GroundProbe™

RF Exposure Calculation for SSR-FX

The F-Series Slope Stability Radar (SSR-FX) uses a mechanically scanned (azimuth only) Slotted WaveGuide Antenna (SWGA) which can be considered an aperture antenna. The Power Density in the Near Field will be higher than that in the Transition Zone or the Far-Field so if the Power Density is below safe levels in the near field it will be safe in the transition zone and far-field as well.

Near Field Power Density- To estimate the RF power density to which a person may be exposed we can use the methods described in OET Bulletin 65 (Edition 97-01).

The maximum value of the near-field power density is given by equation 11, (page 27) and reproduced below.

$$S_{surface} = \frac{4P}{A} \qquad (11)$$

where: $S_{surface}$ = maximum power density at the antenna surface
P = power fed to the antenna
A = physical area of the aperture antenna

Lets assume η=1 Clearly the maximum possible value for efficiency

P=501mW The maximum true average power output by the radar. This is the power as measured by a resistive load power meter at the input to the antenna*.

A=2214cm^2 Antenna Area

=Aperture Length x Aperture Height

= 183cm x 12.1cm

Therefore the maximum near-field power density is 0.9mW/cm^2; a factor of 5.5 below the acceptable limit for Occupational/Controlled Exposure of 5mW/cm^2.

Now if we consider General Population/Uncontrolled Exposure. The maximum near field power density can be calculated as above to be 0.9mW/cm^2 which is below the acceptable limit for General Exposure of 1mW/cm^2. In addition the radar is used in mines which are closed to the general public. Mine staff even those not using the radar are trained to keep clear of the radar unless escorted by someone trained in its operation. Hence General Population/Uncontrolled Exposure will only be for limited periods.

* The worst case power measurements obtained in compliance testing were obtained at -25ºC. These measurements were made with a spectrum analyser using an integration method (DA 02-2138), where the power is computed by summing the power level in each 1MHz band across the 99% EBW of the signal. This results in a peak power measurement for the radar waveform. The power reported for average power is only adjusted by the transmit duty cycle (eg., 50% or 3dB). However, the true average power as measured with a power meter shows the radar waveform used during test has a peak to average ratio of a further 5dB ie 8dB in total. Pre-compliance measurements were conducted using both a power meter and spectrum analyser to measure average and peak power respectively. The power meter consistently reported average power levels 8dB below the peak power measurement of the spectrum analyser. (Note: The power meter and spectrum analyser had been calibrated to read the same power level for single tone.) This 8dB can be understood as 3dB due to transmit duty cycle (as described earlier in the paragraph), 3dB because amplitude modulation is used and remaining 2dB is of the multi-spectral-line inside a resolution bin nature of the modulation signal. Average power levels from a Power Meter which averages on the time scale of seconds are appropriate as the guidelines make clear that the power density may be averaged over 6 minutes for occupational/controlled exposures and 30 minutes for general population/uncontrolled exposures (see excerpt from page 10 below).

Another feature of the exposure guidelines is that exposures, in terms of power density, E^2 or H^2, may be averaged over certain periods of time with the average not to exceed the limit for continuous exposure.[11] As shown in Table 1 of Appendix A, the averaging time for occupational/controlled exposures is 6 minutes, while the averaging time for general population/uncontrolled exposures is 30 minutes. It is important to note that for general