY / 100)
446 PWR = 1000 * WATTS
447 PRINT: PRINT "WHAT IS THE ANTENNA GAIN IN DBI?"
448 INPUT "(Enter 2.2 for dipoles; add 2.2 for antennas rated in DBD): ",
GAIN
449 REM NOW CALCULATING EIRP IN MILLIWATTS
450 EIRP = PWR * (10 ^ (GAIN / 10))
451 PRINT: INPUT "WHAT IS THE DISTANCE TO AREA OF INTEREST FROM ANTENNA
CENTER IN FEET"; FT
452 REM NOW CONVERTING TO CM
453 DX = FT * 30.48
454 PRINT: INPUT "WHAT IS THE FREQUENCY IN MHZ"; F
455 IF F < 1.34 THEN STD1 = 100: STD2 = 100: GOTO 620
456 IF F < 3 THEN STD1 = 100: STD2 = 180 / ((F) ^ 2): GOTO 620
457 IF F < 30 THEN STD1 = 900 / ((F) ^ 2): STD2 = 180 / ((F) ^ 2): GOTO
620
458 IF F < 300 THEN STD1 = 1: STD2 = .2: GOTO 620
459 IF F < 1500 THEN STD1 = F / 300: STD2 = F / 1500: GOTO 620
460 IF F < 100000! THEN STD1 = 5: STD2 = 1: GOTO 620
461 PRINT "THE FCC DOES NOT HAVE EXPOSURE LIMITS ABOVE 100 GHZ": GOTO 540
462 PRINT: PRINT "NOW, DO YOU WISH TO INCLUDE EFFECTS OF GROUND
REFLECTIONS?"
463 PRINT "(Ground effects need not be included in most main-beam
calculations"
464 PRINT "but including them may yield more accurate results with very
low"
465 PRINT "antennas, non-directional antennas, and calculations below
the"
466 INPUT "main lobe of directional antennas.) INCLUDE GROUND EFFECTS
(Y/N)"; G$
467 GF = .25: GR$ = "WITHOUT": IF G$ = "Y" THEN GF = .64: GR$ = "WITH"
468 IF G$ = "y" THEN GF = .64: GR$ = "WITH"
469 PWRDENS = (GF * EIRP) / (3.14159 * (DX ^ 2))
470 PWRDENS = (INT((PWRDENS * 10000) + .5)) / 10000
471 DX1 = SQR((GF * EIRP) / (STD1 * 3.14159)): DX1 = DX1 / 30.48: DX1 =
(INT((DX1 * 10) + .5)) / 10
472 DX2 = SQR((GF * EIRP) / (STD2 * 3.14159)): DX2 = DX2 / 30.48: DX2 =
(INT((DX2 * 10) + .5)) / 10
473 STD1 = (INT((STD1 * 100) + .5)) / 100: STD2 = (INT((STD2 * 100) +
.5)) / 100
474 PRINT:INPUT "PRINT A HARD COPY OF THE RESULTS (Y/N)"; LPRT$
475 CLS: PRINT "HERE ARE THE RESULTS. PRINTED AT "; TIME$; " ON "; DATE$:
PRINT
476 PRINT "WITH"; WATTSORG; "WATTS AVERAGED FOR TRANSMITTING"; TAVG;
"PERCENT OF THE TIME"
477 PRINT "AND A MODE-BASED DUTY CYCLE OF"; DUTY; "PERCENT"
478 PRINT "WITH"; GAIN; "DBI GAIN "; GR$; " GROUND REFLECTIONS, AT"; FT;
"FEET"
479 PRINT "FROM THE ANTENNA CENTER THE ESTIMATED POWER DENSITY IS";
PWRDENS; "MW/CM2.": PRINT
480 PRINT "AT"; F; "MHZ, THE MAXIMUM PERMISSIBLE EXPOSURE (MPE) IN
`CONTROLLED"

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810 PRINT "ENVIRONMENTS' (SUCH AS YOUR OWN HOUSEHOLD OR CAR) IS"; STD1;
"MW/CM2."
