SAR Analysis Report

Justification for SAR test exclusion

Purpose

The purpose of this report is to justify the conclusion that the Bluetooth module LMX9838 device meets the SAR Test Exclusion Thresholds outlined in Section 4.3 of KDB 447498.

Particulars

Equipment: SmartCap Processor Card

Transmitter: EdanSafe LMX9838 Bluetooth module

Reference: Federal Communications Commission, "Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies", KDB 447498 D01 – General RF Exposure – V0502, February 7, 2014. (**KDB 447498**)

Maximum Transmission Power

Page 9 of the LMX9838 datasheet (http://www.ti.com/lit/ds/symlink/lmx9838.pdf) shows the maximum transmit output power as +3dBm, which corresponds to **2mW**. This conversion is based on the expression:

$$P_{(\mathrm{mW})} = 1\mathrm{mW} \cdot 10^{(P_{(\mathrm{dBm})}/\,10)}$$

Using this expression, 3 dBm corresponds to 1.995262315 mW, which rounds up to 2 mW.

Section 4.3 of KDB 447498 clearly states that test exclusion condition are based on source-based, time-averaged maximum conducted output power of the RF channel. The time averaging is clarified in section 6.3 of the same document, which describes the need for a "conservative" estimate of the duty factor when transmissions are sporadic.

The SmartCap Processor Card firmware uses a regular 'heartbeat' of transmission, separated by a sleep mode. For the purposes of this test exclusion justification, we apply the most conservative values possible by assuming a duty factor of 1.0, which equates to continuous, maximum-power transmission.

Test Separation Distance

SmartCap headwear comes in a number of form factors. The product embodiment that results in the minimum test separation distance is the headband design.

When in use, the test separation distance – defined as the minimum distance from the Bluetooth module antenna to the body (head) – is **6mm**.

This is the most conservative applicable value, as it equates to the minimum possible separation, should an external force be applied to hold the Processor Card as close as geometrically possible while still in use.

Transmission Frequency

Page 9 of the LMX9838 datasheet (http://www.ti.com/lit/ds/symlink/lmx9838.pdf) shows three conditions for transmission, each with differing transmission frequencies. Given the inversely proportional relationship between the transmission frequency and the likelihood of meeting the exclusion threshold (based on the expression provided in Section 4.3 of KDB 447498), the highest value included on the datasheet will be used, in keeping with the conservative approach.

As such, the value taken for RF channel transmit frequency is **2.480 GHz**.

Calculation using Exclusion Threshold Expression

Applying the values denoted above to the expression provided in Section 4.3 of KDB 447498 yields the following value:

$$\frac{P_{max}}{d_{min}}\left(\sqrt{F_{(GHz)}}\right) = \frac{2}{6}\left(\sqrt{2.480}\right) = 0.5$$

Where:

P_{max} is the maximum power of channel, including tune-up tolerance, rounded to the nearest mW;

d_{min} is the minimum test separation distance, rounded to the nearest mm; and

$F_{(GHz)}$ is the transmission frequency expressed in GHz

Basis for SAR Test Exclusion

Given that the above calculation above yields a value (rounded to one decimal place, as per Section 4.3 of KDB 447498) lower than the 1-g test exclusion threshold of 3, the SmartCap Processor Card meets the criteria for SAR Test Exclusion, as per the guidelines in the referenced FCC publication.