

RF Exposure Evaluation declaration

Product Name : KNOT
Trade Name : MikroTik
Model No. : RB924i-2nD-BT5&BG77
FCC ID : TV7924BT5BG77
IC : 7442A-924BT5BG77

Applicant : Mikrotiks SIA

Address : Brivibas gatve 214i, Riga, LV-1039, Latvia

Date of Receipt : Dec. 28, 2020

Date of Declaration : Jun. 01, 2021

Report No. : 20C1010R-E3082100013

Report Version : V1.0



The declaration results relate only to the samples calculated.

The declaration shall not be reproduced except in full without the written approval of DEKRA Testing and Certification Co., Ltd..

RF Exposure Evaluation Declaration

Issued Date : Jun. 01, 2021

Report No. : 20C1010R-E3082100013



Product Name : KNOT
Applicant : Mikrotikls SIA
Address : Brivibas gatve 214i, Riga, LV-1039, Latvia
Manufacturer : Mikrotikls SIA
Address : Brivibas gatve 214i, Riga, LV-1039, Latvia
Trade Name : MikroTik
Model No. : RB924i-2nD-BT5&BG77
FCC ID : TV7924BT5BG77
IC : 7442A-924BT5BG77
EUT Voltage : AC 100-240V, 50/60Hz
Testing Voltage : AC 120V/60Hz
Applicable Standard : FCC 47 CFR Part 2.1091 Radiofrequency radiation exposure evaluation: mobile devices.
ISED RSS-102 Issue 5 (2015-03) – Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
Test Lab : Hsin Chu Laboratory
Address : No.372-2, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County 310, Taiwan, R.O.C.
TEL: +886-3-582-8001 / FAX: +886-3-582-8958
Test Result : Complied

Tested By

:



(Ling Chen / Engineer)

Approved By

:



(Louis Hsu / Deputy Manager)

Revision History

Version	Description	Issued Date
V1.0	Initial issue of report	Jun. 01, 2021

1. General Information

1.1. Test Facility

Ambient conditions in the laboratory:

Items	Test Item	Required	Test Site
Temperature (°C)	Peak Output Power	15 - 35	1
Humidity (%RH)		25 - 75	

Note: Test site information refers to Laboratory Information.

Laboratory Information

USA : FCC Registration Number: TW3024
Canada : IC Registration Number: 22397-1 / 22397-2 / 22397-3

The address and introduction of DEKRA Testing and Certification Co., Ltd. laboratories can be founded in our Web site: <http://www.dekra.com.tw>

If you have any comments, please don't hesitate to contact us. Our test sites as below:

Test Laboratory	DEKRA Testing and Certification Co., Ltd.
Address	1. No.372, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County 31061, Taiwan, R.O.C. 2. No.372-2, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County 31061, Taiwan, R.O.C.
Phone number	1. +886-3-582-8001 2. +886-3-582-8001
Fax number	1. +886-3-582-8958 2. +886-3-582-8958
Email address	info.tw@dekra.com
Website	http://www.dekra.com.tw

1.2. List of Test Equipment

Peak Power Output / SR12-H

Instrument	Manufacturer	Model No.	Serial No.	Cal. Date	Next Cal. Date
High Speed Peak Power Meter Dual Input	Anritsu	ML2496A	1602004	2020/11/30	2021/11/29
Pulse Power Sensor	Anritsu	MA2411B	1531043	2020/11/30	2021/11/29
Pulse Power Sensor	Anritsu	MA2411B	1531044	2020/11/30	2021/11/29
Power Meter	Keysight	8990B	MY51000248	2020/05/20	2021/05/19
Power Sensor	Keysight	N1923A	MY57240005	2020/05/20	2021/05/19

Note: All equipment upon which need to calibrated are with calibration period of 1 year.

1.3. Uncertainty

Test item	Uncertainty
Peak Power Output	± 2.26 dB

Note: Determining compliance shall be based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

2. RF Exposure Evaluation

2.1. 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 Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Average Time (Minutes)
(A) Limits for Occupational/ Control Exposures				
300-1500	--	--	F/300	6
1500-100,000	--	--	5	6
(B) Limits for General Population/ Uncontrolled Exposures				
300-1500	--	--	F/1500	6
1500-100,000	--	--	1	30

Note: f is frequency in MHz.

RF Field Strength Limits for Controlled Use Devices (Controlled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-1023	170	180	-	Instantaneous*
0.1-10	-	$1.6/f$	-	6**
1.29-10	$193/f^{0.5}$	-	-	6**
10-20	61.4	0.163	10	6
20-48	$129.8/f^{0.25}$	$0.3444/f^{0.25}$	$44.72/f^{0.5}$	6
48-100	49.33	0.1309	6.455	6
100-6000	$15.60 f^{0.25}$	$0.04138 f^{0.25}$	$0.6455 f^{0.5}$	6
6000-15000	137	0.364	50	6
15000-150000	137	0.364	50	$616000/f^{1.2}$
150000-300000	$0.354 f^{0.5}$	$9.40 \times 10^{-4} f^{0.5}$	$3.33 \times 10^{-4} f$	$616000/f^{1.2}$

Note: f is frequency in MHz.

