RF Exposure Evaluation Report

APPLICANT	:	Wistron NeWeb Corporation
EQUIPMENT	:	LGA Module
BRAND NAME	:	Wistron Neweb Corporation
MODEL NAME	:	M18Q2, M18Q2F, M18Q2G, M18Q2FG
FCC ID	:	NKRM18Q2
STANDARD	:	47 CFR Part 2.1091

We, SPORTON INTERNATIONAL (KUNSHAN) INC., would like to declare that the device has been evaluated in accordance with 47 CFR Part 2.1091, and pass the limit. Without written approval of SPORTON INTERNATIONAL (KUNSHAN) INC., the test report shall not be reproduced except in full.

Mark Qu

Prepared by: Mark Qu / Manager

Jones Tsai

Approved by: Jones Tsai / Manager

SPORTON INTERNATIONAL (KUNSHAN) INC.
No. 3-2, PingXiang Road, Kunshan, Jiangsu Province, P. R. China

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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA622601	Rev. 01	Initial issue of report	May 04, 2016
FA622601	Rev. 02	Update report for re-declaring the maximum RF average output power.	May 17, 2016

1. Administration Data

1.1. Testing Laboratory

Testing Laboratory	
Test Site	SPORTON INTERNATIONAL (KUNSHAN) INC.
Test Site Location	No. 3-2, PingXiang Road, Kunshan, Jiangsu Province, P.R.C. TEL: +86-0512-5790-0158 FAX: +86-0512-5790-0958

Applicant	
Company Name	Wistron NeWeb Corporation
Address	20 Park Avenue II, Hsinchu Science Park, Hsinchu 308, Taiwan, R.O.C

Manufacturer	
Company Name	Wistron NeWeb Corporation
Address	20 Park Avenue II, Hsinchu Science Park, Hsinchu 308, Taiwan, R.O.C

2. Description of Equipment Under Test (EUT)

Product Feature & Specification	
EUT Type	LGA Module
Brand Name	Wistron Neweb Corporation
Model Name	M18Q2, M18Q2F, M18Q2G, M18Q2FG
FCC ID	NKRM18Q2
Wireless Technology and Frequency Range	WCDMA Band II: 1852.4 MHz ~ 1907.6 MHz WCDMA Band V: 826.4 MHz ~ 846.6 MHz LTE Band 2: 1850.7 MHz ~ 1909.3 MHz LTE Band 4: 1710.7 MHz ~ 1754.3 MHz LTE Band 5: 824.7 MHz ~ 848.3 MHz LTE Band 12: 699.7 MHz ~ 715.3 MHz
Mode	· RMC 12.2Kbps · HSDPA · HSUPA · DC-HSDPA · HSPA+ (16QAM uplink is not supported) · LTE: QPSK, 16QAM
Antenna Type	WWAN: Fixed External Antenna
HW Version	v1.0
SW Version	M18Q2_v12.03
EUT Stage	Identical Prototype

Note:

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. There are four types of EUT, the details are summary as the following table.

Function	Model Name			
	M18Q2	M18Q2F	M18Q2G	M18Q2FG
LTE	Supported	Supported	Supported	Supported
UMTS	Not Supported	Supported	Not Supported	Supported
Voice	Not Supported	Not Supported	Not Supported	Not Supported
AGPS	Not Supported	Not Supported	Supported	Supported
VoLTE	Not Supported	Not Supported	Not Supported	Not Supported

All the functons are enabled or disabled by software; the hardware part is electrically identical for each model.

According to the difference list above, we evaluate MPE based on the model M18Q2F.

