Maximum Permissible Exposure (MPE) Evaluation Report

Report No. : **151100385TWN-001**

Model No. : **BEC MX-200**

Issued Date : **Nov. 24, 2015**

Applicant: **Billion Electric Co., Ltd.**
8f., No.192, Sec.2,Zhongxing Road, Xindian Dist., New Taipei City, Taiwan.

Test Method/ Standard: **FCC 1.1310**

Test By: **Intertek Testing Services Taiwan Ltd.**
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Testing Laboratory
0597

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Summary of Tests

MPE Evaluation meet FCC OET No. 65: 1997, IEEE C95.1-2005

Test	Reference	Results
MPE Evaluation	FCC Guidelines for Human Exposure IEEE C95.1	Complies

1. General information

1.1 Identification of the EUT

Product:	MXConnect M2M Advanced Industrial 4G/LTE Router
Model No:	BEC MX-200
FCC ID:	QI3BIL-MX200
Manufacturer:	Billion Electric Co., Ltd.
Address:	8f., No.192, Sec.2, Zhongxing Road, Xindian Dist., New Taipei City, Taiwan.
TX Frequency:	GSM850: 824.2 MHz ~ 848.8 MHz GSM1900: 1850.2 MHz ~ 1909.8 MHz WCDMA Band V: 826.4 MHz ~ 846.6 MHz WCDMA Band II:: 1852.4 MHz ~ 1907.6 MHz LTE Band 17: 706.5 MHz ~ 713.5 MHz
RX Frequency:	GSM850: 869.2 MHz ~ 893.8 MH ,GSM1900: 1930.2 MHz ~ 1989.8 MHz z WCDMA Band V: 871.4 MHz ~ 891.6 MHz WCDMA Band II:: 1932.4 MHz ~ 1987.6 MHz LTE Band 17: 736.5MHz ~ 743.5 MHz
Maximum Output Power to Antenna:	GSM850: 32.2 dBm,GSM1900: 29.0 dBm WCDMA Band V: 22.83dBm ,WCDMA Band II: 22.47 dBm LTE Band 17 : 22.67 dBm
Rated Power:	DC 12 V from adapter
Power Cord:	N/A
Sample Received:	Sep. 30, 2015
Sample condition:	Workable
Test Date(s):	Oct. 1, 2015 ~ Oct. 29, 2015
Note 1:	This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.
Note 2:	When determining the test conclusion, the Measurement Uncertainty of test has been considered.

1.2 Additional information about the EUT

Product SW/HW version :	M200_GPS / 1.00C
Radio SW/HW version :	05.05.58.00 / 11
Test SW Version :	N/A

1.3 Antenna description

Antenna 1

Antenna model number : AN0727-64DP5BSM

The antenna is affixed to the EUT using a unique connector, which allows for replacement of a broken antenna, but DOES NOT use a standard antenna jack or electrical connector.

Antenna Gain	: 0.28 dBi max (850 Band), 0.64 dBi max (1900 Band), -1.3 dBi (LTE Band 17)
Antenna Type	: Dipole antenna
Connector Type	: SMA

Antenna 2

Antenna model number : AB0727-88Y04BSM

The antenna is affixed to the EUT using a unique connector, which allows for replacement of a broken antenna, but DOES NOT use a standard antenna jack or electrical connector.

Antenna Gain	: -1.01 dBi max (850 Band), -0.47 dBi max (1900 Band) -7.31 dBi (LTE Band 17)
Antenna Type	: Dipole antenna
Connector Type	: SMA

The model number “ AN0727-64DP5BSM” is worst case in ERP/EIRP measurement.

2. Test specifications

2.1 Introduction

The EUT operates in the 700MHz/850MHz/1900MHz band. Due to the EUT (include antenna) at its normal operation distance is at least 20 cm from the human body, the EUT was defined as a Mobile Device.

The reason to do the MPE Evaluation is to avoid the RF hazard to human body. The maximum output power and gain of the antenna were used to calculate the limited Power density (S) at 20 cm distance away from the product. The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 and Safety Code 6 are followed.

According to 1.1307 (b)(1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

2.2 RF Exposure calculations

From §FCC 1.1310 table 1, the maximum permissible RF exposure for an uncontrolled environment is 1 mW/(cm^2) (or 10 W/m^2)*

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

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

where, S = Power density (mW/cm^2)
P = Output power to antenna (mW)
R = Distance between radiating structure and observation point (cm)
G = Gain of antenna in numeric
π = 3.1416

Example:
Assume a mobile device operates at 2412MHz and its maximum output power is 50mW, and the maximum gain of antenna is 1 (numeric) /0dBi.

then the power density (S) = $(50 * 1)/4*\pi*20^2$ = 0.00995 (mW/cm^2) (or = 0.0995 W/m^2)

2.3 Operation mode

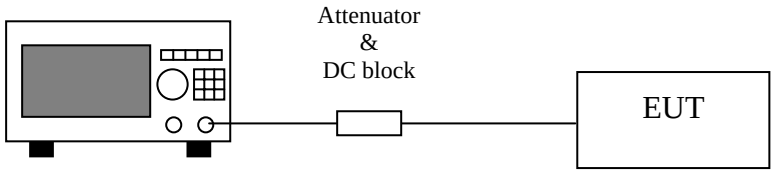
The EUT was established communication with base station simulator and set up to transmit the maximum power.

