RF Exposure Evaluation declaration

Product Name : 4G/LTE Multi-Service 11ac Broadband Router, 4G/LTE Wireless-AC VoIP Broadband Router, 4G/LTE Wireless-AC Broadband Router

Model No. : BEC 6500X, BEC 6500VAL, BEC 6500AT, BEC 6500AEL, BiPAC 4500VAOZ, BiPAC 4500VAPZ, BiPAC 4500AZ, BiPAC 4500AZL

FCC ID : QI3BIL-6500X

Applicant : Billion Electric Co., Ltd.

Address : 8F., No.192, Sec. 2, Zhongxing Rd., Xindian Dist., New Taipei City 231, Taiwan (R.O.C.)

Date of Receipt : Jan. 21, 2019

Date of Declaration : Feb. 12, 2019

Report No. : 1910238R-SAUSP03V00

Report Version : V1.0

Testing Laboratory
3023

Test Report

Issued Date : Feb. 12, 2019
Report No.: 1910238R-HPUSP03V00

Product Name	:	4G/LTE Multi-Service 11ac Broadband Router, 4G/LTE Wireless-AC VoIP Broadband Router, 4G/LTE Wireless-AC Broadband Router
Applicant	:	Billion Electric Co., Ltd.
Address	:	8F., No.192, Sec. 2, Zhongxing Rd., Xindian Dist., New Taipei City 231, Taiwan (R.O.C.)
Manufacturer	:	Billion Electric Co., Ltd.
Trade Name	:	BEC, Billion
Model No.	:	BEC 6500X, BEC 6500VAL, BEC 6500AT, BEC 6500AEL, BiPAC 4500VAOZ, BiPAC 4500VAPZ, BiPAC 4500AZ, BiPAC 4500AZL
Measurement Standard	:	FCC 47 CFR 1.1310
Test Result	:	Complied

Documented By : Elephant Chen
(Adm. Assistant / Elephant Chen)

Tested By : Vorana Chen
(Senior Engineer / Vorana Chen)

Approved By :
(Director /Vincent Lin)

1. GENERAL INFORMATION

1.1. EUT Description

Product Name	4G/LTE Multi-Service 11ac Broadband Router, 4G/LTE Wireless-AC VoIP Broadband Router, 4G/LTE Wireless-AC Broadband Router
Model No.	BEC 6500X, BEC 6500VAL, BEC 6500AT, BEC 6500AEL, BiPAC 4500VAOZ, BiPAC 4500VAPZ, BiPAC 4500AZ, BiPAC 4500AZL
Trade Name	BEC, Billion
IMEI No.	35907306
FCC ID	QI3BIL-6500X
TX Frequency	LTE Band 2: 1850 MHz ~1910 MHz
Rx Frequency	LTE Band 2: 1930 MHz ~1990 MHz
Frequency Range (WLAN)	2412-2462MHz for 802.11b/g/n-20BW, 2422-2452MHz for 802.11n-40BW 802.11a/n-20MHz: 5180-5240MHz, 5745-5825MHz 802.11n-40MHz: 5190-5230MHz, 5755-5795MHz 802.11ac-80MHz: 5210MHz, 5775MHz
HW Version	AAP4520VAOZG10
SW Version	v1.04.1.318

1.2. Antenna List :

No	Manufacturer	Part No	Antenna Type	Peak Gain
1	Grand-Tek Technology (WWAN)	OA-L71-05-04-C5-BL	Dipole Antenna	2dBi for 1.71 GHz ~2.17 GHz
2	GRAND-TEK	1032G00000060 1032G00000070	Dipole Antenna	4.8dBi for 2.4 GHz
3	Invax	AN5000-9201BRS	Dipole Antenna	5.0dBi for 5GHz

1.3. The different description of Model

The different description of Model						
Model No.	**Product Name**	**Trade Name**	**SIM slot** (2FF)	**Wireless**	**VoIP**	**VPN** (*software)
BEC 6500X	4G/LTE Multi-Service 11ac Broadband Router	BEC Billion	1	802.11a/b/g/n/ac	○	○
BEC 6500VAL			1		○	X
BEC 6500AT			1		X	○
BEC 6500AEL			1		X	X
BiPAC 4500VAOZ	4G/LTE Wireless-AC VoIP Broadband Router		1		○	○
BiPAC 4500VAPZ			1		○	X
BiPAC 4500AZ	4G/LTE Wireless-AC Broadband Router		1		X	○
BiPAC 4500AZL			1		X	X
Remarks: "○" means function available , "X" means not support.						

