

RF Exposure Evaluation Declaration

Product Name : Active Ethernet Fiber 802.11ac Gateway with VoIP
Trade Name : BEC, Billion
Model No. : BEC 9900VA
FCC ID : QI3BEC-9900VA

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 : Sep. 16, 2020
Date of Declaration : Nov. 11, 2020
Report No. : 2090564R-E3082100013
Report Version : V1.0



The declaration results relate only to the samples calculated.

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Manufacturer : Billion Electric Co., Ltd.

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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.

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 : 
(Scott Chang / Senior Engineer)

Approved By : 
(Louis Hsu / Deputy Manager)

Revision History

Version	Description	Issued Date
V1.0	Initial issue of report	Nov. 11, 2020

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.

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 Output Power / SR12-H

Instrument	Manufacturer	Model No.	Serial No.	Cal. Date	Next Cal. Date
High Speed Peak Power Meter Dual Input	Anritsu	ML2496A	1602004	2019/12/02	2020/12/01
Pulse Power Sensor	Anritsu	MA2411B	1531043	2019/12/02	2020/12/01
Pulse Power Sensor	Anritsu	MA2411B	1531044	2019/12/02	2020/12/01
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 Output Power	± 2.26 dB

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

F= 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 x 10 ⁻⁴ f 0.5	3.33 x 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

π = 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.

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	Active Ethernet Fiber 802.11ac Gateway with VoIP		
Test Mode	Transmit Mode		
Test Condition	RF Exposure Evaluation		
Date of Test	2020/10/26	Test Site	SR12-H
Temperature(°C)	22	Humidity (%RH)	55

Antenna Gain: The maximum antenna gain is 2.56dBi.

Output Power into Antenna & RF Exposure Evaluation Distance:

WLAN Function 2.4GHz Band					
Mode	Frequency (MHz)	Maximum Conducted Output Power		Maximum Power Density at R = 20 cm (mW/cm ²)	Limit (mW/cm ²)
		dBm	mW		
802.11b (SISO)	2412	15.010	31.696	0.011	1
	2437	15.940	39.264	0.014	1
	2462	17.360	54.450	0.020	1
802.11g (SISO)	2412	17.990	62.951	0.023	1
	2437	17.820	60.534	0.022	1
	2462	17.010	50.234	0.018	1
802.11n (20MHz) (MIMO)	2412	20.016	100.369	0.036	1
	2437	20.035	100.809	0.036	1
	2462	15.209	33.182	0.012	1
802.11n (40MHz) (MIMO)	2422	15.530	35.727	0.013	1
	2437	15.475	35.278	0.013	1
	2452	15.066	32.107	0.012	1

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	Active Ethernet Fiber 802.11ac Gateway with VoIP		
Test Mode	Transmit Mode		
Test Condition	RF Exposure Evaluation		
Date of Test	2020/10/26	Test Site	SR12-H
Temperature(°C)	22	Humidity (%RH)	55

Antenna Gain: The maximum antenna gain is 3.54dBi.

Output Power into Antenna & RF Exposure Evaluation Distance:

WLAN Function 5GHz Band					
Mode	Frequency (MHz)	Conducted Output Power		Power Density at R = 20cm (mW/cm ²)	Limit (mW/cm ²)
		dBm	mW		
802.11a (SISO)	5180	18.440	69.823	0.031	1
	5220	17.490	56.105	0.025	1
	5240	18.150	65.313	0.029	1
	5745	14.220	26.424	0.012	1
	5785	14.210	26.363	0.012	1
	5825	14.150	26.002	0.012	1
802.11n/ac (20MHz) (MIMO)	5180	21.480	140.620	0.063	1
	5220	21.460	139.953	0.063	1
	5240	22.234	167.250	0.075	1
	5745	19.151	82.239	0.037	1
	5785	18.660	73.454	0.033	1
	5825	19.779	95.039	0.043	1
802.11n/ac (40MHz) (MIMO)	5190	21.557	143.125	0.064	1
	5230	21.773	150.431	0.068	1
	5755	20.586	114.458	0.051	1
	5795	21.201	131.844	0.026	1
802.11ac (80MHz) (MIMO)	5210	20.771	119.426	0.054	1
	5775	21.314	135.332	0.061	1

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