Maximum Permissible Exposure Report

Product	:	802.11ac/a/b/g/n 2T2R Wi-Fi + Bluetooth 5.0 USB Module
Model Name	:	WUBT-239ACN(BT) [MU]
Series Model	:	WUBT-239ACN(BT) [M4W], WUBT-239ACN(BT) [PU], WUBT-239ACN(BT) [P4W]
FCC ID	:	RYK-WUBT239ACNBT
Test Regulation	:	47 CFR FCC Part 2.1091
Received Date	:	2021/8/5
Test Date	:	2021/8/9 ~ 2021/10/22
Issued Date	:	2021/11/18
Applicant	:	SparkLAN Communications, Inc. 8F., No.257, Sec. 2, Tiding Blvd., Neihu District, Taipei City 11493, Taiwan (R.O.C.)
Issued By	:	Underwriters Laboratories Taiwan Co., Ltd. Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Testing Laboratory
3398

REVISION HISTORY

Original Test Report No.: 4790038917A-US-R5-V0

Rev.	Test report No.	Date	Page revised	Contents
Original	4790038917A-US-R5-V0	2021/11/18	-	Initial issue

Table of Contents

1. Attestation of Test Results

APPLICANT:	SparkLAN Communications, Inc. 8F., No.257, Sec. 2, Tiding Blvd., Neihu District, Taipei City 11493, Taiwan (R.O.C.)
MANUFACTURER:	SparkLAN Communications, Inc. 8F., No.257, Sec. 2, Tiding Blvd., Neihu District, Taipei City 11493, Taiwan (R.O.C.)
EUT DESCRIPTION:	802.11ac/a/b/g/n 2T2R Wi-Fi + Bluetooth 5.0 USB Module
BRAND:	SparkLAN
MODEL:	WUBT-239ACN(BT) [MU]
SERIES MODEL:	WUBT-239ACN(BT) [M4W], WUBT-239ACN(BT) [PU], WUBT-239ACN(BT) [P4W]
SAMPLE STAGE:	Engineering Verification Test sample

APPLICABLE STANDARDS	
STANDARD	**Test Results**
47 CFR FCC PART 2.1091	PASS

Underwriters Laboratories Taiwan Co., Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by Underwriters Laboratories Taiwan Co., Ltd. based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Underwriters Laboratories Taiwan Co., Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Underwriters Laboratories Taiwan Co., Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Prepared By:

Sally Lu Date : 2021/11/18
Project Handler

Approved and Authorized By:

Waternil Guan Date : 2021/11/18
Engineer

2. Test Methodology and Reference Procedures

The tests documented in this report were performed in accordance with KDB 447498 D01 General RF Exposure Guidance v06.

3. Facilities and Accreditation

Test Location	Underwriters Laboratories Taiwan Co., Ltd.
Address	Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan
Accreditation Certificate	Underwriters Laboratories Taiwan Co., Ltd. is accredited by TAF, Laboratory Code 3398.

4. Equipment Under Test

4.1. Description of EUT

Product Name	802.11ac/a/b/g/n 2T2R Wi-Fi + Bluetooth 5.0 USB Module	
Brand Name	SparkLAN	
Model Name	WUBT-239ACN(BT) [MU]	
Series Model	WUBT-239ACN(BT) [M4W], WUBT-239ACN(BT) [PU], WUBT-239ACN(BT) [P4W]	
Operating Frequency	Bluetooth EDR	2402MHz ~ 2480MHz
	Bluetooth LE	2402MHz ~ 2480MHz
	WLAN	**2.4GHz:** 2412MHz ~ 2462MHz **5GHz:** 5180 ~ 5240 MHz, 5260 ~ 5320 MHz, 5500 ~ 5720 MHz, 5745 ~ 5825 MHz
Modulation	Bluetooth EDR	GFSK, π/4-DQPSK, 8DPSK
	Bluetooth LE	GFSK
	WLAN	CCK, DQPSK, DBPSK for DSSS 256QAM, 64QAM, 16QAM, QPSK, BPSK for OFDM
Number of Channel	Bluetooth EDR	79
	Bluetooth LE	40

