RF Exposure Calculation

Voxter® Elite+
Version: 1.00

Inhaltsübersicht

Author: E. Hensinger / 12.07.2017

1   Description of the product:

The product is a voice terminal. It includes a pre certified WiFi module (FCC ID: O2FMSD40NBT) and a pre certified Bluetooth module (FCC ID: SQGBT800). The product is intended to be used in storages by trained personal only. The product is battery supplied.

2 RF exposure calculation WiFi

The values of the transmit power are taken from the Datasheet of the original certification file FCC ID: TWG-SDCMSD40NBT. The manufacturer defines test distance as 18mm; please refer to document "Test distance definition".

Maximum transmit power levels taken from Datasheet of TWG- SDCMSD40NBT:

Operation mode	Data Rate [Mbps]	Transmit Power [dBm]	Transmit Power [mW]	Tolerance [dBm]
802.11b	1	17	50	±2
	11	16	40	±2
802.11g	6	15	32	±2
	54	13	20	±2
802.11a	6	16	40	±2
	54	14	25	±2

Used formula according to KDB447498 sub clause 4.3.1 a).
The Voxter® Elite+ is a body worn product. Therefore a threshold of 3 is used.

$$\frac{Power\ of\ channel\ [mW]}{Test\ distance\ [mm]} \times \sqrt{f\ [GHz]} \le 3$$

2.1 Calculation of Effective Power:

Operation Mode	Data Rate [Mbps]	Transmit Power [dBm]	Tolerance [dBm]	Antenna Gain [dBi]	Max Power [dBm]	Duty Cycle [%]	Effective Power [mW]
802.11b	1	17	2	2,5	21,5	1	1,41
	11	16	2	2,5	20,5	1	1,12
802.11g	6	15	2	2,5	19,5	1	0,89
	54	13	2	2,5	17,5	1	0,56
802.11a	6	16	2	5	23	1	2,00
	54	14	2	5	21	1	1,26

2.2 SAR Calculation:

Operation Mode	Data Rate [Mbps]	Frequency [GHz]	Effective Power [mW]	Test Distance [mm]	Result	Limit	Pass / Fail
802.11b	1	2,4	1,41	18	**0,12**	3	Pass
	11	2,4	1,12	18	**0,10**	3	Pass
802.11g	6	2,4	0,89	18	**0,08**	3	Pass
	54	2,4	0,56	18	**0,05**	3	Pass
802.11a	6	5	2,00	18	**0,25**	3	Pass
	54	5	1,26	18	**0,16**	3	Pass

3 RF exposure calculation Bluetooth

The values of the transmit power are taken from the RF exposure calculation of the original certification file FCC ID: SQGBT800 . The manufacturer defines test distance as 7,5mm; please refer to document "Test distance definition".

Transmit power levels taken from RF exposure calculation of SQGBT800:

Operation mode	Frequency		Power	
		[MHz]	[dBm]	[mW]
BT800-SA	EDR	2402-2480	9,95	9,88
	LE	2402-2480	9,68	9,31

Used formula according to KDB447498 sub clause 4.3.1 a):
The Voxter® Elite+ is a body worn product. Therefore a threshold of 3 is used.

$$\frac{Power\ of\ channel\ [mW]}{Test\ distance\ [mm]} \times \sqrt{f\ [GHz]} \leq 3$$

Calculation:

Operation mode	Frequency [GHz]	Power [mW]	Test distance [mm]	Result	Limit	Pass / Fail
BT800-SA (BT EDR)	2,4	9,88	7,5	**2,04**	3	Pass
BT800-SA (BT LE)	2,4	9,31	7,5	**1,92**	3	Pass

4 Simultaneous transmission of WiFi and Bluetooth

To show compliance the worst case of WiFi transmission is taken (802.11a), Bluetooth transmission is taken (BT-EDR). This should symbolize the absolute worst case.

| Operation mode	Frequency [GHz]	Power [mW]	Test distance [mm]	Result	Limit	Pass / Fail
802.11a	5	2,00	18	0,25	3	Pass
BT800-SA (BT EDR)	2,4	9,88	7,5	2,04	3	Pass
			Total:	**2,29**	**3**	Pass

5   Duty Cycle Calculation

Voxter® Elite+ was developed specifically for Lydia® voice applications. Voice recognition and voice output via the headset are controlled locally and the device is directly connected to the higher-level system via Wi-Fi. After a voice recognition the result package is send to a server (up to 2048 Byte). The server will send back the next task to the Voxter® Elite+ depending on the recognition result (up to 2048 Byte).

The voice recognition also as the voice generation is done on the Voxter® Elite+. Therefore no voice is transmitted over Wi-Fi.

The following figures shows the communication to the server and back to the Voxter® Elite+ with a data package of 2048 Byte in both directions and a data rate of 1 Mbps (worst case).