*Based on nerve stimulation (NS). ** Based on specific absorption rate (SAR).

Friis Formula

Friis transmission formula: $P_d = (P_{out} \cdot G) / (4 \cdot \pi \cdot r^2)$

Where

P_d = power density in mW/cm^2

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

$\pi = 3.1416$

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

P_d is the limit of MPE, $1 \text{ mW}/\text{cm}^2$. If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance r where the MPE limit is reached.

According to IC RSS-102 Issue 5: For the purpose of this standard, Industry Canada has adopted the SAR and RF field strength limits established in Health Canada's RF exposure guideline.

RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-1021	83	90	-	Instantaneous*
0.1-10	-	$0.73/f$	-	6**
1.1-10	$87/f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	$58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142 f^{0.3417}$	$0.008335 f^{0.3417}$	$0.02619 f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ $f^{1.2}$
150000-300000	$0.158 f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	616000/ $f^{1.2}$
Note: f is frequency in MHz. *Based on nerve stimulation (NS). ** Based on specific absorption rate (SAR).				

RF Field Strength Limits for Controlled Use Devices (Controlled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-1023	170	180	-	Instantaneous*
0.1-10	-	$1.6/f$	-	6**
1.29-10	$193/f^{0.5}$	-	-	6**
10-20	61.4	0.163	10	6
20-48	$129.8/f^{0.25}$	$0.3444/f^{0.25}$	$44.72/f^{0.5}$	6
48-100	49.33	0.1309	6.455	6
100-6000	$15.60 f^{0.25}$	$0.04138 f^{0.25}$	$0.6455 f^{0.5}$	6
6000-15000	137	0.364	50	6
15000-150000	137	0.364	50	616000/ $f^{1.2}$
150000-300000	$0.354 f^{0.5}$	$9.40 \times 10^{-4} f^{0.5}$	$3.33 \times 10^{-4} f$	616000/ $f^{1.2}$
Note: f is frequency in MHz. *Based on nerve stimulation (NS). ** Based on specific absorption rate (SAR).				

Friis Formula

Friis transmission formula: $P_d = (P_{out} * G) / (4 * \pi * r^2)$

Where

P_d = power density in W/m^2

P_{out} = output power to antenna in W

G = gain of antenna in linear scale

π = 3.1416

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

P_d is the limit of MPE $0.02619 f^{0.6834} W/m^2$. If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance r where the MPE limit is reached.

2.2. Test Procedure

Software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.

2.3. Test Result of RF Exposure Evaluation

Product	KNOT		
Test Mode	Transmit		
Test Condition	RF Exposure Evaluation		
Date of Test	2021/01/30	Test Site	SR12-H
Temperature(°C)	22.0°C	Test Humidity	66.0%

Antenna Gain: The maximum antenna gain is 1.5dBi.

Output Power into Antenna & RF Exposure Evaluation Distance:

WLAN Function 2.4GHz Band								
Mode	Frequency (MHz)	Conducted Output Power			Power Density at R = 20cm (0.2m)		Limit	
		dBm	mW	W	FCC (mW/cm ²)	IC (W/m ²)	FCC (mW/cm ²)	IC (W/m ²)
802.11b	2412	9.286	8.485	0.008	0.002	0.024	1	5.366
	2437	9.183	8.285	0.008	0.002	0.023	1	5.404
	2462	9.851	9.662	0.010	0.003	0.027	1	5.442
802.11g	2412	14.455	27.896	0.028	0.008	0.078	1	5.366
	2437	14.462	27.940	0.028	0.008	0.079	1	5.404
	2462	15.146	32.701	0.033	0.009	0.092	1	5.442
802.11n (20MHz)	2412	14.317	27.021	0.027	0.008	0.076	1	5.366
	2437	14.243	26.564	0.027	0.007	0.075	1	5.404
	2462	14.483	28.073	0.028	0.008	0.079	1	5.442
802.11n (40MHz)	2422	13.079	20.320	0.020	0.006	0.057	1	5.381
	2437	16.008	39.882	0.040	0.011	0.112	1	5.404
	2452	12.277	16.892	0.017	0.005	0.047	1	5.427

Note:

1. The antenna information is from the customer declaration.
2. The EUT description is from the customer declaration.
3. The product specification and testing instructions for the EUT declared in the report are provided by the manufacturer who will take all responsibilities for the accuracy.
4. The results are evaluated using the maximum power.