Number of Channel	2.4G WLAN 2412 ~ 2462 MHz	11 for 802.11b, 802.11g, 802.11n (HT20) 7 for 802.11n (HT40)
	5G WLAN 5180 ~ 5240 MHz	4 for 802.11a, 802.11n (HT20), 802.11ac (VHT20)
		2 for 802.11n (HT40), 802.11ac (VHT40)
		1 for 802.11ac (VHT80)
	5G WLAN 5260 ~ 5320 MHz	4 for 802.11a, 802.11n (HT20), 802.11ac (VHT20)
		2 for 802.11n (HT40), 802.11ac (VHT40)
		1 for 802.11ac (VHT80)
	5G WLAN 5500 ~ 5720 MHz	12 for 802.11a, 802.11n (HT20), 802.11ac (VHT20)
		6 for 802.11n (HT40), 802.11ac (VHT40)
		3 for 802.11ac (VHT80)
	5G WLAN 5745 ~ 5825 MHz	5 for 802.11a, 802.11n (HT20), 802.11ac (VHT20)
		2 for 802.11n (HT40), 802.11ac (VHT40)
		1 for 802.11ac (VHT80)
Normal Voltage	5Vdc	
Sample ID	Conducted Test: 4197850 Radiated Test: 4197853	

Note:

1. The models difference table as below:

Brand	Model	Difference
SparkLAN	WUBT-239ACN(BT) [MU]	1. External antenna
	WUBT-239ACN(BT) [M4W]	1. External antenna 2. USB Connector is 4-Pin Wafer
	WUBT-239ACN(BT) [PU]	1. PCB Antenna
	WUBT-239ACN(BT) [P4W]	1. PCB Antenna 2. USB Connector is 4-Pin Wafer

Except above change, there are no change to technical construction that is included circuit diagram, PCB Layout, components and component layout, all electrical construction and mechanical construction.

2. The EUT provides two completed transmitters and two receivers.

Modulation Mode	Tx,Rx Function
802.11a	2TX,2RX
802.11b	2TX,2RX
802.11g	2TX,2RX
802.11n (HT20)	2TX,2RX
802.11n (HT40)	2TX,2RX
802.11ac (VHT20)	2TX,2RX
802.11ac (VHT40)	2TX,2RX
802.11ac (VHT80)	2TX,2RX

3. The EUT contains following accessory devices:

Product	Brand	Model	Description
Dipole Antenna 1	SparkLAN	AD-301N	-
Dipole Antenna 2	SparkLAN	AD-103AG	-
Dipole Antenna 3	SparkLAN	AD-305N	-
Dipole Antenna 4	SparkLAN	AD-303N	-
Dipole Antenna 5	SparkLAN	AD-302N	-
Dipole Antenna 6	SparkLAN	AD-315N	-

4. The above EUT information is declared by manufacturer and for more detailed features description, please refer the manufacturer's or user's manual.

4.2. Description of Available Antennas

Ant. No.	Transmitter Circuit	Brand Name	Model Name	Ant. Type	Maximum Gain (dBi)	Remark
1	Chain (0)+(1)	SparkLAN	AD-301N	Dipole	2.4GHz: 4.4 5GHz: 5.8	Ipex
2	Chain (0)+(1)	SparkLAN	AD-103AG	Dipole	2.4GHz: 2.02 5GHz: 2.03	Ipex
3	Chain (0)+(1)	SparkLAN	AD-305N	Dipole	2.4GHz: 5 5GHz: 5.53	Ipex
4	Chain (0)+(1)	SparkLAN	AD-303N	Dipole	2.4GHz: 3.14 5GHz: 3.45	Ipex
5	Chain (0)+(1)	SparkLAN	AD-302N	Dipole	2.4GHz: 3.14 5GHz: 2.87	Ipex
6	Chain (0)	SparkLAN	N/A	PCB	2.4GHz: 0.7 5GHz: 4.24	Ant L
	Chain (1)	SparkLAN	N/A	PCB	2.4GHz: 0.25 5GHz: 3.83	Ant R
7	Chain (0)+(1)	SparkLAN	AD-315N	Dipole	2.4GHz: 3 5GHz: 5	MHF

Note: The above antenna information was provided from customer and for more detailed features description, please refer the manufacturer's specification or user's manual.

