Working Paper

Analysis of the FCC Regulations for Radiation Safe Distance with respect to the Spectra 58100/58200 Range of Products

C.F.Fisher
Ref: phn-0736

Abstract

This document analyses the exclusion zone required to ensure human radiation level limits are not exceeded by the Spectra 58100/58200 range of products with integrated or external antennas. The guidelines in FCC Bulletin 65 are used to compute the safe distances.

Revision History

Version	Date	Comments	Author
0.001	7 February 2005	Initial Issue	CF
0.002	1 November 2005	Update to include the effects of 58200 peak duty cycle of 80% Transmit	CF

Operational Parameters of the Spectra 58100/58200 Products

1 Scope

The purpose of this brief working paper is to identify the mean RF power produced by the Spectra 58100/58200 equipments under various operating conditions. This mean RF power plus the antenna gain used in specific installations identifies the effective power density (dBm/cm^2) that is to be compared against allowed limits for human exposure.

2 References

Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields:
OET Bulletin 65, Edition 97-01, August 1997 [1]

3 Background

Reference [1] identifies how the radiated power density should be calculated for different distances from the antenna. The variables used are Radiated Power Density (S), conducted power (P), Antenna Gain (G) and distance (R) . The formula given is

$$S= (P * G)/(4 * Pi * R)^2$$

The limit allowed for S depends on whether the exposure risk is to a member of the public or not. The limits for public exposure are the lower, and so a power density limit of $1mW/cm^2$ is used for S. This is used to compute a 'safe' distance from the antenna. It is clear from [1] that the power to be used should be the RMS power averaged over a period of 6 minutes.

4 Spectra 58100/58200 Specific Issues

4.1 FCC Regulations

The Spectra 58XX is approved under section 15.247 and this regulation now allows measurement of the mean transmitted power during the burst, averaged over all symbols. The regulations allow 30dBm to be transmitted as the conducted power. In the case of As there are two polarisations transmitted by Spectra 58100/58200, this total power cannot be exceeded by the sum of the two powers transmitted.

4.2 Spectra 58100/58200

The power levelling loops in Spectra measure the transmitted power on both polarisations at all times and limit each to the Maximum Transmit Power –3dB. The Maximum Transmit Power for Spectra equipments in production is set to 25dBm.
The transmit duty cycle for the Spectra equipment is a maximum of 50% over any significant period of operation. Short term peaks in transmission requirements for data may increase the transmit duty cycle from one end of the link to 80%. However, the regulations refer to mean radiation power density, and over the 6 minute averaging period, the duty cycle is likely to be 50%. This reduces the effective power by 3dB.

4.3 FCC Testing

The FCC test results showed that the power for the two channels combined was always less than 27dBm, although the power level on production units has been reduced to 25dBm maximum. As a conservative measure, consider the 27dBm as the maximum power possible.

4.4 Cable Losses

It is considered that a cable loss of less than 1dB is unlikely in the case of the connectorised version operating with external antennas.

5 Recommendations

It is recommended that the power level used for computing the 'safe distance' for human exposure is either

a) The Maximum Transmit Power level (27dBm) less the allowance for long term average value of the maximum duty cycle.
b) The power level in (a) less the minimum cable losses. Safe distance calculations are also included for this case.

Total Transmit Power in burst	27	dBm
Less TDD duty cycle	-3	dB
Total Mean Transmit Power	251.19	mW
Total Mean Transmit Power with 1dB cable loss	199.53	mW
Safety Power Density Limit	1	mW/cm2

Antenna Type	Manufacturer's Gain (dBi)	Safe Distance for 0dB Cable Loss (m)	Safe Distance for 1.0dB Cable Loss (m)
Integrated	23.5	0.67	N/A
2 ft Flat Plate	28	1.12	1.00
2ft Parabolic Dish	28.5	1.19	1.06
3ft Parabolic Dish	31.5	1.68	1.50
4ft Parabolic Dish	34.5	2.37	2.12
6ft Parabolic Dish	37.7	3.43	3.06

Note: During the very short periods with an 80% duty cycle, the distances would apparently increase by about 25% according to the formulae used, although the requirements apply over an averaging period of six minutes.