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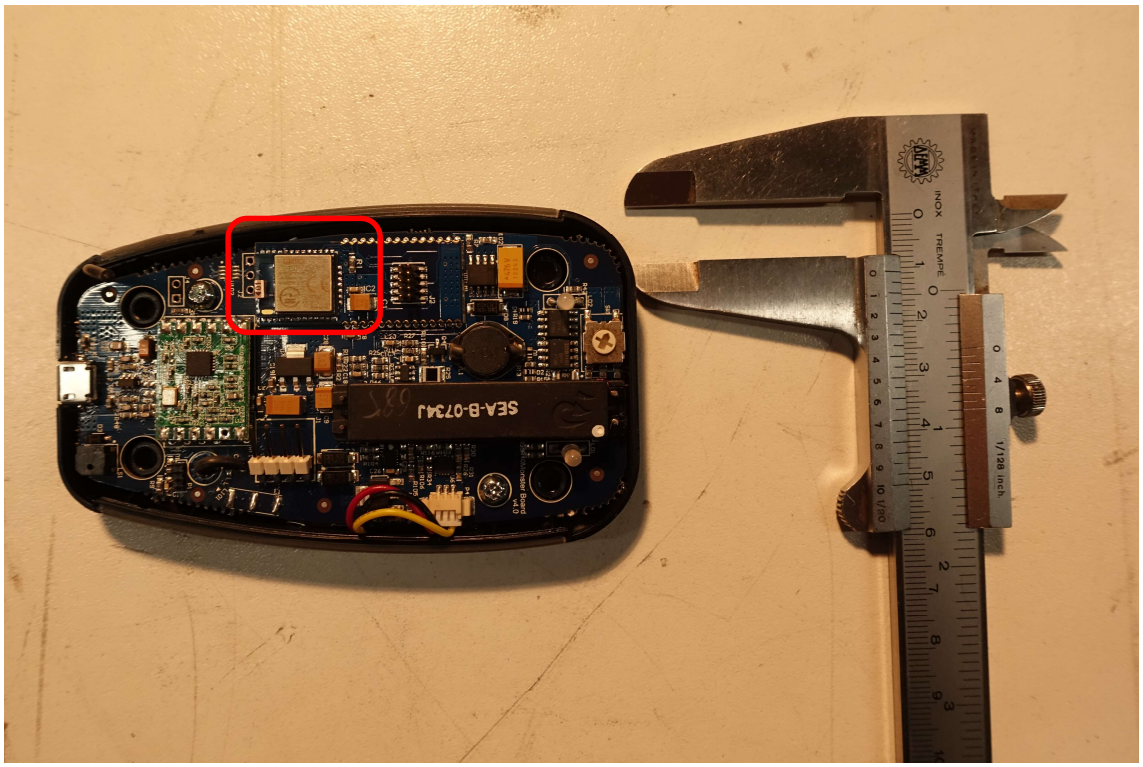
Project No. 1611302246 date 27/06/2017

ASSESSMENT REPORT: SAR exclusion on family Type TPM-NK01 made by ADE

Dear Rasin,

accordingly with the SAR document issued by SILICON Labs, issued for the BT121 module, we have measured the distance between Antenna of the BT121 module and the Hand & Body considered as the most conservative distance of the plastic cover during the worst case of the operational mode.

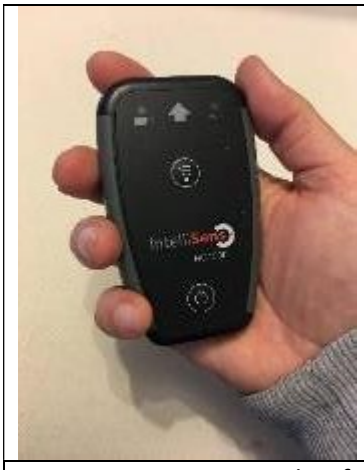
As you can see the measures by a caliper shown that we have in any case upper to 7 mm, declared by SILICON Labs as the limit to determine the SAR measurement.



In this view we measure 9 mm as the minimum distance between the BT Antenna and the cover.

We taking into account that ***the housing grantee a minimum distance of 7.5 mm*** *as separation between the Bluetooth antenna inside the device and the closest hand surface in contact with the external device in the correlated point of the Bluetooth antenna. Accordingly with this our measurements and the SILICON Lab evaluation about the SAR, we can confirm on the HC1000 that the SAR measurement can be excluded.*

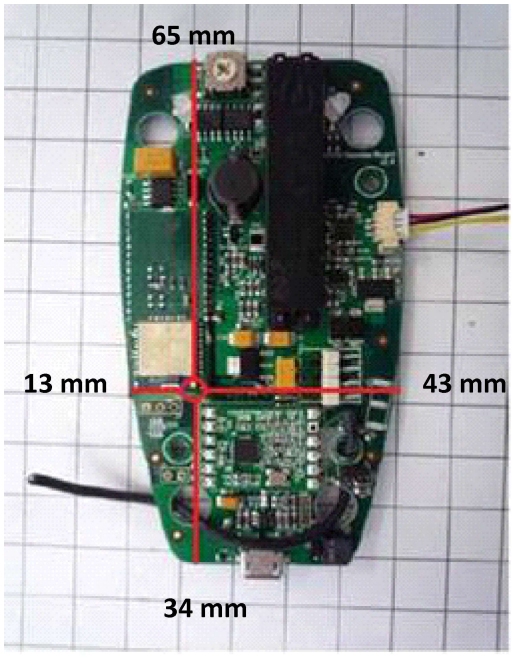
As you can check on the following photos the Worst Case is when the HC1000 is take on from the table (Status 1) in the other case the hand position respect the BT Antenna not cover the BT Antenna area.