For the duty cycle calculation we assume that the communication to the server will happen every five seconds. This is a worst case assumption for a practical use case.
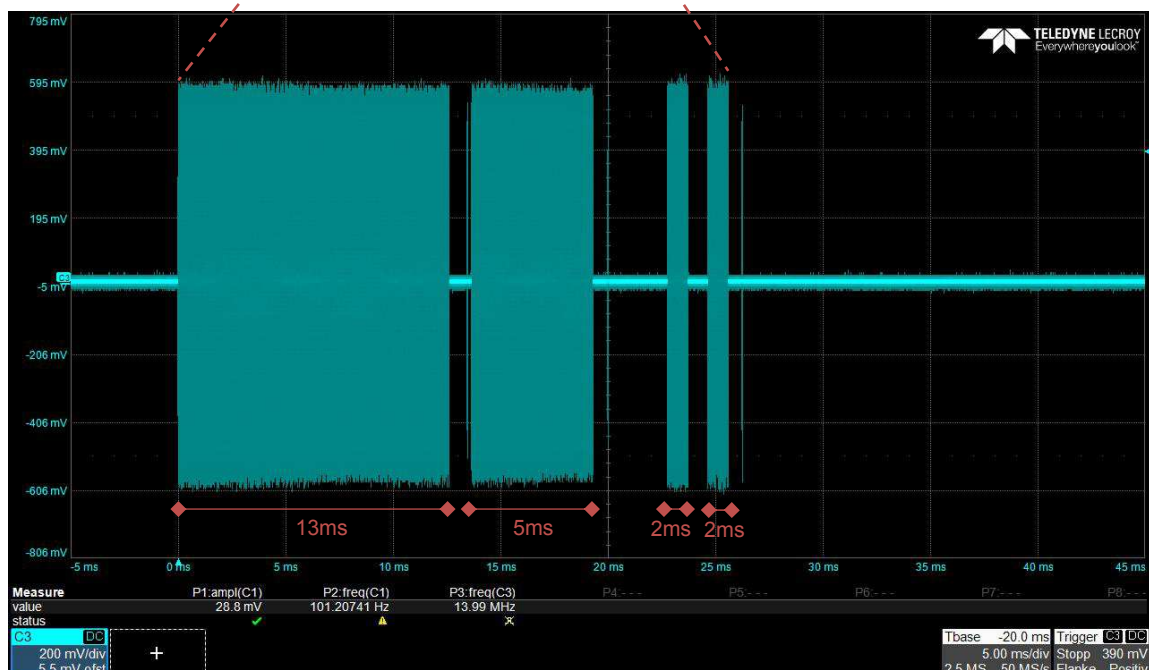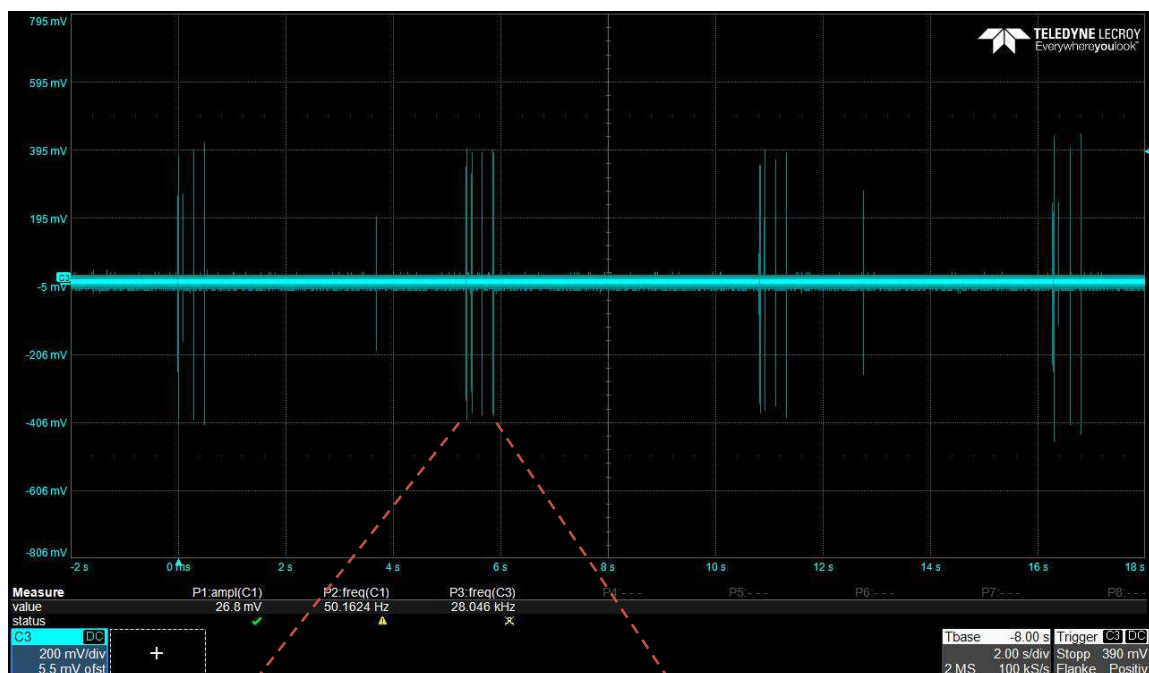
The duty cycle is calculated as the following:

	Calculation	Result
Transmit summary duration (of one block)	s. figure above	22ms (13ms + 5 ms + 2 ms + 2 ms)
Blocks per minute (every five seconds)	60s / 5s	12
Transmit summary duration (in one minute)	12 x 22ms	264ms
Duty Cycle	100% / 60000ms x 264ms	**0,44%**

As there are also some Wi-Fi protocol packages we are calculating with a Duty Cycle of **1%**