3. Maximum RF average output power among production units

Mode	WCDMA Band V	WCDMA Band II
	average power(dBm)	
RMC 12.2Kbps	25.5	25.5

LTE Band 12				
average power(dBm)				
Modulation	BW (MHz)	RB size	Target MPR	Target Power
QPSK	10	≤ 12	0	25
QPSK	10	> 12	1	24
16QAM	10	≤ 12	1	24
16QAM	10	> 12	2	23
QPSK	5	≤ 8	0	25
QPSK	5	> 8	1	24
16QAM	5	≤ 8	1	24
16QAM	5	> 8	2	23
QPSK	3	≤ 4	0	25
QPSK	3	> 4	1	24
16QAM	3	≤ 4	1	24
16QAM	3	> 4	2	23
QPSK	1.4	≤ 5	0	25
QPSK	1.4	> 5	1	24
16QAM	1.4	≤ 5	1	24
16QAM	1.4	> 5	2	23

LTE Band 5				
average power(dBm)				
Modulation	BW (MHz)	RB size	Target MPR	Target Power
QPSK	10	≤ 12	0	25
QPSK	10	> 12	1	24
16QAM	10	≤ 12	1	24
16QAM	10	> 12	2	23
QPSK	5	≤ 8	0	25
QPSK	5	> 8	1	24
16QAM	5	≤ 8	1	24
16QAM	5	> 8	2	23
QPSK	3	≤ 4	0	25
QPSK	3	> 4	1	24
16QAM	3	≤ 4	1	24
16QAM	3	> 4	2	23
QPSK	1.4	≤ 5	0	25
QPSK	1.4	> 5	1	24
16QAM	1.4	≤ 5	1	24
16QAM	1.4	> 5	2	23

LTE Band 4				
average power(dBm)				
Modulation	BW (MHz)	RB size	Target MPR	Target Power
QPSK	20	≤ 18	0	25
QPSK	20	> 18	1	24
16QAM	20	≤ 18	1	24
16QAM	20	> 18	2	23
QPSK	15	≤ 16	0	25
QPSK	15	> 16	1	24
16QAM	15	≤ 16	1	24
16QAM	15	> 16	2	23
QPSK	10	≤ 12	0	25
QPSK	10	> 12	1	24
16QAM	10	≤ 12	1	24
16QAM	10	> 12	2	23
QPSK	5	≤ 8	0	25
QPSK	5	> 8	1	24
16QAM	5	≤ 8	1	24
16QAM	5	> 8	2	23
QPSK	3	≤ 4	0	25
QPSK	3	> 4	1	24
16QAM	3	≤ 4	1	24
16QAM	3	> 4	2	23
QPSK	1.4	≤ 5	0	25
QPSK	1.4	> 5	1	24
16QAM	1.4	≤ 5	1	24
16QAM	1.4	> 5	2	23

LTE Band 2				
average power(dBm)				
Modulation	BW (MHz)	RB size	Target MPR	Target Power
QPSK	20	≤ 18	0	24.5
QPSK	20	> 18	1	23.5
16QAM	20	≤ 18	1	23.5
16QAM	20	> 18	2	22.5
QPSK	15	≤ 16	0	24.5
QPSK	15	> 16	1	23.5
16QAM	15	≤ 16	1	23.5
16QAM	15	> 16	2	22.5
QPSK	10	≤ 12	0	24.5
QPSK	10	> 12	1	23.5
16QAM	10	≤ 12	1	23.5
16QAM	10	> 12	2	22.5
QPSK	5	≤ 8	0	24.5
QPSK	5	> 8	1	23.5
16QAM	5	≤ 8	1	23.5
16QAM	5	> 8	2	22.5
QPSK	3	≤ 4	0	24.5
QPSK	3	> 4	1	23.5
16QAM	3	≤ 4	1	23.5
16QAM	3	> 4	2	22.5
QPSK	1.4	≤ 5	0	24.5
QPSK	1.4	> 5	1	23.5
16QAM	1.4	≤ 5	1	23.5
16QAM	1.4	> 5	2	22.5

Remark:

1. By design, maximum LTE RF power of smaller supported bandwidth does not exceed the RF power of largest supported bandwidth; the information is included in “tune-up procedure” exhibit
2. LTE MPR implementation is the same for normal mode and power reduction mode.

The table below summarized necessary items addressed in KDB 941225 D05 v02.