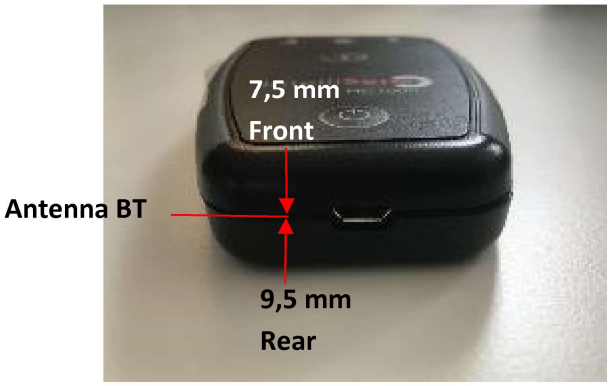
		
Picture 1 - HC1000 is takes from the table (no BT operates)	Picture 2 - HC1000 during the use (upper view), pushing the button to active the Bluetooth	Picture 2 - HC1000 during the use (lateral bottom view), pushing the button to active the Bluetooth

Taking into account the requirements of the par.4.3.1 of the 447498 D01 General RF Exposure Guidance v06 we have measured the relevant distances around the EUT, see following table.

Table of measured distance btw. BT Antenna and the external around surface of the housing of HC1000

Side identification	*Distance measure*	*Remarks*
BT Antenna vs. upper surface (Front)	*7,5 mm*	*Worst case, minor distance from the Body*
BT Antenna vs. bottom surface (Rear)	*9,5 mm*	*---*
BT Antenna vs. USB side	*34 mm*	*---*
BT Antenna vs. LED side	*65 mm*	*Major distance from the Body*
BT Antenna vs. Right side	*43 mm*	*---*
BT Antenna vs. Left side	*13 mm*	*---*





Accordingly with the Bluegiga report we can confirm that the Bluetooth transmission operates in the BT121 module for 300,1ms in a period of 31,6 seconds, we can treat the object of the par.6.3 of the KDB 447489 D01 "General RF Exposure Guidance" v06 and considering the HC1000 as Low transmission duty factor device.

About the transmission data value we have assumed the data presented in the "Average Time of Occupancy of Hopping Frequency" of the Test Report of the BT121, Reference number: 280383-1-1 issued by SGS.

The maximum output power of the BT module is 13mW

Really about the Bluetooth, we have been measured 88 dBμV/m at distance of 3m on the first prototype of the HC1000 and measured today at 84 dBμV/m on a sample taken random from the production measured on March 2017.

Note that the HC1000 cannot transmit at the maximum power declared by Bluegiga on the Exemption SAR letter, equal to 13mW as conducted measurement on the BT121 module tested by SGS in the Report with Reference number: 280383-1-1.

Accordingly with Mobile and portable device RF exposure and equipment authorization requirements of the 47 CFR Sections 1.1307, 2.1091, and 2.1093, we apply the requirements of the FCC technical document: 447498 D01 General RF Exposure Guidance v06 provides guidance pertaining to RF exposure requirements for mobile and portable device equipment authorizations.

RF Exposure evaluation for Bluetooth on the HC1000

According to the clause 4.3 of the KDB 447498 D01 General RF Exposure Guidance v06, regarding the standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions.

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by this following formula:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] $\cdot[\sqrt{f_{(GHz)}}] \leq 3.0$ for 1-g SAR and ≤ 7.5 for 10-g extremity SAR,

where

$f_{(GHz)}$ is the RF channel transmit frequency in GHz

Power and distance are rounded to the nearest mW and mm before calculation.

The result is rounded to one decimal place for comparison

Worse case is as below: [2480MHz] 13 mW output power

(13.0 mW / 7.5 mm) $\cdot[\sqrt{2.480\ (GHz)}]= 2.73 < 3.0$ for 1-g SAR from the body

SAR Test Exclusion calculation for TX 125kHz on the HC1000

According to the clause 4.3.1 of the KDB 447498 we calculate the comparison for SAR threshold as follow:

Carrier frequency = 125 kHz
Field Strength at 3m = 62,866 dBµV/m
Output Power = 62,866 – 95.2 = -32,334 dBm
Output Power = 0,001 mW
Minimum separation distance from the Body = 7,5 mm

