MIRION TECHNOLOGIES	R&D Test Report	Project: RDS-32
Laati / Issued **TK**	Testipaikka / Test location **Turku** / Testi päivä / Test date **10.08.2020**	Päiväys / Date **05.03.2021**
Aihe / Subject	Maximum permissible exposure	

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1. Purpose for the test

This test is done to evaluate device compliance with FCC guidelines for human exposure to radiofrequency electromagnetic fields of the WRM radio module and the Bluetooth low energy (BLE) radio.

2. Approval criteria

According to KDB publication for mobile and portable devices (KDB 447498) 4.3.1 a) SAR test exclusion can be calculated:

- [(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] · [vf(GHz)] ≤ 3.0 for 1-g SAR, and ≤ 7.5 for 10-g extremity.

The calculation is used to see if further SAR testing is needed.

According to CFR § 2.1093 d) 2) exposure may be averaged over a time period not to exceed 30 minutes to determine compliance with general population/uncontrolled SAR limits.

3. Test plan

WRM radio (FCC ID: MCQ-XB900HP) sends data with frequency hopping band of 902 MHz – 928 MHz. Data is sent in minimum interval of 2 seconds.

The frequency band shall be measured to determine the duration of data being sent and calculate the minimum distance in a worst case scenario.
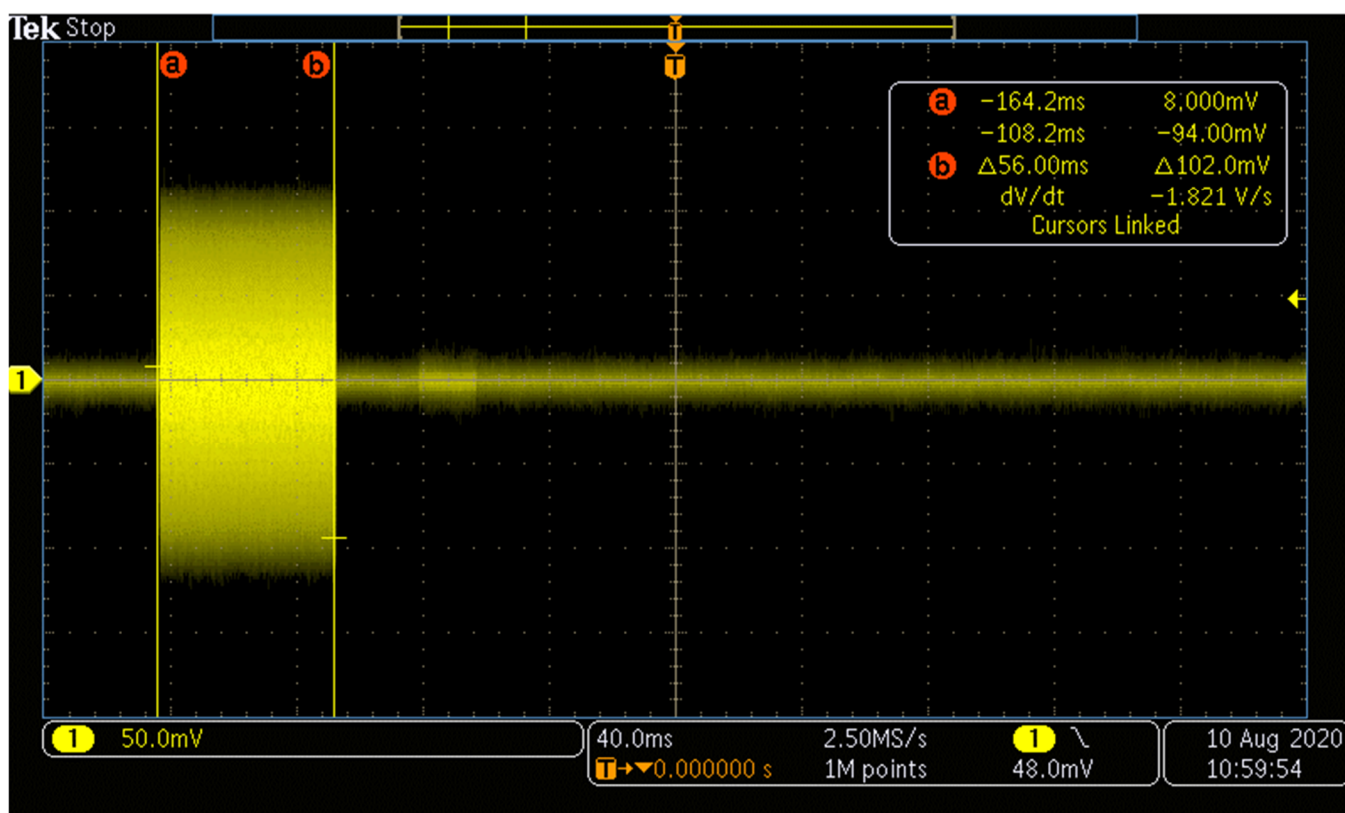
BLE radio sends data with frequency hopping band of 2402 MHz – 2480 MHz.