Product	KNOT		
Test Mode	Transmit		
Test Condition	RF Exposure Evaluation		
Date of Test	2021/05/07	Test Site	SR12-H
Temperature(°C)	24.0°C	Test Humidity	68.0%

Antenna Gain: The maximum antenna gain is 2dBi.

Output Power into Antenna & RF Exposure Evaluation Distance:

Bluetooth Function BT 5.0								
Mode	Frequency (MHz)	Conducted Output Power			Power Density at R = 20cm (0.2m)		Limit	
		dBm	mW	W	FCC (mW/cm ²)	IC (W/m ²)	FCC (mW/cm ²)	IC (W/m ²)
GFSK 1Mbps	2402	4.520	2.831	0.003	0.001	0.009	1	5.351
	2441	4.100	2.570	0.003	0.001	0.008	1	5.409
	2480	3.420	2.198	0.002	0.001	0.007	1	5.469
GFSK 2Mbps	2402	4.530	2.838	0.003	0.001	0.009	1	5.351
	2441	4.110	2.576	0.003	0.001	0.008	1	5.409
	2480	3.430	2.203	0.002	0.001	0.007	1	5.469

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4. The results are evaluated using the maximum power.

Product	KNOT
Test Mode	Transmit
Test Condition	RF Exposure Evaluation

Antenna Gain: The maximum antenna gain is 5dBi.

Output Power into Antenna & RF Exposure Evaluation Distance:

WWAN Function (Certified Module FCC ID: XMR201912BG77; IC: 10224A-201912BG77)								
Band	Frequency (MHz)	Maximum conducted output power (per tune-up)			Power Density at R = 20cm (0.2m)		Limit	
		dBm	mW	W	FCC (mW/cm ²)	IC (W/m ²)	FCC (mW/cm ²)	IC (W/m ²)
Cat-M1 Band 2	1850.7	22	158.489	0.158	0.100	0.997	1.000	4.477
Cat-M1 Band 4	1710.7	22	158.489	0.158	0.100	0.997	1.000	4.243
Cat-M1 Band 5	824.7	22	158.489	0.158	0.100	0.997	0.550	2.577
Cat-M1 Band 12	699.7	22	158.489	0.158	0.100	0.997	0.466	2.303
Cat-M1 Band 13	779.5	22	158.489	0.158	0.100	0.997	0.520	2.480
Cat-M1 Band 25	1850.7	22	158.489	0.158	0.100	0.997	1.000	4.477
Cat-M1 Band 26	814.7	22	158.489	0.158	0.100	0.997	0.543	2.556
Cat-M1 Band 66	1710.7	22	158.489	0.158	0.100	0.997	1.000	4.243
Cat-M1 Band 85	700.5	22	158.489	0.158	0.100	0.997	0.467	2.305
NB-IOT Band 2	1850.2	22	158.489	0.158	0.100	0.997	1.000	4.477
NB-IOT Band 4	1710.2	22	158.489	0.158	0.100	0.997	1.000	4.242
NB-IOT Band 5	824.2	22	158.489	0.158	0.100	0.997	0.549	2.576
NB-IOT Band 12	699.2	22	158.489	0.158	0.100	0.997	0.466	2.302
NB-IOT Band 13	777.2	22	158.489	0.158	0.100	0.997	0.518	2.475
NB-IOT Band 25	1850.2	22	158.489	0.158	0.100	0.997	1.000	4.477
NB-IOT Band 66	1710.2	22	158.489	0.158	0.100	0.997	1.000	4.242
NB-IOT Band 71	663.2	22	158.489	0.158	0.100	0.997	0.442	2.220
NB-IOT Band 85	698.2	22	158.489	0.158	0.100	0.997	0.465	2.300

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4. The results are evaluated using the maximum power.

Collocation Power Density

Product	KNOT
Test Mode	Transmit
Test Condition	RF Exposure Evaluation

For FCC

Power Density for WiFi 2.4GHz (mW/cm ²)	Power Density for LTE (mW/cm ²)	Collocation Power Density (mW/cm ²)	Limit (mW/cm ²)
0.011	0.100	0.111	1.000

Power Density for WiFi 2.4GHz (mW/cm ²)	Power Density for NB-IOT (mW/cm ²)	Collocation Power Density (mW/cm ²)	Limit (mW/cm ²)
0.011	0.100	0.111	1.000

For IC

Power Density for WiFi 2.4GHz (W/m ²)	Power Density for WiFi 2.4GHz /Limit	Power Density for Cat-M1 (W/m ²)	Power Density for Cat-M1 /Limit	Collocation Power Density /Limit	Limit
0.112	0.021	0.997	0.433	0.454	1

Power Density for WiFi 2.4GHz (W/m ²)	Power Density for WiFi 2.4GHz /Limit	Power Density for NB-IOT (W/m ²)	Power Density for NB-IOT /Limit	Collocation Power Density /Limit	Limit
0.112	0.021	0.997	0.449	0.47	1