

RF Exposure Evaluation Report

Product Name : Gigabit LTE Multi-Service Router / LTE Dual-SIM Dual-Band
Wireless VoIP VPN Router
Model No. : BEC 6600VAL, BEC 6600AEL, BEC 6600X, BiPAC 4520VAOZ R3,
BiPAC 4520VAPZ R3, BiPAC 4500VAOZ R3, BiPAC 4500VAPZ R3,
BiPAC 4520AZ R3, BiPAC 4520AZL R3, BiPAC 4500AZ R3,
BiPAC 4500AZL R3, BiPAC 4520VNOZ R3, BiPAC 4520VNPZ R3,
BiPAC 4500VNOZ R3, BiPAC 4500VNPZ R3, BiPAC 4520NZ R3,
BiPAC 4520NZL R3, BiPAC 4500NZ R3, BiPAC 4500NZL R3,
BiPAC 4520Z R3, BiPAC 4520ZL R3, BiPAC 4500Z R3,
BiPAC 4500ZL R3
FCC ID : QI3BEC-6600AEL

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 : Aug. 28, 2020

Date of Declaration : Sep. 14, 2020

Report No. : 2080882R-E3082100013

Report Version : V1.0



The test results relate only to the samples tested.

The test results shown in the test report are traceable to the national/international standard through the calibration report of the equipment and evaluated measurement uncertainty herein.

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Measurement uncertainties evaluated for each testing system and associated connections are given here to provide the system information for reference. Compliance determinations do not take into account measurement uncertainties for each testing system, but are based on the results of the compliance measurement.

Issued Date: Sep. 14, 2020

Report No.: 2080882R-E3082100013



Product Name	Gigabit LTE Multi-Service Router / LTE Dual-SIM Dual-Band Wireless VoIP VPN 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.	
Model No.	BEC 6600VAL, BEC 6600AEL, BEC 6600X, BiPAC 4520VAOZ R3, BiPAC 4520VAPZ R3, BiPAC 4500VAOZ R3, BiPAC 4500VAPZ R3, BiPAC 4520AZ R3, BiPAC 4520AZL R3, BiPAC 4500AZ R3, BiPAC 4500AZL R3, BiPAC 4520VNOZ R3, BiPAC 4520VNPZ R3, BiPAC 4500VNOZ R3, BiPAC 4500VNPZ R3, BiPAC 4520NZ R3, BiPAC 4520NZL R3, BiPAC 4500NZ R3, BiPAC 4500NZL R3, BiPAC 4520Z R3, BiPAC 4520ZL R3, BiPAC 4500Z R3, BiPAC 4500ZL R3	
FCC ID.	QI3BEC-6600AEL	
Trade Name	BEC, Billion	
Applicable Standard	KDB 447498 D01 v06	<input checked="" type="checkbox"/> Minimum test separation distance \geq 20 cm <input type="checkbox"/> For low power devices
Test Result	Complied	

Documented By

:



(Senior Adm. Specialist / Genie Chang)

Tested By

:



(Senior Engineer / Wen Lee)

Approved By

:



(Director / Vincent Lin)

Revision History

Report No.	Version	Description	Issued Date
2080882R-E3082100013	V1.0	Initial issue of report.	2020-09-14

