Genio® System 2.1

SAR exclusion calculation

Contents

1. Purpose

The purpose of this document is to provide SAR exempt calculation for the Genio® System 2.1. The document applies to Genio® System 2.1 which utilizes the Genio® AC Model #2364 that integrates BLE transmitter.

2. Scope

This document applies for the Genio® AC Model #2364 which is a part of the Genio® System 2.1.

The detailed technical description is required for FCC certification process. Other Genio® System 2.1 components require SDoC (self-declaration of conformity) and hence not technically detailed described in this document.
Genio® AC Model #2364 must comply with the FCC SAR requirement. This document provides SAR exclusion calculation to prove that the AC Model #2364 BLE transmitter comply with the FCC requirement.

3. Background

3.1. Genio Activation Chip (AC Model #2364)

The Genio® 2.1 AC Model #2364 consists of integrated BLE Communication capabilities.

Figure 1:Activation Chip (AC) view

3.2. AC BLE

The AC communicates with the RaspberryPi based Sleep Lab application via 2.4GHz Bluetooth low energy (BLE).
The AC software is based on BLE stack Version soft device (sd) s140 V7.2.0 implemented on Nordic (P.N NRF52840-QIAA) BLE microcontroller.

BLE transmitter
- Manufacturer – Nordic
- P.N - NRF52840-QIAA

BLE Antenna
- Manufacturer – Yageo (PulseLarsen Antennas)
- P.N - ANT3216LL00R2400A

BLE Architecture
- GFSK Modulation
- 1Mbps bitrate
- Antenna gain: 5.05dBi peak

4. SAR exempt calculation

Calculating the SAR exclusion numeric threshold according to 4.3.1 a) and 4.1 f) of KDB 447498 D01:

- Rounding channel max. power + tune up tol. to the nearest mW:
  -14.50dBm+2dB = -12.50dBm → 0.05mW → 1mW
- Channel max power taken from the "NYXRAD_FCC.46250_BLE" report.

Test specification:	Section 15.247(b)3 / RSS-247 section 5.4(4), Maximum output power			
Test procedure:	ANSI C63.10 sections 11.9.2.2.4			
Test mode:	Compliance	Verdict:		PASS
Date(s):	17-Apr-22			
Temperature: 20 °C	Relative Humidity: 50 %	Air Pressure: 1016 hPa		Power: 3.7 VDC
Remarks:				

Table 7.2.2 Peak output power test results

ASSIGNED FREQUENCY:	2400.0 – 2483.5 MHz
TEST DISTANCE:	3 m
TEST SITE:	Semi anechoic chamber
EUT HEIGHT:	1.5 m
DETECTOR USED:	Peak
TEST ANTENNA TYPE:	Double ridged guide (above 1000 MHz)
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum
DETECTOR USED:	Peak
RESOLUTION BANDWIDTH:	3 MHz
VIDEO BANDWIDTH:	10 MHz
MODULATION:	GFSK
BITRATE:	1 Mbps

Frequency, MHz	Field strength, dB(μV/m)	Antenna polarization	Antenna height, m	Azimuth, degrees*	EUT antenna gain, dBi	Peak output power, dBm**	Limit, dBm	Margin, dB***	Verdict
2402.0	85.75	Horizontal	1.70	80	5.05	-14.50	30	-44.50	Pass
2442.0	77.51	Horizontal	1.60	-10	5.05	-22.74	30	-52.74	Pass
2480.0	80.15	Horizontal	1.60	0	5.05	-20.10	30	-50.10	Pass

*- EUT front panel refer to 0 degrees position of turntable.
**- Peak output power was calculated from the field strength of carrier as follows: $P = (E \times d)^2 / (30 \times G)$,
where P is the peak output power in W, E is the field strength in V/m, d is the test distance in meters and G is the transmitter numeric antenna gain over an isotropic radiator. The above equation was converted in logarithmic units for 3 m test distance: *Peak output power in dBm = Field strength in dB(μV/m) - Transmitter antenna gain in dBi – 95.2 dB*
***- Margin = Peak output power – specification limit.
Note: Maximum peak output power was obtained at Unom (115%Unom, 85%Unom) input power voltage.

- Test separation distance: 5mm
- Tune up tolerance: 2dB
- Frequency – related to the max. power: 2.40GHz
- Calculation: 1/5*sqrt(2.40) = 0.30 → one decimal place rounding: 0.3

Conclusion: since 0.3 is less than the 3.0 numeric threshold, the Genio2.1 BLE transmitter meets SAR exclusion limit.