SAR Exclusion threshold:
KDB 447498 Sect. 4.3.1

Step 1:
Power allowed = 3*(7,5mm)/(√0.1GHz) = 71,42mW

Step 2:
Power threshold = 71,42mW + 0 = 71,42 mW

Step 3:
Power threshold = [71,42mW * (1+log(100/0.125))] = 278,75 mW

Output power = 0.001 mW < 278,75 mW

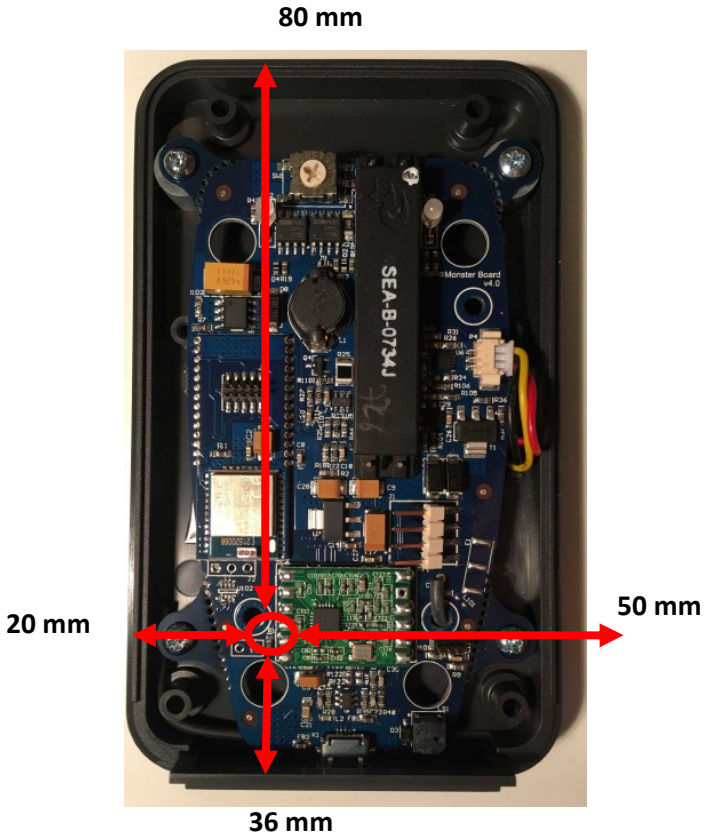
In conclusion, SAR measurement is not required.

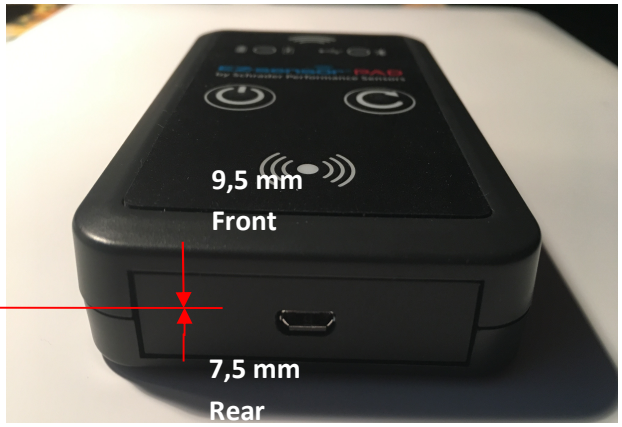
No simultaneous transmission, between Bluetooth 2,4 GHz and TX 125 kHz,

is possible in the HC1000 version.

Table of measured distance btw. BT Antenna and the external around surface of the housing of EZ-sensor PAD

Side identification	*Distance measure*	*Remarks*
BT Antenna vs. upper surface (Front)	*9,5 mm*	*---*
BT Antenna vs. bottom surface (Rear)	*7,5 mm*	*Worst case, minor distance from the Body*
BT Antenna vs. USB side	*36 mm*	*---*
BT Antenna vs. LED side	*80 mm*	*Major distance from the Body*
BT Antenna vs. Right side	*50 mm*	*---*
BT Antenna vs. Left side	*20 mm*	*---*





Accordingly with the Bluegiga report we can confirm that the Bluetooth transmission operates in the BT121 module for 300,1ms in a period of 31,6 seconds, we can treat the object of the par.6.3 of the KDB 447489 D01 "General RF Exposure Guidance" v06 and considering for the EZ-sensor PAD, as the same of the HC1000, as Low transmission duty factor device.

About the transmission data value we have assumed the data presented in the "Average Time of Occupancy of Hopping Frequency" of the Test Report of the BT121, Reference number: 280383-1-1 issued by SGS.

The maximum output power of the BT module is 13mW

Really about the Bluetooth, we have been measured 88 dBμV/m at distance of 3m on the first prototype of the EZ-sensor PAD and measured today at 84 dBμV/m on a sample taken random from the production measured on March 2017.

Note that the EZ-sensor PAD cannot transmit at the maximum power declared by Bluegiga on the Exemption SAR letter, equal to 13mW as conducted measurement on the BT121 module tested by SGS in the Report with Reference number: 280383-1-1.

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Output power = 0.001 mW < 278,75 mW

In conclusion, SAR measurement is not required.

No simultaneous transmission, between Bluetooth 2,4 GHz and TX 125 kHz,

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Best regards,

Francesco Barbierato

EMC Senior Engineer