2.4 Test equipment

Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
Power Meter	Anritsu	ML2495A	0844001	2014/11/12	2015/11/11
Power Sensor	Anritsu	MA2411B	0738452	2014/11/12	2015/11/11
RF Cable	Mini-Circuits	CBL-4FT-SMSM+	CB0003	2015/05/06	2016/05/05
Simulator	Rohde & Schwarz	CMW 500	124781	2015/09/27	2016/09/25

Note: The above equipments are within the valid calibration period.

2.5 Test Set-up



Base station simulator

Remark: Cable loss is 2 dB.

3. Test results

Mode:GPRS

Channel	Frequency (MHz)	Antenna Gain0 (numeric)	Output power to antenna 0 (mW)	Power density (mW/cm2)	Limit of power density (mW/cm2)
128	824.2	1.07	1659.59	0.3522	1.0
190	836.6	1.07	1659.59	0.3522	1.0
251	848.8	1.07	1621.81	0.3441	1.0
512	1850.2	1.16	794.33	0.1831	1.0
661	1880	1.16	741.31	0.1709	1.0
810	1909.8	1.16	741.31	0.1709	1.0

Mode:EGPRS

Channel	Frequency (MHz)	Antenna Gain0 (numeric)	Output power to antenna 0 (mW)	Power density (mW/cm2)	Limit of power density (mW/cm2)
128	824.2	1.07	446.68	0.0948	1.0
190	836.6	1.07	436.52	0.0926	1.0
251	848.8	1.07	436.52	0.0926	1.0
512	1850.2	1.16	316.23	0.0729	1.0
661	1880	1.16	323.59	0.0746	1.0
810	1909.8	1.16	316.23	0.0729	1.0

Mode:WCDMA Rel99 Band V/ WCDMA Rel99 Band II

Channel	Frequency (MHz)	Antenna Gain0 (numeric)	Output power to antenna 0 (mW)	Power density (mW/cm2)	Limit of power density (mW/cm2)
4132	826.4	1.07	188.80	0.0401	1.0
4182	836.4	1.07	191.87	0.0407	1.0
4233	846.6	1.07	184.93	0.0392	1.0
9262	1850.2	1.16	176.60	0.0407	1.0
9400	1880	1.16	174.18	0.0402	1.0
9538	1909.8	1.16	176.20	0.0406	1.0

Mode: Band 5 HSDPA 850MHz

Channel	Frequency (MHz)	Antenna Gain0 (numeric)	Output power to antenna 0 (mW)	Power density (mW/cm2)	Limit of power density (mW/cm2)
4132	826.4	1.07	140.28	0.0298	1.0
4182	836.4	1.07	146.89	0.0312	1.0
4233	846.6	1.07	148.94	0.0316	1.0
4132	826.4	1.07	125.03	0.0265	1.0
4182	836.4	1.07	131.22	0.0278	1.0
4233	846.6	1.07	127.06	0.0270	1.0
4132	826.4	1.07	128.82	0.0273	1.0
4182	836.4	1.07	134.59	0.0286	1.0
4232	846.6	1.07	133.66	0.0284	1.0
4132	826.4	1.07	130.62	0.0277	1.0
4182	836.4	1.07	133.97	0.0284	1.0
4233	846.6	1.07	133.35	0.0283	1.0

Mode: Band 2 HSDPA 1900MHz

Channel	Frequency (MHz)	Antenna Gain0 (numeric)	Output power to antenna 0 (mW)	Power density (mW/cm2)	Limit of power density (mW/cm2)
9262	1852.4	1.16	153.11	0.0353	1.0
9400	1880	1.16	157.40	0.0363	1.0
9538	1907.6	1.16	155.60	0.0359	1.0
9262	1852.4	1.16	154.88	0.0357	1.0
9400	1880	1.16	158.12	0.0365	1.0
9538	1907.6	1.16	156.68	0.0361	1.0
9262	1852.4	1.16	139.96	0.0323	1.0
9400	1880	1.16	142.56	0.0329	1.0
9538	1907.6	1.16	139.64	0.0322	1.0
9262	1852.4	1.16	139.64	0.0322	1.0
9400	1880	1.16	139.96	0.0323	1.0
9538	1907.6	1.16	142.89	0.0329	1.0