1. GENERAL INFORMATION

1.1. EUT Description

Product Name	Gigabit LTE Multi-Service Router / LTE Dual-SIM Dual-Band Wireless VoIP VPN Router
Trade Name	BEC, Billion
Model No.	BEC 6600VAL, BEC 6600AEL, BEC 6600X, BiPAC 4520VAOZ R3, BiPAC 4520VAPZ R3, BiPAC 4500VAOZ R3, BiPAC 4500VAPZ R3, BiPAC 4520AZ R3, BiPAC 4520AZL R3, BiPAC 4500AZ R3, BiPAC 4500AZL R3, BiPAC 4520VNOZ R3, BiPAC 4520VNPZ R3, BiPAC 4500VNOZ R3, BiPAC 4500VNPZ R3, BiPAC 4520NZ R3, BiPAC 4520NZL R3, BiPAC 4500NZ R3, BiPAC 4500NZL R3, BiPAC 4520Z R3, BiPAC 4520ZL R3, BiPAC 4500Z R3, BiPAC 4500ZL R3
FCC ID.	QI3BEC-6600AEL
TX Frequency	LTE Band 2: 1850MHz ~1910MHz
Rx Frequency	LTE Band 2: 1930MHz ~1990MHz
Bandwidth	LTE Band 2: 1.4MHz/3MHz/5MHz/10MHz/15MHz/20MHz
Frequency Range	2412-2462MHz for 802.11b/g/n-20BW, 2422-2452MHz for 802.11n-40BW 802.11a/n/ac-20MHz: 5180-5240MHz, 5745-5825MHz 802.11n/ac-40MHz: 5190-5230MHz, 5755-5795MHz 802.11ac-80MHz: 5210MHz, 5775MHz
Number of Channels	802.11b/g/n-20MHz: 11, n-40MHz: 7 802.11a/n/ac-20MHz: 9, 802.11n/ac-40MHz: 4, 802.11ac-80MHz: 2
Data Rate	802.11b: 1-11Mbps, 802.11g: 6-54Mbps, 802.11n: up to 450Mbps 802.11a: 6 - 54Mbps, 802.11n: up to 600Mbps 802.11ac-80MHz: up to 1733.3MHz
Type of Modulation	802.11b:DSSS (DBPSK, DQPSK, CCK) 802.11g/n:OFDM (BPSK, QPSK, 16QAM, 64QAM) 802.11a/n/ac: OFDM, BPSK, QPSK, 16QAM, 64QAM, 256QAM
HW Version	V1.0
SW Version	1.00.1.23
Antenna Gain	Refer to the table "Antenna List"
Channel Control	Auto

Note: The different of the each model is shown as below:

