RF Exposure Lab

CERTIFICATE OF COMPLIANCE
SAR EVALUATION

u-blox AG	Dates of Test:	March 6, 2023
Zuercherstrasse 68	Test Report Number:	SAR.20230305
Thalwil, Ch-8800		Revision B
Switzerland	Lab Designation Number: US1195(FCC)	

FCC ID:	XPYUBX19KM01
Model(s):	Wearable Panic Button
Contains WWAN Module:	u-blox Model: SARA-R510M8S; FCC ID: XPYUBX19KM01; IC: 8595A-UBX19KM01
Contains WiFi Module:	Espressif Model: ESP32-PICO D4; FCC ID: 2AC7Z-ESP868507; IC: 21098-ESPPICOMINI
Contains BLE Module:	Fanstel Model: BM833; FCC ID: X8WBM833; IC: 4100A-BM833F
Equipment Type:	Wireless Panic Button
Classification:	Portable Transmitter Next to Body
TX Frequency Range:	698 – 716 MHz; 1710 – 1780 MHz; 1850 – 1915 MHz; 2402 – 2480 MHz; 2412 – 2462 MHz
Frequency Tolerance:	± 2.5 ppm
Maximum RF Output:	700 MHz – 23.0 dBm, 1750 MHz – 23.0 dBm, 1900 MHz – 23.0 dBm, 2450 MHz (WiFi) – 20.5 dBm, 2450 MHz (BLE) – 9.0 dBm Conducted
Signal Modulation:	QPSK, 16QAM, 8PSK, GMSK, DSSS, OFDM
Antenna Type:	Cellular: Ignion Model NN03-310; WiFi: Molex Model 2119640001; BLE: PCB Trace on Module
Application Type:	Certification
Standard(s):	47CFR1.1310, 47CFR2.1093, KDB447498 D01 v06, KDB248227 D01 v02r02, KDB941225 D05 v02r05, RSS-102 Issue 5, Safety Code 6
Separation Distance:	0 mm

This wireless portable device has been shown to be excluded for RF exposure requirements for uncontrolled environment/general exposure limits specified in above listed standards for standalone SAR. The device has also been shown to meet the simultaneous requirements of each standard as well (See test report).

I attest to the accuracy of the data. I assume full responsibility for the completeness of these calculations and vouch for the qualifications of all persons making them.

Jay M. Moulton
Vice President

ACCREDITED
Certificate # 2387.01

Table of Contents

Comment/Revision	Date
Original Release	April 14, 2023
Revision A – Remove Bands 5, 8, 13, 25, 26, 66, 71 & 85	May 3, 2023
Revision B – Correct FCC ID for Fanstel module	May 3, 2023

Note: The latest version supersedes all previous versions listed in the above table. The latest version shall be used.

1. Introduction

This report shows exclusion calculations of the u-blox AG Model Wearable Panic Button Wireless Panic Button with 47CFR1.1310, 47CFR2.1093, KDB447498 D01 v06, KDB248227 D02 v02r02 and KDB941225 D05 v02r05.

The device contains three modules. One cellular module, one WiFi/BT module and one BLE Module.

2.   Radiation Sources

Module	Band	Technology	Class	3GPP Nominal Power dBm	Setpoint Nominal Power dBm	Tolerance dBm	Lower Tolerance dBm	Upper Tolerance dBm
uBlox SARA-R510M8S	Band 2	Cat M1/NB2	3	N/A	N/A	N/A	N/A	23.0
	Band 4	Cat M1/NB2	3	N/A	N/A	N/A	N/A	23.0
	Band 12	Cat M1/NB2	3	N/A	N/A	N/A	N/A	23.0
Espressif ESP32-PICO D4	2.4 GHz	802.11b	N/A	N/A	20.0	± 0.5	19.5	20.5
	2.4 GHz	802.11g	N/A	N/A	16.0	± 1.0	15.0	17.0
	2.4 GHz	802.11n	N/A	N/A	14.0	± 1.0	13.0	15.0
	2.4 GHz	BLE	N/A	N/A	N/A	N/A	N/A	Disabled
Fanstel BM833	2.4 GHz	BLE	N/A	N/A	N/A	N/A	N/A	9.0

Note: All additional cellular bands in the uBlox radio are disabled with firmware.