820 PRINT "THE MPE IN `UNCONTROLLED ENVIRONMENTS' (PLACES ACCESSIBLE TO
OTHERS)"
830 PRINT "IS"; STD2; "MW/CM2. THIS INSTALLATION WOULD MEET THE
CONTROLLED MPE"
840 PRINT "LIMIT AT"; DX1; "FEET AND THE UNCONTROLLED LIMIT AT"; DX2;
"FEET."
850 PRINT: PRINT "ALTERNATE CALCULATION FOR EXPOSURE OUTSIDE AN ANTENNA'S
MAIN LOBE:"
860 PRINT "If you wish to estimate the power density at a point outside
the main"
870 PRINT "lobe of a directional antenna and if the antenna's pattern is
known "
880 PRINT "or can be estimated, recalculate using the antenna's gain in
the relevant"
890 PRINT "direction. Example: for a Yagi with 7 dBi forward gain and a
front-to-back"
900 PRINT "ratio of 20 dB, run the program again and enter the antenna
gain as"
910 PRINT "-13 to estimate exposure off the back of the antenna."
920 IF LPRT$ <> "Y" THEN END
930 PRINT "IF YOU ARE USING PC-BASIC, IT WILL PRINT THIS REPORT WHEN YOU
EXIT."
940 LPRINT:LPRINT
950 LPRINT "THE RESULTS OF THIS RF EXPOSURE CALCULATION ARE AS FOLLOWS:"
960 LPRINT
970 LPRINT "THIS WAS PRINTED AT "; TIME$; " ON "; DATE$: LPRINT
980 LPRINT "WITH"; WATTSORG; "WATTS AVERAGED FOR TRANSMITTING"; TAVG;
"PERCENT OF THE TIME"
990 LPRINT "AND A MODE-BASED DUTY CYCLE OF"; DUTY; "PERCENT"
1000 LPRINT "WITH"; GAIN; "DBI GAIN "; GR$; " GROUND REFLECTIONS, AT";
FT; "FEET"
1010 LPRINT "FROM THE ANTENNA CENTER THE ESTIMATED POWER DENSITY IS";
PWRDENS; "MW/CM2.": LPRINT
1020 LPRINT "AT"; F; "MHZ, THE MAXIMUM PERMISSIBLE EXPOSURE (MPE) IN
`CONTROLLED"
1030 LPRINT "ENVIRONMENTS' (SUCH AS YOUR OWN HOUSEHOLD OR CAR) IS"; STD1;
"MW/CM2."
1040 LPRINT "THE MPE IN `UNCONTROLLED ENVIRONMENTS' (PLACES ACCESSIBLE TO
OTHERS)"
1050 LPRINT "IS"; STD2; "MW/CM2. THIS INSTALLATION WOULD MEET THE
CONTROLLED MPE"
1060 LPRINT "LIMIT AT"; DX1; "FEET AND THE UNCONTROLLED LIMIT AT"; DX2;
"FEET."
1070 LPRINT: LPRINT "ALTERNATE CALCULATION FOR EXPOSURE OUTSIDE AN
ANTENNA'S MAIN LOBE:"
1080 LPRINT "If you wish to estimate the power density at a point outside
the main"
1090 LPRINT "lobe of a directional antenna and if the antenna's pattern
is known "
1100 LPRINT "or can be estimated, recalculate using the antenna's gain in
the "
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1110 LPRINT "relevant direction. Example: for a Yagi with 7 dBi forward  
gain "  
1120 LPRINT "and a front-to-back ratio of 20 dB, run the program again  
and "  
1130 LPRINT "enter the antenna gain as -13 to estimate exposure off the  
back"  
1140 LPRINT "of the antenna."  
1150 LPRINT CHR$(12)  
1160 END
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