Model Name: BEC 6600AEL

Gigabit LTE Multi-Service Router

Model Name: BiPAC 4520VAOZ R3

LTE Dual-SIM Dual-Band Wireless VoIP VPN Router

	Trade Name	External LTE Antenna	Wi-Fi Antenna	VPN	VoIP	WiFi 5GHz/2.4GHz	SIM Slot	USB Host	Power Adapter
BEC 6600VAL	BEC	LTE Wide-band Antenna *4pcs	5/ 2.4GHz External WiFi Antenna *2pcs 5/ 2.4GHz Embedded WiFi Antenna *2pcs	X	O	5GHz+2.4GHz	1	O	DC 15V/ 2.0A
BEC 6600AEL	BEC	LTE Wide-band Antenna *4pcs	5/ 2.4GHz External WiFi Antenna *2pcs 5/ 2.4GHz Embedded WiFi Antenna *2pcs	O	X	5GHz+2.4GHz	1	O	DC 15V/ 2.0A
BEC 6600X	BEC	LTE Wide-band Antenna *4pcs	5/ 2.4GHz External WiFi Antenna *2pcs 5/ 2.4GHz Embedded WiFi Antenna *2pcs	O	O	5GHz+2.4GHz	1	O	DC 15V/ 2.0A
BiPAC 4520VAOZ R3	Billion	LTE Wide-band Antenna *4pcs	5/ 2.4GHz External WiFi Antenna *2pcs 5/ 2.4GHz Embedded WiFi Antenna *2pcs	O	O	5GHz+2.4GHz	2	O	DC 15V/ 2.0A
BiPAC 4520VAPZ R3	Billion	LTE Wide-band Antenna *4pcs	5/ 2.4GHz External WiFi Antenna *2pcs 5/ 2.4GHz Embedded WiFi Antenna *2pcs	X	O	5GHz+2.4GHz	2	O	DC 15V/ 2.0A
BiPAC 4500VAOZ R3	Billion	LTE Wide-band Antenna *4pcs	5/ 2.4GHz External WiFi Antenna *2pcs 5/ 2.4GHz Embedded WiFi Antenna *2pcs	O	O	5GHz+2.4GHz	1	O	DC 15V/ 2.0A
BiPAC 4500VAPZ R3	Billion	LTE Wide-band Antenna *4pcs	5/ 2.4GHz External WiFi Antenna *2pcs 5/ 2.4GHz Embedded WiFi Antenna *2pcs	X	O	5GHz+2.4GHz	1	O	DC 15V/ 2.0A
BiPAC 4520AZ R3	Billion	LTE Wide-band Antenna *4pcs	5/ 2.4GHz External WiFi Antenna *2pcs 5/ 2.4GHz Embedded WiFi Antenna *2pcs	O	X	5GHz+2.4GHz	2	O	DC 15V/ 2.0A
BiPAC 4520AZL R3	Billion	LTE Wide-band Antenna *4pcs	5/ 2.4GHz External WiFi Antenna *2pcs 5/ 2.4GHz Embedded WiFi Antenna *2pcs	X	X	5GHz+2.4GHz	2	O	DC 15V/ 2.0A
BiPAC 4500AZ R3	Billion	LTE Wide-band Antenna *4pcs	5/ 2.4GHz External WiFi Antenna *2pcs 5/ 2.4GHz Embedded WiFi Antenna *2pcs	O	X	5GHz+2.4GHz	1	O	DC 15V/ 2.0A
BiPAC 4500AZL R3	Billion	LTE Wide-band Antenna *4pcs	5/ 2.4GHz External WiFi Antenna *2pcs 5/ 2.4GHz Embedded WiFi Antenna *2pcs	X	X	5GHz+2.4GHz	1	O	DC 15V/ 2.0A
BiPAC 4520VNOZ R3	Billion	LTE Wide-band Antenna *4pcs	5/ 2.4GHz External WiFi Antenna *2pcs 5/ 2.4GHz Embedded WiFi Antenna *1pcs	O	O	2.4GHz	2	O	DC 15V/ 2.0A
BiPAC 4520VNPZ R3	Billion	LTE Wide-band Antenna *4pcs	5/ 2.4GHz External WiFi Antenna *2pcs 5/ 2.4GHz Embedded WiFi Antenna *1pcs	X	O	2.4GHz	2	O	DC 15V/ 2.0A
BiPAC 4500VNOZ R3	Billion	LTE Wide-band Antenna *4pcs	5/ 2.4GHz External WiFi Antenna *2pcs 5/ 2.4GHz Embedded WiFi Antenna *1pcs	O	O	2.4GHz	1	O	DC 15V/ 2.0A
BiPAC 4500VNPZ R3	Billion	LTE Wide-band Antenna *4pcs	5/ 2.4GHz External WiFi Antenna *2pcs 5/ 2.4GHz Embedded WiFi Antenna *1pcs	X	O	2.4GHz	1	O	DC 15V/ 2.0A
BiPAC 4520NZ R3	Billion	LTE Wide-band Antenna *4pcs	5/ 2.4GHz External WiFi Antenna *2pcs 5/ 2.4GHz Embedded WiFi Antenna *1pcs	O	X	2.4GHz	2	O	DC 15V/ 2.0A
BiPAC 4520NZL R3	Billion	LTE Wide-band Antenna *4pcs	5/ 2.4GHz External WiFi Antenna *2pcs 5/ 2.4GHz Embedded WiFi Antenna *1pcs	X	X	2.4GHz	2	O	DC 15V/ 2.0A
BiPAC 4500NZ R3	Billion	LTE Wide-band Antenna *4pcs	5/ 2.4GHz External WiFi Antenna *2pcs 5/ 2.4GHz Embedded WiFi Antenna *1pcs	O	X	2.4GHz	1	O	DC 15V/ 2.0A
BiPAC 4500NZL R3	Billion	LTE Wide-band Antenna *4pcs	5/ 2.4GHz External WiFi Antenna *2pcs 5/ 2.4GHz Embedded WiFi Antenna *1pcs	X	X	2.4GHz	1	O	DC 15V/ 2.0A
BiPAC 4520Z R3	Billion	LTE Wide-band Antenna *4pcs	X	O	X	X	2	O	DC 15V/ 2.0A
BiPAC 4520ZL R3	Billion	LTE Wide-band Antenna *4pcs	X	X	X	X	2	O	DC 15V/ 2.0A
BiPAC 4500Z R3	Billion	LTE Wide-band Antenna *4pcs	X	O	X	X	1	O	DC 15V/ 2.0A
BiPAC 4500ZL R3	Billion	LTE Wide-band Antenna *4pcs	X	X	X	X	1	O	DC 15V/ 2.0A