3. Photos
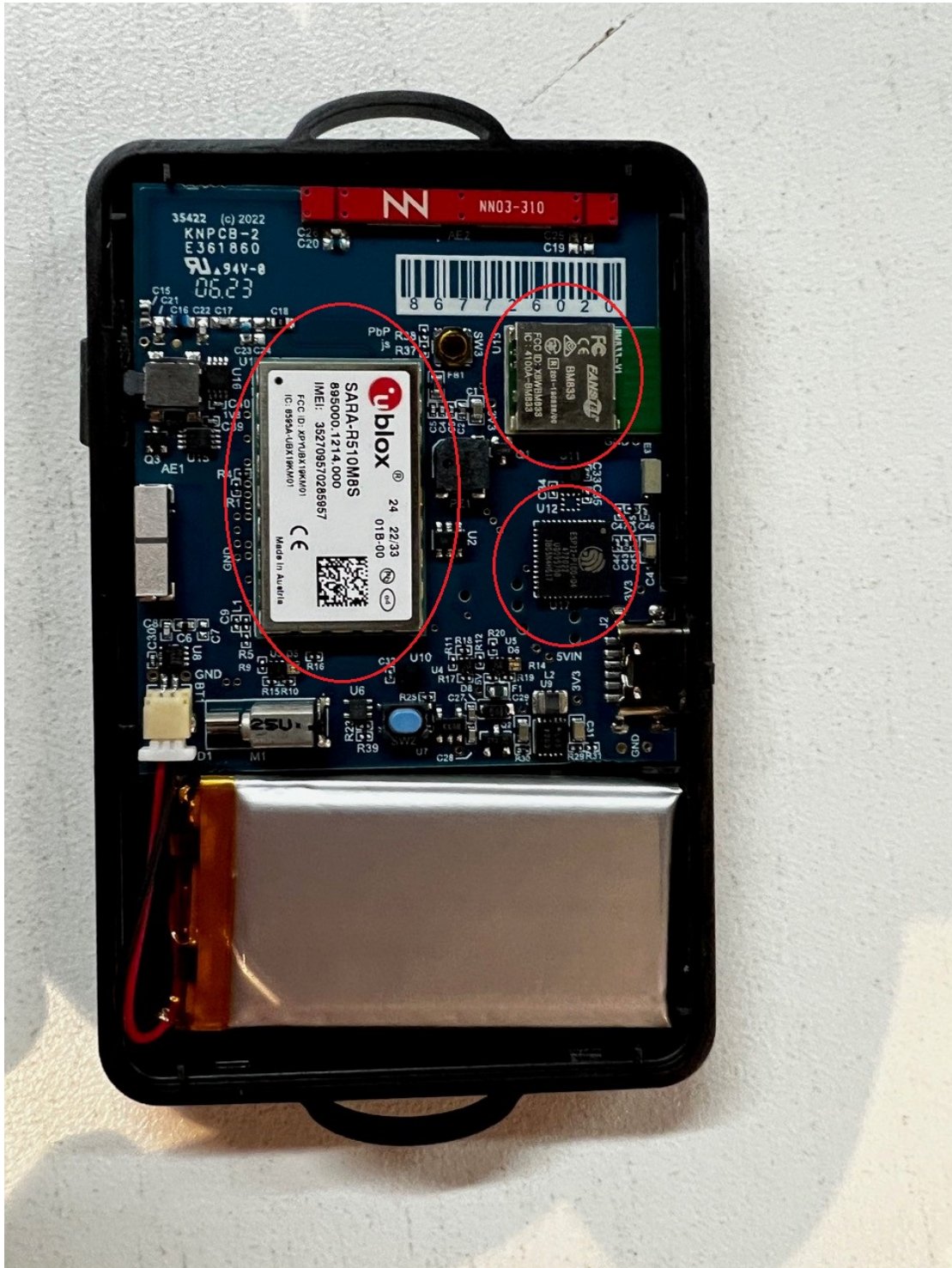
Internal Photo of Radio Modules

External Photo of Device

4. RF Exposure Classifications

Device Types	
Fixed	A fixed device is defined as a device physically secured at one fixed location and cannot be easily re-located.
Mobile	A mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons. (47 CFR 2.1091)
Portable	A portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user. (47 CFR 2.1093)

Exposure Categories	
Occupational / Controlled	Limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.
General population / uncontrolled	Exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

5. RF Exposure Limits Standalone And Simultaneous SAR

FCC Requirements

The FCC SAR test exclusion for standalone SAR is determined for each operating configuration and exposure condition the device can operate.

$$P_{th}(mW) = \begin{cases} ERP_{20cm}(d/20\ cm)^x & 0.5\ cm \leq d \leq 20\ cm \\ ERP_{20cm} & 20\ cm < d \leq 40\ cm \end{cases}$$

$$x = -\log_{10}\left(\frac{60}{ERP_{20cm}\sqrt{f}}\right)$$

$$ERP_{20cm}(mW) = \begin{cases} 2040f & 0.3\ GHz \leq f \leq 1.5\ GHz \\ 3060 & 1.5\ GHz < f \leq 6.0\ GHz \end{cases}$$

$$d = \text{separation distance (cm)}$$

For simultaneous evaluation, the sum of the individual SAR values of each of the transmitters must be less than the limit to comply. If the transmitter is excluded from SAR testing, the SAR value is estimated based on the formula below.