5. Requirement

Limits for General Population/Uncontrolled Exposure

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (E) (V/m)**	**Magnetic Field Strength (H) (A/m)**	**Power Density (S) (mW/cm^2)**	**Averaging Time |E|2, |H|2 or S (minutes)**
0.3-1.34	614	1.63	*100	30
1.34-30	824/f	2.19/f	$*180/f^2$	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100,000	--	--	1.0	30
Note 1: f = frequency in MHz, * means Plane-wave equivalent power density				
Note 2: 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.				

Power Density (S) is calculated by the following formula:

$S=(P*G)/4\pi R^2$

where: S = power density (in appropriate units, e.g. mW/cm^2)
P = power input to the antenna (in appropriate units, e.g., mW)
G = power gain of the antenna in the direction of interest relative to an isotropic radiator R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

6. Radio Frequency Radiation Exposure Evaluation

Bluetooth EDR

Evaluation Frequency	Max. Average power	Antenna Gain	Max. EIRP	Max. EIRP	Power density @ 20 cm	Limit
(MHz)	(dBm)	(dBi)	(dBm)	(mW)	(mW/cm^2)	(mW/cm^2)
2402 ~ 2480	10.24	5.00	15.24	33.420	0.00665	1

Bluetooth LE

Evaluation Frequency	Max. Average power	Antenna Gain	Max. EIRP	Max. EIRP	Power density @ 20 cm	Limit
(MHz)	(dBm)	(dBi)	(dBm)	(mW)	(mW/cm^2)	(mW/cm^2)
2402 ~ 2480	5.67	5.00	10.67	11.668	0.00232	1

WLAN 2.4GHz

Evaluation Frequency	Max. Average power	Directional Gain	Max. EIRP	Max. EIRP	Power density @ 20 cm	Limit
(MHz)	(dBm)	(dBi)	(dBm)	(mW)	(mW/cm^2)	(mW/cm^2)
2412 ~ 2462	21.35	8.01	29.36	862.979	0.17169	1

WLAN 5GHz

Evaluation Frequency	Max. Average power	Directional Gain	Max. EIRP	Max. EIRP	Power density @ 20 cm	Limit
(MHz)	(dBm)	(dBi)	(dBm)	(mW)	(mW/cm^2)	(mW/cm^2)
5180 ~ 5240	16.85	8.81	25.66	368.129	0.07324	1
5260 ~ 5320	17.84	8.81	26.65	462.381	0.09199	1
5500 ~ 5700	17.60	8.81	26.41	437.522	0.08704	1
5745 ~ 5825	17.05	8.81	25.86	385.478	0.07669	1

Note:
1. Max. EIRP (dBm) = Max. Average power (dBm) + Antenna Gain (dBi)
2. Max. EIRP (mW) = $10^{(\text{Max. EIRP (dBm)} / 10)}$
3. Power density (mW/cm^2) = Max. EIRP (mW) / [$4 \times \pi \times$ (calculated distance)^2], the calculated distance is 20 cm.

Conclusion:

The Bluetooth and WLAN 2.4GHz can transmit simultaneously, the formula of calculated the MPE is:
CPD1 / LPD1 + CPD2 / LPD2 + ……etc. < 1
CPD = Calculation power density
LPD = Limit of power density

Situation is (0.00665 / 1) + (0.17168 / 1) = 0.17833

The Bluetooth and WLAN 5GHz can transmit simultaneously, the formula of calculated the MPE is:
CPD1 / LPD1 + CPD2 / LPD2 + ……etc. < 1
CPD = Calculation power density
LPD = Limit of power density

Situation is (0.00665 / 1) + (0.09199 / 1) = 0.09864

Therefore the maximum calculations of above situations are less than the "1" limit.

According to 47 CFR §2.1091, the RF exposure analysis concludes that the RF Exposure is FCC compliant.

END OF REPORT