Note: "O" means YES, and "X" means NO

Antenna List

No.	Manufacturer	Part No.	Antenna Type	Peak Gain
1	GRAND-TEK	AAZANDXSX0AL711200	Dipole Antenna	3.5 dBi for LTE Band 2
2	GRAND-TEK	AAZANDXSX0AL711200 (RX)	Dipole Antenna	3.5 dBi for LTE Band 2
3	Master Wave	98PH8PIPF000(ANT1) 98PH7PIPF000(ANT2)	PCB Antenna	3.69dBi for 2.4 GHz 3.95dBi for 5.150-5.250 GHz 4.90dBi for 5.725-5.850 GHz
4	Master Wave	98612PRSX000	Dipole Antenna	2.56dBi for 2.4 GHz 3.13dBi for 5.150-5.250 GHz 3.52dBi for 5.725-5.850 GHz

Note: Only the higher gain antenna was tested and recorded in this report.

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: $P_d = (P_{out} * G) / (4 * \pi * R^2)$

Where

P_d = power density in mW/cm²

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

π = 3.1416

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

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 : Gigabit LTE Multi-Service Router / LTE Dual-SIM Dual-Band Wireless VoIP
VPN Router
Test Item : RF Exposure Evaluation
Test Site : N/A

LTE Band 2-Peak Gain: 3.5dBi

Frequency	Conducted Peak Power (dBm)	Maximum ERP/EIRP (W)	Maximum ERP/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
1857.5	22.86	0.433	2	100	22.86	193.20	0.0860	1	Pass
1880	22.81	0.428	2	100	22.81	190.99	0.0851	1	Pass
1900	22.79	0.426	2	100	22.79	190.11	0.0847	1	Pass

Note: The conducted output power is refer to report No.: 2080882R-E3042110004 from the DEKRA.

WLAN

Peak Gain for 2.4G: 3.69dBi

Band	Frequency	Maximum Conducted Peak Power (dBm)	Duty Cycle (%)	Output Power to Antenna (dBm)	Output Power to Antenna (mW)	Power Density at R = 20 cm (mW/cm ²)	Limit (mW/cm ²)	Pass/Fail
b	2462	22.04	95.09	21.82	152.1	0.07	1	Pass
g	2462	29.98	79.83	29.00	794.6	0.37	1	Pass
n20	2412	29.81	54.79	27.20	524.4	0.24	1	Pass
n40	2422	29.96	60.85	27.80	602.9	0.28	1	Pass

Note: The conducted output power is refer to report No.: 2080882R-E3032110113 from the DEKRA.

WLAN

Peak Gain for 5G: 4.9dBi

Band	Frequency	Maximum Conducted Average Power (dBm)	Duty Cycle (%)	Output Power to Antenna (dBm)	Output Power to Antenna (mW)	Power Density at R = 20 cm (mW/cm ²)	Limit (mW/cm ²)	Pass/Fail
a	5825	27.14	79.25	26.13	410.2	0.25	1	Pass
n20	5825	26.91	51.87	24.06	254.6	0.16	1	Pass
n40	5795	28.11	38.20	23.93	247.2	0.15	1	Pass
ac80	5775	21.15	27.13	15.48	35.4	0.02	1	Pass

Note: The conducted output power is refer to report No.: 2080882R-E3032110125 from the DEKRA.

2.3. calculations for Multi-Transmitter

Mode	Exposure Calculations Ratios	result	Limit	Pass/Fail
WLAN 2.4G	0.370	0.706	1	Pass
WLAN 5G	0.250			
WWAN	0.086			

Ratios = Limit / RF Exposure