<table>
<tr><td>FCC ID</td><td>NKRM18Q2</td></tr>
<tr><td>EUT</td><td>LGA Module</td></tr>
<tr><td>Operating Frequency Range of each LTE transmission band</td><td>LTE Band 12: 699.7 MHz ~ 715.3 MHz
LTE Band 5: 824.7 MHz ~ 848.3 MHz
LTE Band 4: 1710.7 MHz ~ 1754.3 MHz
LTE Band 2: 1850.7 MHz ~ 1909.3 MHz</td></tr>
<tr><td>Channel Bandwidth</td><td>LTE Band 5:1.4MHz, 3MHz, 5MHz, 10MHz
LTE Band 4:1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz
LTE Band 2:1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz
LTE Band 12:1.4MHz, 3MHz, 5MHz, 10MHz</td></tr>
<tr><td>E category, uplink modulations used</td><td>Category 4, QPSK, and 16QAM</td></tr>
<tr><td>LTE Voice / Data requirements</td><td>Data only</td></tr>
<tr><td>LTE MPR permanently built-in by design</td><td>Yes, per 3GPP TS 36.101 v11.0.0
Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 3
<table>
<tr><th rowspan="2">Modulation</th><th colspan="6">Channel bandwidth / Transmission bandwidth (RB)</th><th rowspan="2">MPR (dB)</th></tr>
<tr><th>1.4 MHz</th><th>3.0 MHz</th><th>5 MHz</th><th>10 MHz</th><th>15 MHz</th><th>20 MHz</th></tr>
<tr><td>QPSK</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 1</td></tr>
<tr><td>16 QAM</td><td>≤ 5</td><td>≤ 4</td><td>≤ 8</td><td>≤ 12</td><td>≤ 16</td><td>≤ 18</td><td>≤ 1</td></tr>
<tr><td>16 QAM</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 2</td></tr>
</table></td></tr>
<tr><td>LTE A-MPR</td><td>In the base station simulator configuration, Network Setting value is set to NS_01 to disable A-MPR during SAR testing.</td></tr>
<tr><td>Base station simulator used for Testing</td><td>Anritsu MT8820C</td></tr>
</table>

Transmission (H, M, L) channel numbers and frequencies in each LTE band								
LTE Band 12								
	Bandwidth 1.4 MHz		Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	23017	699.7	23025	700.5	23035	701.5	23060	704
M	23095	707.5	23095	707.5	23095	707.5	23095	707.5
H	23173	715.3	23165	714.5	23155	713.5	23130	711
LTE Band 5								
	Bandwidth 1.4 MHz		Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	20407	824.7	20415	825.5	20425	826.5	20450	829
M	20525	836.5	20525	836.5	20525	836.5	20525	836.5
H	20643	848.3	20635	847.5	20625	846.5	20600	844

LTE Band 4												
	Bandwidth 1.4 MHz		Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	19957	1710.7	19965	1711.5	19975	1712.5	20000	1715	20025	1717.5	20050	1720
M	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5
H	20393	1754.3	20385	1753.5	20375	1752.5	20350	1750	20325	1747.5	20300	1745
LTE Band 2												
	Bandwidth 1.4 MHz		Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	18607	1850.7	18615	1851.5	18625	1852.5	18650	1855	18675	1857.5	18700	1860
M	18900	1880	18900	1880	18900	1880	18900	1880	18900	1880	18900	1880
H	19193	1909.3	19185	1908.5	19175	1907.5	19150	1905	19125	1902.5	19100	1900

4. RF Exposure Limit Introduction

According to ANSI/IEEE C95.1-1992, the criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in §1.1310.

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f2)	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f2)	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100,000			1.0	30

The MPE was calculated at 20 cm to show compliance with the power density limit.

The following formula was used to calculate the Power Density:

$$S = \frac{PG}{4\pi R^2}$$

Where:
S = Power Density
P = Output Power at Antenna Terminals
G = Gain of Transmit Antenna (linear gain)
R = Distance from Transmitting Antenna