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] * [$\sqrt{f_{(GHz)}}$/x] W/kg, for test separation distances ≤ 50 mm;
    Where x = 7.5 for 1-g SAR

6.   Cellular Modem Specifications

The upper end of the tolerance for the u-blox modem (SARA-510M8S) is 23 dBm for LTE bands. Therefore, the upper end of the conducted tolerance is 23 dBm (199.5 mW). The antenna gain for each band is a positive gain. The table below shows the gain for each band.

Modem	Band	Technology	Gain	Radiated
u-Blox SARA-510M8S	2	Cat M1/NB2	2.7 dBi	25.7 dBi
	4	Cat M1/NB2	2.7 dBi	25.7 dBi
	12	Cat M1/NB2	1.5 dBi	24.5 dBi

Therefore, the radiated power level is used to calculate the exclusion.

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7. WiFi/BT Modem Specifications

The upper end of the tolerance for the Espressif modem (ESP32-PICO D4) is 20.5 dBm maximum for the WiFi bands. Therefore, the upper end of the conducted tolerance is 20.5 dBm (112.2 mW). The upper end of the tolerance for the Fanstel modem (BM833) is 9 dBm for BLE bands. Therefore, the upper end of the conducted tolerance is 9 dBm (7.9 mW). The antenna gain for each band is a positive gain. The table below shows the gain for each band.

Modem	Band	Technology	Gain	Radiated
Espressif ESP32-PICO D4	2.4 GHz	b	2.7 dBi	23.2 dBi
		g	2.7 dBi	19.7 dBi
		n	2.7 dBi	17.7 dBi
		BLE	Disabled	
Fanstel BM833	2.4 GHz	BLE	0 dBi	9.0 dBi

Therefore, the radiated power level is used to calculate the exclusion.

8.   Duty Cycle Evaluation for WWAN

The WWAN transmitter has a duty cycle of 0.052%. The device has a maximum transmit period of 10.3 ms in a minimum 20 second period. The maximum allowable period is 100 seconds. Therefore, the evaluation in this report is based on a 10.3 ms transmit period for a 20 second interval yielding the 0.052% duty cycle. Therefore, the maximum source based time averaged power for the WWAN high frequency bands is 371.5 mW * 0.00052 = 0.19 mW. The maximum source based time averaged power for the WWAN low frequency bands is 281.8 mW * 0.00052 = 0.15 mW.

9.   Duty Cycle Evaluation for WiFi

The WiFi transmitter has a duty cycle of 0.062%. The device has a maximum transmit period of 12.3 ms in a minimum 20 second period. The maximum allowable period is 100 seconds. Therefore, the evaluation in this report is based on a 12.3 ms transmit period for a 20 second interval yielding the 0.062% duty cycle. Therefore, the maximum source based time averaged power for the WiFi bands is 208.9 mW * 0.00062 = 0.13 mW.

10.   Duty Cycle Evaluation for BT Transmitters

The BT transmitters have a duty cycle of 1.2%. The device has a maximum transmit period of 1.2 ms in a minimum 100 ms period. The maximum allowable period is 100 seconds. Therefore, the evaluation in this report is based on a 1.2 ms transmit period for a 100 ms interval yielding the 1.2% duty cycle. Therefore, the maximum source based time averaged power for the BT bands is 7.9 mW * 0.012 = 0.10 mW.

11. Standalone SAR Exclusion Assessment

FCC Requirements

Based on the formula in section 5, the exclusion calculation for each of the transmitters is listed below.

u-Blox Model SARA-R510M8S
Band 2 = 4.77 dBm = 3 mW
Band 4 = 6.02 dBm = 4 mW
Band 12 = 10.41 dBm = 11 mW

Espressif Model ESP32-PICO D4
2.4 GHz Band = 4.77 dBm = 3 mW

Fanstel Model BM833
2.4 GHz Band = 4.77 dBm = 3 mW

The maximum transmit power for each of the bands is listed below which includes the transmit duty cycle calculated on page 12.

u-Blox Model SARA-R510M8S Maximum Power with Duty Cycle
Band 2 = 25.7 dBm = 371.5 mW * 0.00052 = 0.19 mW
Band 4 = 25.7 dBm = 371.5 mW * 0.00052 = 0.19 mW
Band 12 = 24.5 dBm = 281.8 mW * 0.00052 = 0.15 mW

Espressif Model ESP32-PICO D4 Maximum Power with Duty Cycle
2.4 GHz Band = 23.2 dBm = 208.9 mW * 0.00062 = 0.13 mW

Fanstel Model BM833 Maximum Power with Duty Cycle
2.4 GHz Band = 9.0 dBm = 7.9 mW * 0.012 = 0.10 mW

Therefore, all transmitters are excluded from standalone SAR evaluations.

12.   Simultaneous SAR Assessment

FCC Requirements

This device does not allow any simultaneous transmission. Therefore, no evaluation was conducted on the device.