RF Exposure Evaluation declaration

Product Name : Advanced Industrial 4G/LTE Router, WWAN Failover Manager

Model No. : MX-200, MX-200e, M100, MX-200A, MX-200Ae

FCC ID : QI3BIL-MX200A

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 : May. 15, 2017

Date of Declaration : Jun. 19, 2017

Report No. : 1750358R-RFUSP02V00

Report Version : V1.0

Testing Laboratory
3023

1. GENERAL INFORMATION

1.1. EUT Description

Product Name	Advanced Industrial 4G/LTE Router, WWAN Failover Manager
Model No.	MX-200, MX-200e, M100, MX-200A, MX-200Ae
Trade Name	BEC, Billion
IMEI No.	35907206
FCC ID	QI3BIL-MX200A
TX Frequency	LTE Band 2: 1850 MHz ~1910 MHz LTE Band 4: 1710 MHz~1755 MHz LTE Band 5: 824MHz ~849MHz LTE Band 12: 699MHz~716MHz LTE Band 13: 777~787MHz LTE Band 30: 2305~2315MHz
Rx Frequency	LTE Band 2: 1930 MHz ~1990 MHz LTE Band 4: 2110 MHz ~2155 MHz LTE Band 5: 869~894MHz LTE Band 12: 729~746MHz LTE Band 13: 746~756MHz LTE Band 30: 2350~2360MHz
HW Version	1.011
SW Version	1.04.1.103p
Antenna Type	Dipole

1.2. Antenna List :

No	Manufacturer	Part No	Peak Gain
1	Cortec Technolgy Inc.	AN0727-64DP5BSM	0.71 dBi for 700-960MHz 2.32 dBi for 1710-2200MHz 0.44 dBi for 2200-2100MHz

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.

2.2. Test Procedure

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

The temperature and related humidity: 22.3℃ and 50％ RH.

2.3. Test Result of RF Exposure Evaluation

Product : Advanced Industrial 4G/LTE Router, WWAN Failover Manager
Test Item : RF Exposure Evaluation
Test Site : N/A

LTE Band 2 -Peak Gain: 2.32dBi

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
1851.5	23.76	0.406	2	100	23.76	237.68	0.0807	1	Pass
1880	23.59	0.390	2	100	23.59	228.56	0.0776	1	Pass
1908.5	23.42	0.375	2	100	23.42	219.79	0.0746	1	Pass

LTE Band 4 -Peak Gain: 2.32dBi

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
1711.5	23.46	0.378	1	100	23.46	221.82	0.0753	1	Pass
1732.5	23.21	0.357	1	100	23.21	209.41	0.0711	1	Pass
1752.5	22.93	0.335	1	100	22.93	196.34	0.0666	1	Pass

LTE Band 5 -Peak Gain: 0.71dBi

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
824.7	22.33	0.123	7	100	22.33	171.00	0.0401	0.550	Pass
836.5	22.56	0.129	7	100	22.56	180.30	0.0422	0.558	Pass
847.5	22.37	0.124	7	100	22.37	172.58	0.0404	0.565	Pass

LTE Band 12 -Peak Gain: 0.71dBi

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
704	23.17	0.149	3	100	23.17	207.49	0.0486	0.469	Pass
707.5	22.94	0.141	3	100	22.94	196.79	0.0461	0.472	Pass
714.5	22.78	0.136	3	100	22.78	189.67	0.0444	0.476	Pass

LTE Band 13 -Peak Gain: 0.71dBi

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
779.5	22.43	0.126	3	100	22.43	174.98	0.0410	0.520	Pass
782	22.29	0.122	3	100	22.29	169.43	0.0397	0.521	Pass
784.5	22.41	0.125	3	100	22.41	174.18	0.0408	0.523	Pass

LTE Band 30 -Peak Gain: 0.44dBi

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
2307.5	21.60	0.160	0.25	100	21.6	144.54	0.0318	1.000	Pass
2310	21.45	0.155	0.25	100	21.45	139.64	0.0307	1.000	Pass
2312.5	21.29	0.149	0.25	100	21.29	134.59	0.0296	1.000	Pass

Note: The conducted output power is refer to report No.: 1750358R-HPUSP50V00 from the DEKRA.