Since the BLE radio has much less power output, the calculation can be done using maximum power output.
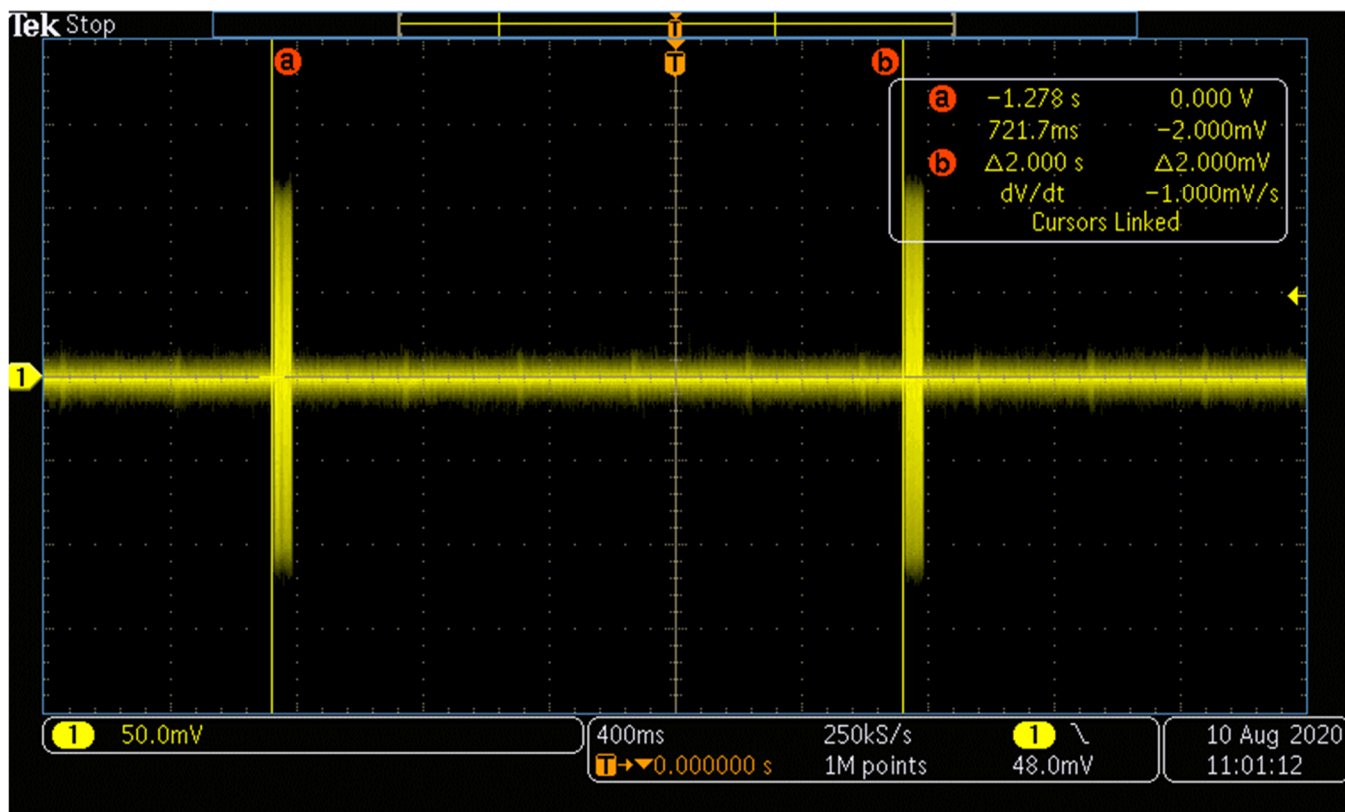
4. Test results

4.1 WRM radio

The device was set to send data in 2 second interval and the duration of the data stream measured (see Figure 1 and 2).

Figure 1 The duration of data stream

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Figure 2 Time between two data streams

The minimum separation distance was calculated over 30 minutes data sent every 2 seconds for 56 ms with the power of 298 mW stated in the original FCC grant:

- Number of messages sent over 30 minutes: $\frac{1800s}{2s} = 900$ messages
- Total time sending messages over 30 minutes: $900 * 0,056s = 50,4\ s$
- Average power over 30 minutes: $\frac{50,4s}{1800s} * 298mW = 8,344mW$
- Minimum separation distance with lowest frequency: $\frac{8,344mW}{3/\sqrt{0,902\text{GHz}}} = 2,64mm$
- Minimum separation distance with highest frequency: $\frac{8,344mW}{3/\sqrt{0,928\text{GHz}}} = 2,68mm$

