SCHEIDT&BACHMANN SB

SV51 SAR-Calculation

Human-exposure aspects for the S&B Stationary-
Validator.

Table of contend

Revisions

Version:	By:	Date:	Department:	Reason:
00.01.00	Nils Hündgen	09.01.2017	GSHW	Creation
00.01.01	Nils Hündgen	11.01.2017	GSHW	Added RFID
00.01.02	Nils Hündgen	28.04.2017	GSHW	Updated according to testresults
00.01.03	Nils Hündgen	10.05.2017	GSHW	Update after review
01.00.00	Nils Hündgen	12.05.2017	GSHW	Signed Version
01.00.01	Nils Hündgen	28.11.2017	GSHW	Added HVIN

1 Product

PMN (Product Marketing Name): FareGo Val SV|51

FCC ID: O5K-NVP

IC ID: 8312A-NVP

HVIN: SV51

2 Wifi

2.1 RF Exposure Requirements

Friis Formula

Friis transmission formula:

$$P_d = \frac{P_{out} \cdot G}{4 \cdot \pi \cdot R^2}$$

Where

$P_d = $ power density in mW/cm^2

$P_{out} = $ output power to antenna in mW

$G = $ gain of antenna in linear scale

$R = $ distance between observation point and center of the radiator in cm

2.2 Limits

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in 1.1307(b)

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Filed Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm2)	Average Time (Minutes)
(A)Limits for Occupation/Control Exposures				
300-1500	--	--	F/300	6
1500-100,000	--	--	5	6
(B)Limits for General Occupation/UnControlled Exposures				
300-1500	--	--	F/1500	6
1500-100,000	--	--	1	30

F= Frequency in MHz

Table 1

Therefore all relevant frequencies are in the range of 1.5GHz – 100GHz the reference level for all further calculations will be:

$$1 \, {}^{mW}/_{cm^2}$$

2.3   Calculation and conclusion

This device is evaluated by mobile device with general population/uncontrolled exposure condition

For this device, the calculation is using the most conservative values, and the results are as follows:

2.3.1 Radio Equipment

The radio equipment for Wifi is an uBlox ELLA-W-163 module.

The maximum output power (tune-up value) related to each mode has been named by the manufacturing company of the module.

2.3.2 Integration of module

The radio equipment module is soldered on a CPU-module of the company Keith & Koep GmbH.

The integration of the module causes an insertion-loss in the antenna-path which has been named by the manufacturing company of the module.

2.3.3 Antenna

The Antenna is an embedded PCB antenna of the company Round Solutions GmbH & Co KG.

The Gain (related to the used frequency) is named in the Datasheet. An extract of the datasheet is shown in:

Table 2 extract from the Wifi antenna datasheet

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WLAN a/b/g/n + Japan Antenna (GHz)	2.390-2.490 b, g	4.900-5.100 Japan	5.150-5.350 a	5.70-5.900 a
Peak Gain	1.5-2.5 dBi	3.0-5.0 dBi	3.0-5.0 dBi	3.0-5.0 dBi
Efficiency	65%	65%	65%	50%
VSWR Match	<2.0:1	<2.5:1	<2.0:1	<2.5:1
Feed Point Impedance	50 Ω			

Table 2 extract from the Wifi antenna datasheet

2.3.4 Calculations

Band	Freq. [MHz]	CH	Conducted Output Power	Tune-Up Limit (dBm)	Loss (Trizeps) (dBi)	Gain (max) (dBi)	EIRP (max) (dBm)	EIRP (max) (W)	r(m)	P_d (max) (mW/cm^2)
802.11 b	2412	1	18	19	0,5	2,5	21	0,1259	0,2	0,0250
(2 MBit/s)	2437	6	18	19	0,5	2,5	21	0,1259	0,2	0,0250
	2462	11	18	19	0,5	2,5	21	0,1259	0,2	0,0250
802.11 n	2412	1	15	16	0,5	2,5	18	0,0631	0,2	0,0126
HT40, MCS8	2437	6	15	16	0,5	2,5	18	0,0631	0,2	0,0126
	2462	11	15	16	0,5	2,5	18	0,0631	0,2	0,0126
802.11 a	5180-5320	36 - 64	15	16	2	5	19	0,0794	0,2	0,0158
	5500-5700	100-140	15	16	2	5	19	0,0794	0,2	0,0158
	5745-5825	149-165	15	16	2	5	19	0,0794	0,2	0,0158
802.11 n	5190-5310	36 - 60	15	16	2	5	19	0,0794	0,2	0,0158
HT40, MCS8	5510-5670	100-132	15	16	2	5	19	0,0794	0,2	0,0158
	5755-5795	149-157	15	16	2	5	19	0,0794	0,2	0,0158

Table 3: Calculations of RF Exposure

According to the table above, we can conclude the maximum calculated RF Exposure at observation point with a distance of $0.2m$ is $0.025 \, mW/cm^2$, which is below the required reference level of $1 \, mW/cm^2$, so it is into compliance.

2.3.5 Results

Frequency [MHz]	Maximum RF Exposure [mW/cm^2]	Limit of RF Exposure [mW/cm^2]	Verdict
2412 - 5795	0.025	1	PASS

Table 4

3 RFID

3.1 RF Exposure Calculations

Analysis of RF Exposure for Portable and Mobile use per KDB 447498 D01 Mobile Portable RF Exposure v06 and RSS-102 Issue 5 March 2015

Portable exposure SAR Exemption Calculation using a separation distance of 5 mm:

As per Clause 4.3.1.1 of KDB 447498 D01 v06:

$$\frac{max.\,power\,of\,channel, including\,tune-up\,tolerance, mW}{min.\,test\,separation\,distance, mm} \cdot \sqrt{f\,(GHz)} \leq 3.0$$

$$\left(\frac{1.19\mu W}{5\,mm}\right) \cdot \left(\sqrt{0.01356(GHz)}\right) = 0.0277 \leq 3.0$$

The above calculation is based on time-averaged maximum radiated output power of 1.19µW which was calculated from the maximum measured field strength of 1.585µA/m @ 10 meters.

3.1.1 Results

Frequency [MHz]	Maximum RF Exposure	Limit of RF Exposure	Verdict
13.56	0.0277	3	PASS

Table 5

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