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Environmental Evaluation for RF Exposure for the DM10

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1. Introduction

1.1. Purpose of the Report

This technical report is a detailed environmental evaluation of the radiofrequency exposure expected from use of the DM10 transmitter. The analysis below demonstrates that the DM10 device is in compliance with the requirements for maximum permissible exposure (MPE) to radiofrequency exposure as defined in the FCC Rules, 47 CFR 2.1091.

This report serves as the technical basis for the statement of compliance and a request for an exclusion from routine SAR environmental evaluation submitted with the application for certification for the DM10, FCC ID: AXATR-415.

1.2. Description of the DM10 Device

The DM10 Transceiver has been designed as an OEM module for use by various OEM integrators. The transmitter delivers up to 0.355 watts ERP of output power. The transmitter operates in the band designated for cellular telephone use, from 824 to 849 MHz. The transceiver is designed with a form factor suitable for integration into a variety of applications, such as meter reading, security alarm communications, location-on-demand systems, fixed wireless local loop, and vehicular emergency communications.

The mode of operation is as a CLASS 4 cellular terminal, dual mode (AMPS, DAMPS), with nominally 0.355 Watts when set to the highest power level, at the antenna connector. In AMPS mode, there are 8 power levels per TIA, and in DAMPS mode, there are 11 power levels. The module is shipped without an antenna, and the actual ERP in practice may vary somewhat with the application. The Interface Manual that is supplied to our customers (system integrators) specifies the use of an antenna with maximum system gain of 1 dBd (3.15 dBi), which is derived from the use of an antenna with 2.5 dBd (4.65dBi) gain in conjunction with 1.5 dB cable loss. With 1 dBd (3.15 dBi) of antenna system gain, the PL0 0.355 watts at the antenna connector is boosted to 0.447 watts ERP.

2. Classification of Device / Applicability of Rules

2.1. Mobile devices

The DM10 is properly defined as a mobile device per 47 CFR 2.1091 (b), which states that “mobile devices are defined as transmitters designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between radiating antennas and the body of the user or nearby persons.”

While some applications of the DM10 device will be in fixed locations, the transmitter is designed to be used in mobile applications. In general, the applications for DM10 are such that there is a separation distance of greater than 20 centimeters.

2.2. Routine environmental evaluation

47 CFR 2.1091 (c) states that “mobile devices that operate in the Cellular Radiotelephone Service...are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use if…their effective radiated power (ERP) is 1.5 watts or more.”

Ericsson requests an exclusion from routine RF exposure evaluation. This exclusion is supported in the following paragraphs with analysis of the maximum RF exposures from a DM10 transmitter under worst-case and typical conditions which clearly demonstrates compliance with the FCC regulations. Additionally, the OEM module does not include an integrated antenna (the antenna and antenna cable are supplied by the system integrator).

2.3. Applicable limits for exposure to radiofrequency exposure

The table below is excerpted from Table 1B of 47 CFR 1.1310 titled Limits for Maximum Permissible Exposure (MPE), Limits for General Population/Uncontrolled Exposure:

Frequency Range (MHz)	**Power Density (mW/cm^2)**	**Averaging Time (minutes)**
300 - 1500	f/1500 *	30

* f = frequency in MHz

So, given the highest frequency of operation of 850 MHz, the MPE limit is f/1500 = 850/1500 = **0.567 mW/cm^2.**

Given that power density **$S = EIRP / 4*\pi*R^2$**, and using **R=20 cm** and **S=MPE=0.567 mW/cm^2**, we find that **the maximum EIRP is 2.85 W** in order to produce exposure levels below the MPE at 20 centimeters. (Note that EIRP=1.64*ERP, where 1.64 is the gain of a dipole antenna. Therefore **the maximum ERP is 1.74 W**, that is, the maximum *average* power that produces MPE limit levels at 20 cm.). It should be noted that this power density equation is only accurate in the farfield; at 20 cm distance, it will overestimate the MPE.

3. Worst-case exposure analysis

To complete a worst-case scenario, we must determine the peak ERP delivered by the device. The DM10 CLASS 4 transmitter is calibrated to deliver 0.355 watts to the antenna connector. There is 1 dBd (3.15 dBi) antenna system gain as described in section 1.2. The transmitter output tolerance is specified as +2 / -4 dB, so the maximum output power is 0.71W ERP at PL2.

Using a separation of 20 centimeters (per the definition of mobile device as discussed in section 2.1), the average field strength density in a worst-case scenario:

$S_{avg} = (1.64*ERP / (4*\pi*R^2)) * duration / time = (1.64 * .71 / (4*\pi*20^2)) * 1/1 =$ **0.23 mW/cm^2**

Note that this worst case exposure is well below the MPE limit of 0.567 mW/cm^2 derived in section 2.3.

4. Typical exposure analysis

For Class 4 operation (continuous), a maximum of 0.355 watts is delivered to the antenna connector. With the 1 dBd (3.15 dBi) antenna system gain, the maximum transmitter power in the Class 4 mode is 0.45 watts ERP. The (average) field strength density in this scenario is:

$S_{avg} = (1.64*ERP / (4*\pi*R^2)) * duration / time = (1.64 * 0.45 / (4*\pi*20^2)) *1/1 =$ **0.15 mW/cm^2**

Note that this exposure is well below the MPE limit of 0.567 mW/cm^2 derived in section 2.3.

5. Conclusions

The preceding analysis demonstrates that exposure to RF from the DM10 device is well below the limits imposed by the FCC regulations.

In order to minimize RF exposure, applications developers (i.e. Ericsson's customers) will receive guidelines for use and installation of the DM10 device to reduce the possibility of even inadvertent exposure. The transmitter should be installed in such a manner as to make it unlikely that a human body can be maintained in close proximity (i.e. less than 20 centimeters) to the radiating antenna. A statement to this effect is included in the user's manual (DM10 FCC filing - Exhibit 8 Interface Manual).