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	30
1500-100,000	--	--	1	30

F= Frequency in MHz

Friis Formula

Friis transmission formula: $Pd = (Pout*G)/(4*Pi*R^2)$

Where

Pd = power density in mW/cm^2

Pout = 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

Pd is the limit of MPE, 1 mW/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.

Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneously transmitting antennas incorporated in a host device is ≤ 1.0.

2.2. Test Result of RF Exposure Evaluation

Product : 4G/LTE Multi-Service 11ac Broadband Router, 4G/LTE Wireless-AC VoIP Broadband Router, 4G/LTE Wireless-AC Broadband Router
Test Item : RF Exposure Evaluation
Test Site : N/A

LTE Band 2 -Peak Gain: 2dBi

Frequency	Conducted Peak Power (dBm)	Maximum EIRP (W)	Maximum EIRP Limit (W)	Duty Cycle (%)	Conducted Average Power (dBm)	Output Power to Antenna (mW)	Power Density at R = 20 cm (mW/cm^2)	Limit (mW/cm^2)	Pass/Fail
1851.5	22.74	0.298	2	100	22.74	187.93	0.0593	1	Pass
1880	22.53	0.284	2	100	22.53	179.06	0.0565	1	Pass
1905	22.83	0.304	2	100	22.83	191.87	0.0605	1	Pass

Note: The conducted output power is refer to report No.: 1910238R-HPUSP40V00 from the DEKRA.

WLAN
Peak Gain for 2.4G: 4.8dBi, Peak Gain for 5G: 5dBi

Band	Frequency	Conducted maximum Peak Power (dBm)	Output Power to Antenna (mW)	Power Density at R = 20 cm (mW/cm^2)	Limit (mW/cm^2)	Pass/Fail
2.4	2422	29.48	887.2	0.533	1	Pass
5	5785	24.51	282.5	0.178	1	Pass

Note1: The 2.4G conducted output power is refer to report No.: 1910238R-RFUSP26V00 from the DEKRA.
Note2: The 5G conducted output power is refer to report No.: 1910238R-RFUSP58V00 from the DEKRA.

2.3. calculations for Multi-Transsmitter

Mode	Exposure Calculations	result	Limit	Pass/Fail
WLAN 2.4G	0.533	0.772	1	Pass
WLAN 5G	0.178			
WWAN	0.061			

Inclusion tolerance:

LTE Band 2 -Peak Gain: 2dBi

Frequency	Tune-Up Power (dBm)	Maximum EIRP (W)	Maximum EIRP Limit (W)	Duty Cycle (%)	Conducted Average Power (dBm)	Output Power to Antenna (mW)	Power Density at R = 20 cm (mW/cm^2)	Limit (mW/cm^2)	Pass/Fail
1851.5	24.00	0.398	2	100	24	251.19	0.0792	1	Pass
1880	24.00	0.398	2	100	24	251.19	0.0792	1	Pass
1905	24.00	0.398	2	100	24	251.19	0.0792	1	Pass

WLAN
Peak Gain for 2.4G: 4.8dBi, Peak Gain for 5G: 5dBi

Band	Frequency	Tune-Up Power (dBm	Output Power to Antenna (mW)	Power Density at R = 20 cm (mW/cm^2)	Limit (mW/cm^2)	Pass/Fail
2.4	2412-2462	30	1000.0	0.601	1	Pass
5	5180-5825	25	316.2	0.199	1	Pass

2.4. calculations for Multi-Transsmitter

Mode	Exposure Calculations	result	Limit	Pass/Fail
WLAN 2.4G	0.601	0.861	1	Pass
WLAN 5G	0.199			
WWAN	0.061			