Mode: Band 5 HSPA 850MHz

Channel	Frequency (MHz)	Antenna Gain0 (numeric)	Output power to antenna 0 (mW)	Power density (mW/cm2)	Limit of power density (mW/cm2)
4132	826.4	1.07	142.23	0.0302	1.0
4182	836.4	1.07	148.25	0.0315	1.0
4233	846.6	1.07	146.55	0.0311	1.0
4132	826.4	1.07	110.15	0.0234	1.0
4182	836.4	1.07	116.14	0.0246	1.0
4233	846.6	1.07	113.24	0.0240	1.0
4132	826.4	1.07	143.88	0.0305	1.0
4182	836.4	1.07	150.31	0.0319	1.0
4233	846.6	1.07	149.97	0.0318	1.0
4132	826.4	1.07	144.21	0.0306	1.0
4182	836.4	1.07	149.62	0.0317	1.0
4233	846.6	1.07	149.28	0.0317	1.0
4132	826.4	1.07	144.54	0.0307	1.0
4182	836.4	1.07	147.91	0.0314	1.0
4233	846.6	1.07	148.94	0.0316	1.0

Mode: Band 2 HSPA 1900MHz

Channel	Frequency (MHz)	Antenna Gain0 (numeric)	Output power to antenna 0 (mW)	Power density (mW/cm2)	Limit of power density (mW/cm2)
4132	826.4	1.07	142.23	0.0302	1.0
4182	836.4	1.07	148.25	0.0315	1.0
4233	846.6	1.07	146.55	0.0311	1.0
4132	826.4	1.07	110.15	0.0234	1.0
4182	836.4	1.07	116.14	0.0246	1.0
4233	846.6	1.07	113.24	0.0240	1.0
4132	826.4	1.07	143.88	0.0305	1.0
4182	836.4	1.07	150.31	0.0319	1.0
4233	846.6	1.07	149.97	0.0318	1.0
4132	826.4	1.07	144.21	0.0306	1.0
4182	836.4	1.07	149.62	0.0317	1.0
4233	846.6	1.07	149.28	0.0317	1.0
4132	826.4	1.07	144.54	0.0307	1.0
4182	836.4	1.07	147.91	0.0314	1.0
4233	846.6	1.07	148.94	0.0316	1.0

Mode : LTE Band 17, BW 5MHz, QPSK

Channel	Frequency (MHz)	Antenna Gain0 (numeric)	Output power to antenna 0 (mW)	Power density (mW/cm2)	Limit of power density (mW/cm2)
23755	706.5	0.74	167.49	0.0247	1.0
23755	706.5	0.74	184.93	0.0273	1.0
23755	706.5	0.74	135.52	0.0200	1.0
23790	710	0.74	182.81	0.0270	1.0
23790	710	0.74	184.93	0.0273	1.0
23790	710	0.74	139.64	0.0206	1.0
23825	713.5	0.74	172.19	0.0254	1.0
23825	713.5	0.74	159.59	0.0235	1.0
23825	713.5	0.74	133.35	0.0197	1.0

Mode : LTE Band 17, BW 5MHz, 16QAM

Channel	Frequency (MHz)	Antenna Gain0 (numeric)	Output power to antenna 0 (mW)	Power density (mW/cm2)	Limit of power density (mW/cm2)
23755	706.5	0.74	125.89	0.0186	1.0
23755	706.5	0.74	127.64	0.0188	1.0
23755	706.5	0.74	116.68	0.0172	1.0
23790	710	0.74	129.12	0.0190	1.0
23790	710	0.74	123.31	0.0182	1.0
23790	710	0.74	113.76	0.0168	1.0
23825	713.5	0.74	126.18	0.0186	1.0
23825	713.5	0.74	119.40	0.0176	1.0
23825	713.5	0.74	109.65	0.0162	1.0

Mode : LTE Band 17, BW 10MHz, QPSK

Channel	Frequency (MHz)	Antenna Gain0 (numeric)	Output power to antenna 0 (mW)	Power density (mW/cm2)	Limit of power density (mW/cm2)
23780	709	0.74	155.96	0.0230	1.0
23780	709	0.74	157.76	0.0233	1.0
23780	709	0.74	157.76	0.0233	1.0
23790	710	0.74	171.79	0.0253	1.0
23790	710	0.74	167.88	0.0248	1.0
23790	710	0.74	138.04	0.0204	1.0
23800	711	0.74	153.46	0.0226	1.0
23800	711	0.74	144.21	0.0213	1.0
23800	711	0.74	123.59	0.0182	1.0

Mode : LTE Band 17, BW 10MHz, 16QAM

Channel	Frequency (MHz)	Antenna Gain0 (numeric)	Output power to antenna 0 (mW)	Power density (mW/cm2)	Limit of power density (mW/cm2)
23780	709	0.74	114.29	0.0169	1.0
23780	709	0.74	111.69	0.0165	1.0
23780	709	0.74	95.50	0.0141	1.0
23790	710	0.74	123.03	0.0181	1.0
23790	710	0.74	131.52	0.0194	1.0
23790	710	0.74	107.89	0.0159	1.0
23800	711	0.74	110.66	0.0163	1.0
23800	711	0.74	106.91	0.0158	1.0
23800	711	0.74	95.06	0.0140	1.0

The Notice in Installation Manual has been stated as below:
While installing and operating this transmitter, the radio frequency exposure limit of 1 mW/ (cm^2) may be exceeded at distances close to the transmitter. Therefore, the user must maintain a minimum distance of 20 cm from the device at all time.