5. Radio Frequency Radiation Exposure Evaluation

5.1. Standalone Power Density Calculation

Band	Frequency (MHz)	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum ERP (dBm)	Maximum ERP (W)	Maximum EIRP (dBm)	Maximum EIRP (W)	Maximum Output Power Limit (W)	Average EIRP (mW)	Power Density at 20cm (mW/cm^2)	Limit (mW/cm^2)
WCDMA Band V	826.4	8.0	25.5	31.350	1.365	33.500	2.239	7.000	2238.721	0.446	0.551
WCDMA Band II	1852.4	7.5	25.5	30.850	1.216	33.000	1.995	2.000	1995.262	0.397	1.000
LTE Band 12	699.7	8.0	25.0	30.850	1.216	33.000	1.995	3.000	1995.262	0.397	0.466
LTE Band 5	824.7	8.0	25.0	30.850	1.216	33.000	1.995	7.000	1995.262	0.397	0.550
LTE Band 4	1710.7	5.0	25.0	27.850	0.610	30.000	1.000	1.000	1000.000	0.199	1.000
LTE Band 2	1850.7	7.5	24.50	29.850	0.966	32.000	1.585	2.000	1584.893	0.315	1.000

Note: For conservativeness, the lowest frequency of each band is used to determine the MPE limit of that band

5.2. Collocated Power Density Calculation

Note:

1. This MPE analysis is applicable to any collocated transmitters with transmit power for WLAN is less than or equal to 27dBm and for Bluetooth is less than or equal to 26dBm.
2. A maximum antenna gain of 4 dBi for WLAN /BT has been assumed for all collocated antennas.

Band	Frequency (MHz)	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum EIRP (dBm)	Maximum EIRP (W)	Average EIRP (mW)	Power Density at 20cm (mW/cm^2)	Limit (mW/cm^2)	Power Density / Limit
WCDMA Band 5	826.4	5.0	25.5	30.5	1.12	1122.02	0.446	0.551	**0.810**
WCDMA Band 2	1852.4	7.5	25.5	33.0	2.00	1995.26	0.397	1.000	0.397
LTE Band 12	699.7	7.0	25.0	32.0	1.58	1584.89	0.315	0.466	0.676
LTE Band 5	824.7	5.0	25.0	30.0	1.00	1000.00	0.397	0.550	0.722
LTE Band 4	1710.7	5.0	25.0	30.0	1.00	1000.00	0.199	1.000	0.199
LTE Band 2	1850.7	7.5	24.50	32.0	1.58	1584.89	0.315	1.000	0.315
WLNA2.4GHz Band	2412.0	4.0	23.0	27.0	0.50	501.19	0.100	1.000	**0.100**
WLNA5GHz Band	5180.0	4.0	23.0	27.0	0.50	501.19	0.100	1.000	0.100
Bluetooth	2402.0	4.0	22.0	26.0	0.40	398.11	0.079	1.000	**0.079**

Note:

1. For colocation analysis, WCDMA Band 5 is chosen for summation due to the highest (power density/limit) among all WWAN wireless modes.
2. ∑(Power Density / Limit): This is a summation of [(power density for each transmitter/antenna included in the simultaneous transmission)/ (corresponding MPE limit)], for WWAN + WLAN + Bluetooth.
3. Considering the WWAN module collocation with the WLAN and Bluetooth transmitter of the EIRP performance listed in the table above, the aggregated (power density /limit) is smaller than 1, and MPE of 3 collocated transmitters is compliant

Max WLAN Power Density / Limit	Max Bluetooth Power Density / Limit	Max WWAN Power Density / Limit	∑(Power Density / Limit) of WWAN + WLAN + Bluetooth
0.10	0.079	0.810	0.989

Conclusion:

Based on 47 CFR §2.1091, the analysis concludes that this product when transmitting in standalone within a host device, is compliant with the FCC RF exposure requirements in mobile exposure condition, provided the conducted power and antenna gain do not exceed the limits for each given frequency band per wireless technology as follow table:

Device	Technology	Frequency (MHz)	Maximum Conducted Power (dBm)	Stanalone Maximum Antenna Gain (dBi)	Collocated Maximum Antenna Gain (dBi)
M18Q2, M18Q2F, M18Q2G, M18Q2FG	WCDMA	826.4	25.5	8.0	5.0
		1852.4	25.5	7.5	7.5
	LTE Band 12	699.7	25.0	8.0	7.0
	LTE Band 5	824.7	25.0	8.0	5.0
	LTE Band 4	1710.7	25.0	5.0	5.0
	LTE Band 2	1850.7	24.5	7.5	7.5
Collocated Transmitters	WLAN	2412.0	23.0		4.0
	WLAN	5180.0	23.0		4.0
	BT	2402.0	22.0		4.0