The frame thickness was measured from 3d model (see Figure 3) to be at minimum 3,2 mm.
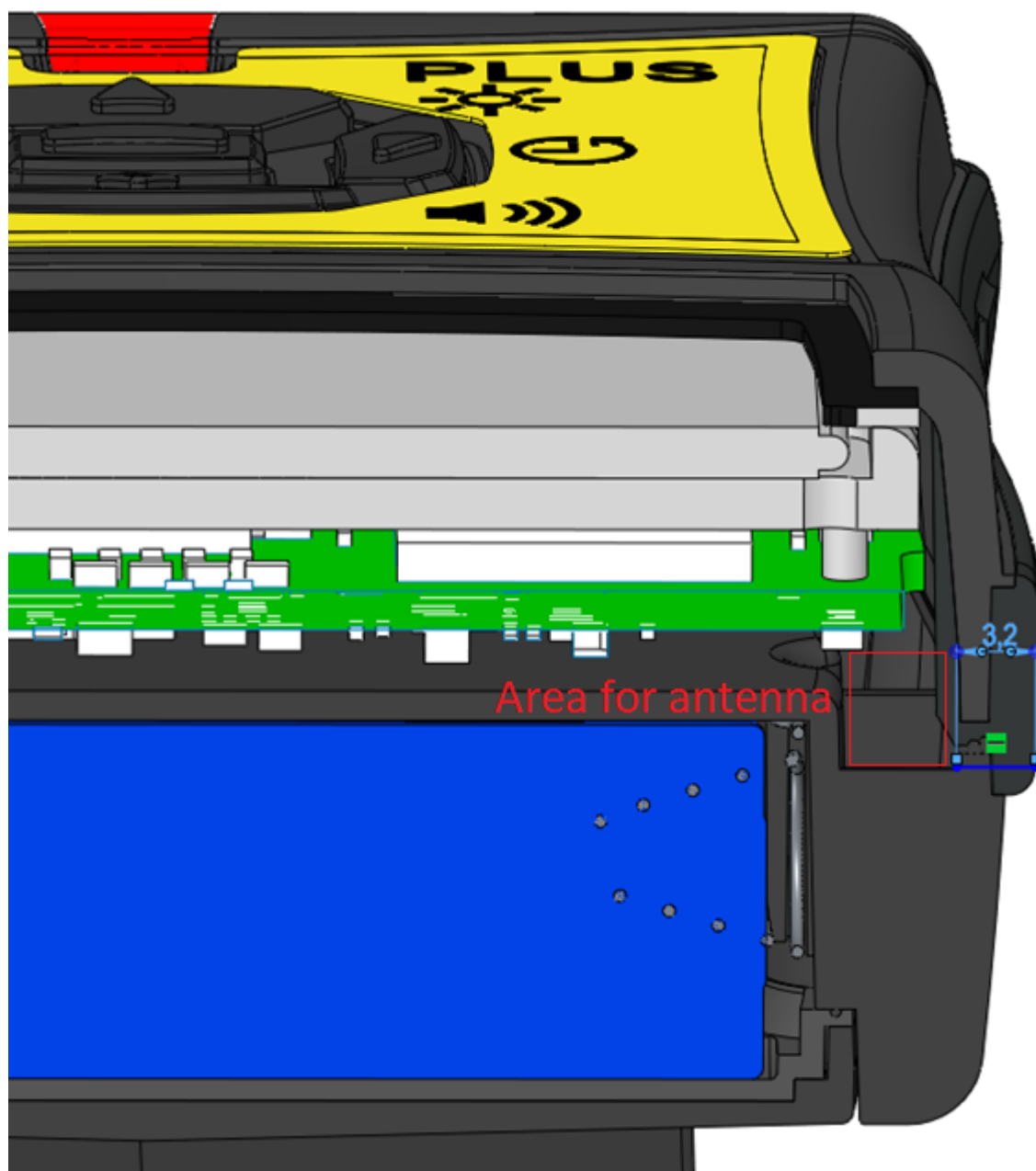
Figure 3 Frame thickness and area for antenna

4.2 BLE radio

The minimum separation distance was calculated using the maximum power output of +5dBm (3,16mW) stated in Texas Instruments CC2640 datasheet and the antenna gain of 1,2dBi (numeric 1,32):

- Minimum separation distance with lowest frequency: $\frac{3,16mW*1,32}{3/\sqrt{2,402\text{GHz}}} = 2,16mm$
- Minimum separation distance with highest frequency: $\frac{3,16mW*1,32}{3/\sqrt{2,480\text{GHz}}} = 2,19mm$

5. Conclusions

According to the calculations the average exposure for the WRM radio over 30 minutes does not require SAR testing as long as the antenna is 2,68 mm away from the user.

For the BLE radio, the minimum separation distance is 2,19 mm at maximum power output. The frame thickness is more than the minimum separation distance at the area where the antennas are positioned.

The radios do not transmit simultaneously.