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RF Radiation Exposure Evaluation Report

for the

SSMS Transceiver Model CT2A

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1 INTRODUCTION

The data contained herein provides an engineering assessment of the proposed mobile terminal in the context of maximum permissible RF exposure limits. The analysis assumes worst case close proximity exposure (20 cm or more) at the peak output power possible. It must be noted that this analysis represents worst case as a means to simplify the analysis procedure. The methodology utilized in the following presentation is based on the *FCC Office of Engineering and Technology Bulletin No. 65 - Edition 97-01 - "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields"* (Hereafter referred to as 'The FCC Method').

2 BASIC DESCRIPTION

The proposed license is for a system whose terminal will be used with a receive and transmit antenna. The units are designed for use on mobile platforms. Antennas will typically be mounted on the upper portions of mobile platforms, typically 1.5 to 3 m above the ground.

In all applications under normal operating conditions, a significant distance (> 20cm) exists between the antenna and humans. In addition, it is typical that there exists significant shielding in the form of a metal cab and/or bodywork between humans and antenna.

2.1 Selection of Evaluation Method

Under the definition put forward in the FCC method (Page 9), the exposure is to be considered as falling under 'general population/uncontrolled' exposure limits as the application 'presents situations where the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure'.

Similarly under the FCC method, the unit is to be classified as 'mobile' (as opposed to portable). This classification of 'Mobile' is designed to differentiate applications where the antenna is, under normal operation, not used in close proximity to the human body (e.g. cellular telephones). As described on page 40 of the FCC method, *'"mobile" devices are defined ...as transmitting devices designed to be used in other than fixed locations that would normally be used with radiating structures maintained 20 cm or more from the body of the user or nearby persons'*. As the antenna in this application is by necessity to be mounted with a clear view of the satellite, the required mounting

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location are at points as high as possible on the mobile platform (e.g. on roofs and/or superstructure) and are, consequently, significantly more than 20 cm from humans under operating conditions.

Another important feature of the terminal addressed by the FCC method is the duty factor of the device. In the case of the terminal described in this application, the terminal transmits in bursts of a maximum of 1 second every 15 second.

According to the definition provided in Appendix 'A' of the FCC method (page 74) the terminal can be considered as using *"source-based time averaging based on ...a time-division-multiple-access (TDMA) scheme for transmission of a signal'*. It follows that time averaging is a permissible means of evaluating the MPE. It should be added that the MPE method produces the most conservative method of evaluating emissions of the methods presented in the FCC Method.

The power density equation used in the evaluation is set out on page 19 of the FCC Method:

$$S = EIRP/4\pi R^2$$

Where EIRP = equivalent (or effective) isotropically radiated power.

This equation was selected as it best applies to the omni-directional antennas used in the design and as it is (FCC Method, page 19) '*generally accurate in the far-field of an antenna but will over-predict power density in the near field, where they could be used for making a "worst case" or conservative prediction'*.

The Maximum Permissible Exposure (MPE) limit of the terminal is specified in Appendix A, Table 1 'LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE) Section B 'Limits for General Population/Uncontrolled Exposure' as found on page 67 of the FCC Method.

The MPE limit for devices operating in the transmission frequency range from 1631.5 to 1660.5 MHz is $1mW/cm^2$ in any 30 minutes.

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3 ANTENNA CHARACTERISTICS

For the purpose of giving a worst case analysis of the proposed antenna, the radiation pattern of the antenna, while strictly non-isotropic, is assumed to be isotropic and will produce a uniform spherical radiation pattern at peak gain. This worst case application of EIRP pattern significantly simplifies the analysis procedure and produces an absolute worst case figure that can be compared against the maximum permissible limits.

For the purpose of the analysis the following worst case assumptions are being made on antenna options.

3.1 Antenna type 1 – Model SSMSRP1

This is a microstrip patch type antenna. The transmit antenna is a circular box with diameter of 12.5 cm and height 2cm. The antenna is designed for mounting to flat surfaces.

The antenna's transmit peak gain is 7.5 dBi across the transmit band. The transmit bandwidth is between 1631.5 to 1660.5 MHz.

This antenna is generically for use on mobile platforms.

The antenna is to be installed on the uppermost part of the vehicle where there is a clear view of the coverage satellite. In the case of small vehicles such as cars or small trucks, this would mean on the roof of the vehicle with the closest distance between bystander and antenna being greater than 0.7 m. Vehicle occupants would be shielded by the metal chassis which would shield the occupants from almost all RF. In the case of large trucks and earth moving equipment the distances will be 2m or greater depending on the application. In these applications users are similarly shielded.

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4 ANALYSIS

For the purpose of analysis, an antenna peak gain of 7.5 dBi will be considered. The transmitter for use with the proposed terminal has a maximum power of 3.2 W (5 dBW) at the antenna flange.

The resulting maximum effective isotropic radiated power EIRP of 12.5 dBW or 17.8 W, assumes all the transmitter power is transferred to the antenna (radiating element) with no losses.

The proposed terminal operates in a time division multiple access (TDMA) or Demand Access Multiple Access (DAMA) scheme and transmits an RF signal for a maximum of 1 second, with a repetition interval of no less than 15 seconds. This leads to a maximum duty-cycle factor of 1/15.

The far field equations are used to predict the power density at a distance of 20 cm or more from the radiating element. As explained in the FCC method (page 19), if this distance falls into the antenna near field region, the equations will result in a highly conservative or absolute "worst case" prediction.

The power density is evaluated with the following equation as presented in the FCC method referred to above:

$$S = EIRP/4\pi R^2$$

Using EIRP = 17800 mW and R = 20 cm the minimum distance considered for a mobile device, we get:

$$S = 3.54\ mW/cm^2$$

Considering the duty-cycle factor of 1/15 (1 Second burst at a minimum of 15 Seconds) we get:

$$S_{avg} = 0.23\ mW/cm^2$$ in any 30 minutes interval

Applying the *'truly worst-case prediction of power density at or near a surface, such as at ground-level or on a rooftop, 100% reflection of incoming radiation can be assumed, resulting in a potential doubling of predicted field strength and a four-fold increase (far*

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field equivalent) power density' equation described on page 20 of the FCC method we get:

$S_{avg} = 0.92$ mW/cm^2 in any 30 minute interval.

This value is less than the maximum permissible exposure limit of 1mW/ cm^2 in any 30 minute interval.

Taking into account that the estimated power density has been calculated using highly conservative methods and assumptions, it is considered that the proposed terminal amply satisfies the MPE limits for general population/uncontrolled exposure.

5 CONCLUSION

With proper installation and use, this MT is in compliance with the standards laid out in ANSI/IEEE C95.1-1992, "Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 KHz to 300 GHz".