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7th September 2021

Re: RF exposure calculation for Dimension4 UWB+BLE tag (D4UWBBLE)
FCC ID: SEAUWBBLE

To Whom It May Concern:

We have prepared an RF exposure analysis for the Dimension4 UWB+BLE tag (D4UWBBLE, FCC ID: SEAUWBBLE). A KDB enquiry was made with the FCC, and response received, pertaining to this application, and both the enquiry and response have been uploaded with the application. This analysis takes into account the FCC's guidance in this matter.

Background

The Dimension4 UWB+BLE Tag is a composite device consisting of a Part 15.250 wideband transmitter operating in the 5.925-7.25GHz band around 6.5GHz, a proprietary Part 15.247 Bluetooth Low Energy (BLE)-based radio transceiver operating in the range 2401.00-2481.75MHz, and associated digital circuitry.

Both the Part 15.250 wideband and Part 15.247 2.4GHz BLE transmitters are connected to internal, permanently-affixed antennas. The Part 15.250 wideband transmitter has a single antenna. The Part 15.247 2.4GHz BLE transmitter has two antennas connected to the transmitter via an antenna switch – only one of the 2.4GHz antennas can be active at any one time. It is never the case that both transmitters are active simultaneously.

For RF exposure purposes, the device is being certified as a portable device, in the General Population exposure environment, and may be carried by people. The minimum separation of the Part 15.250 wideband antenna from the user's body is 2mm (guaranteed by the design of the enclosure of the device) and the minimum separation of any Part 15.247 2.4GHz BLE antenna from the user's body is 2.4mm (again guaranteed by the design of the enclosure of the device).

Per the FCC's guidance in response to our KDB enquiry, we have analysed the transmitters using draft guidance KDB 447498 DR04 (which includes 447498 D01 General RF Exposure Guidance v07).

Part 15.247 transmitter output power

The Part 15.247 2.4GHz transmitter has two antennas, which are never active simultaneously, and it does not use beam-forming or coherent transmission methods. Its maximum peak conducted output power after tune-up is -1.5dBm = 0.7079mW (see UL-RPT-RP13627946-616A.pdf, page 22).

The antennas for the Part 15.247 transmitter measure 3.1mm x 3.1mm x 4.1mm, so the maximum possible dimension of the antenna is $\text{sqrt}(3.1^2+3.1^2+4.1^2)$=6mm. This is much less than a quarter-wavelength at 2.4GHz (=31mm), and so the per the footnote #10 on page 14 of KDB 447498 DR04 the maximum peak conducted output power may be conservatively used in lieu of ERP as a worst-case estimate of the maximum time-averaged available power of the device.

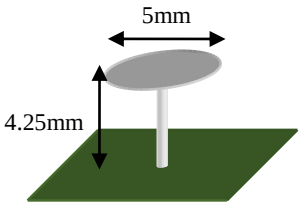
Part 15.250 transmitter output power

The average output power of the Part 15.250 wideband transmitter operating at 6.5GHz is directly proportional to the rate of transmissions (i.e. the number of location-determining packets it transmits per second). That transmission rate cannot in any circumstance be higher than 167 location packets per second due to limitations in the device's microcontroller.

Full-bandwidth source power measurements are not routinely made during Part 15.250 testing. Therefore, direct measurements were made of the full-bandwidth power delivered to the antenna using a wide-bandwidth thermocouple-based average RF power meter (Agilent E4416A+8481A), which is modulation-independent. The average power measurements were made with the device set to beacon continuously at its highest possible transmission rate (167 maximum-payload location packets per second), and were taken over a signal averaging period of 20s (to comply with the interim guidance on MPE time averaging in the "RF Exposure: Order/NPRM Issues" TCB Workshop notes)

After correction for cable losses, the source-based, time-averaged feed power in the worst-case configuration (167 maximum-payload packets/sec.) was found to be -28.3dBm = **1.5µW**.

The antennas for the Part 15.250 transmitter have the dimensions shown below:



Therefore, the maximum possible dimension of the antenna is less than sqrt($4.25^2+5^2+5^2$)=8.25mm. This is much less than a quarter-wavelength at 6.5GHz (=11.5mm), and so the per the footnote #10 on page 14 of KDB 447498 DR04 the maximum average conducted output power may be used in lieu of ERP as an estimate of the maximum time-averaged available power of the device.

Exposure analysis

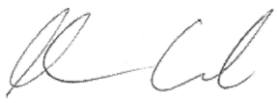
Although the Part 15.247 and Part 15.250 transmitters are never active simultaneously, and although both transmitters are individually below the 1mW exemption of section 2.1.2 of KDB 447498 DR04, the transmitters may be active within the same source-based time-averaging period used in SAR and MPE assessments, and therefore we have considered them to be simultaneously-active in this analysis because this represents a worst-case, conservative condition.

The sum of the output powers for the two devices is 0.7079mW (Part 15.247 transmitter) plus 1.5µW (Part 15.250 transmitter), giving a maximum total output power of 0.7094mW. This is below the 1mW exemption of section 2.2.1(b) KDB 447498 DR04 for multi-source devices treated in this manner, and therefore the device complies with the exemption requirements of KDB 447498 DR04.

Summary

In conclusion, the device is excluded from SAR/MPE testing by virtue of its low-output-power characteristics.

Yours faithfully,



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7th September 2021